The expectations gap for engineering field in Malaysia in the 21st century

Alena Y.T. Tan, Esyin Chew and Vineetha Kalavally

Abstract

Purpose – *This paper aims to explore the expectations of relevant stakeholders in the engineering field to better understand the demands of the twenty-first century. As the number of unemployed continues to grow in Malaysia, it is evident that as industries continue to develop, demands and new requirements for skilled workers change over time.*

Design/methodology/approach – *Through face-to-face interviews, the study explored the expectations of accreditation bodies, industry operators and academics in the engineering field.*

Findings – *Three major findings were documented: mismatch of expectations in engineering field across the stakeholders; the expected "must-have-skills" from the perspectives of the stakeholders; and the need to reassess how information transmission is cascaded to all stakeholders and remains relevant to market demand.*

Research limitations/implications – *It is recognized that the findings from this study may only be relevant to the engineering field and not to the other different disciplines, but the qualitative findings provide some key issues in understanding the gap between relevant stakeholders that may motivate future studies to further extend into the other disciplines.*

Practical implications – *With this mismatch drawn out clearly, all relevant stakeholders would be able to revisit and revaluate their existing strategy in addressing, cascading crucial information and equipping graduates with analytical skills to gain immediate employment in the market.*

Originality/value – *A clearer understanding on the expectations and the "must-have-skills" required in the engineering field in the twenty-first century.*

Keywords *Employability, Analytical skills, Assessment and feedback, Educational technologies, Employers and academics' perspectives, Mismatch of expectations*

Paper type *Research paper*

Alena Y.T. Tan, Esyin Chew and Vineetha Kalavally are all based at the Monash University Sunway Campus, Bandar Sunway, Malaysia.

1. Introduction

According to the Malaysia Higher Education Indicator (2013), approximately 273,893 graduated from across different institutions of higher learning (IHL). A total of 68,368 graduated from engineering-related courses, and 32.1 per cent of that total number was in the trend of unemployment upon graduating.

This unemployment statistics raises predicament; with the rising number of graduates produced by IHLs yearly, the struggle of hiring qualified candidates remains a challenge for many employers today. According to UNESCO (2006), there are several identified issues related to this unemployment trend in this region: mismatch of qualifications with industry operators/employers' needs; lack of supply and demand information on labour market; lack of proper career guidance and information; lack of exposure of students to the real world of work; lack of soft skills; and economic issues. It is, therefore, evident that demands and new requirements for skilled workers change over time. This poses a great challenge to the engineering profession, whereby the employers in the twenty-first century have much higher expectations for the engineering graduates to possess applicable graduate attributes[1]. Other than the expected engineering technical skills, they are also

This research was funded by Malaysia Ministry of Higher Education under the Fundamental Research Grant Scheme (FRGS).

expected to be equipped with the ability to think critically, to communicate effectively and to handle and manage unfamiliar problems, just to name a few, along with the merits of societal, ethical, economical and legal knowledge (Nguyen, 1998; Guilbeau and Pizziconi, 1998).

As stated by Singh *et al.* (2014), the twenty-first century attributes have become a cornerstone of graduates' employability. They further indicated that there is a clear mismatch of expectations of graduate attributes between IHLs and employers in Malaysia. Similarly, UNESCO (2012) anchored on the notion of mismatch in supply and demand of graduates entering the job market. To which, the National Graduate Employability Blueprint (NGEB) (2012), also stated that deficiency of science and technical graduates in the job market, coupled by poor command over English, further aggravates this issue. Yet, in the current curricula, the focus is on the content specialization rather than embedding the needed employability skills (NGEB, 2012). Consequently, employers resorted to opt for foreign graduates, who are perceived to demonstrate the qualities of graduate attributes. Leaving behind the liability of nurturing and imparting fundamental graduate attributes and skills to IHLs. As such, the Malaysian ministry of education has setup a taskforce to identify and develop key graduate attributes for each discipline in hope to enhance level of employability (NGEB, 2012).

In contrary, Husain *et al.* (2010) argued that the major issue arises from nonstandardized employability skills, such as "basic skills, thinking skills, resources skills, information skills, interpersonal skills, system and technology skills and personal qualities" required by various employers. However, their research also indicated that some employers do not require specific skills such information skills, system and technology skills. It is explained that these specific skill sets' requirement varies based on respective fields' requirements, which is not standardized even among the same industry. Furthermore, many industries today are seeking for both hard and soft skills in a potential candidate, unlike what is being pointed out by Husain *et al.* (2010) that employers are mainly seeking for employees with employability skills (soft skills). Buntat *et al.* (2013) highlighted that employers are also looking for employees who have both technical knowledge and expertise (hard skills) and employability skills as well. Based on their findings, the top five essential employability skills which employers are looking for includes "possessing honesty, cooperating with others, using technology instrument and information system effectively, making decisions and managing time", which are conflicting with the findings from Husain *et al.* (2010). Both studies have shown to have rather similar yet distinctive definition and components of what employability skills really are. Thus, it is necessary to further explore on the expectations of engineering education from the perspectives of relevant stakeholders and to identify the mismatch of expectations, if there are any, in response to the demands of the twenty-first century. As such, requirements for these employers looking beyond technical skills that graduates should possess may be the key to securing employment upon graduating.

2. Methods

In this research, qualitative inquiry was adopted, in an in-depth manner, to explore the expectations from fresh graduates among the accreditation bodies, employers and academics in Malaysia, and to verify as to what extent does the mismatch (if there is any) between the industry experts and academics' expectations of graduate competencies exist.

This research uses an inductive analytical procedures approach as explained by Saunders *et al.* (2009), which allow a good mixture of findings between the social reality of the research participants and the theory that emerges from the findings, so that it is all grounded in reality. Face-to-face interviews were conducted and data reduction/template analysis was used. To purposefully focus on parts of the collected data, and to developed categories where data were coded and analyzed to identify and explore the themes,

patterns and relationship. Pre-interview criteria were set to select a multitude of individuals from large organizations to best represent a holistic view and direction of the engineering industries. A sample of 27 interview candidates holding middle- and high-management positions in the engineering industry with a balanced mixture of a large, local corporations and multinational companies were invited to participate in the interview. Academicians and government agencies were represented by both local and foreign universities. Senior lecturers and professors who had a good mixture of experience, working in the related industry, were selected through the snowballing technique/purposeful sampling. In addition, findings based on published documents and possible phone/email/face-to-face discussions with the relevant government agencies, such as the Board of Engineers Malaysia (BEM), were conducted.

A consent form was given to each interviewee to inform the participating rights in the research and seek permission for the use of voice recorder prior to the interview sessions. The average time of an interview was approximately 30-45 minutes per session based on the input and feedback. The findings of this research were collected and analyzed using the transcendental phenomenology method as a phenomenon was identified to study. In this case, they were the requirements and expectations of related stakeholders, and data were collected from several individuals who had experienced the phenomenon and were constructed in a transcendental consciousness (Husserl, 1931; Mohanty, 1989, 2008). Colaizzi's (1978) phenomenological method was used in analyzing participants' transcripts, as all interviews were audio-recorded and transcribed verbatim. In this method, all typed transcripts were read several times to obtain an overall understanding. Each transcript, significant phrases or sentences that pertained directly to experience of the expectations of engineering education in Malaysia were identified and categorized. Meanings were then formulated from the significant statements and phrases and were clustered into themes, allowing for the emergence of themes common to all of the participants' transcripts. The results were then integrated into an in-depth, exhaustive description of the phenomenon.

3. Results and discussion

The findings showed that the expectations of the engineering employers and the requirements of the Malaysian Engineering Accreditation Council (EAC)/Board of Engineers Malaysia (BEM) mainly agreed on the importance of having a balance of both technical and soft skills competencies, depicted in the following statements:

3.1 Engineering employers

> Perhaps soft skills like courtesy, reasonably healthy work ethics and to be responsible. The minimal of basic skills that take – I mean expertise or competency that is reflective of the certificate of the paper that they bring [. . .] Perhaps one more if I may add this, basic communication skills, at least, the ability to tell us that they don't understand something [. . .].

> I can classify the expectations into two categories. The first would be the hard skills and second would be the soft skills. Hard skills will essentially be engineering background [. . .] For the soft skills, I would expect the fresh graduates to be first humble, willing to learn, innovative – meaning being able to think out of the box [. . .].

3.2 Malaysian engineering accreditation council (EAC)/board of engineers Malaysia (BEM)

> What the EAC and the board normally look at in fresh graduates is that the degree that they obtained must be recognized, they have fulfilled a minimum requirement as stipulated by the EAC [. . .].

> So that when they reach the fourth year, they are market-ready; able to communicate and able to present technical presentations and so on [. . .].

3.3 Differences between employers and EAC/BEM

Responses from participants suggested many variations of soft skills that a graduate should have to increase their chances of being employed mentioned by the NGEB (2012), such as teamwork, the ability to present, to make decisions, to communicate effectively and so on, just to name a few. This report summarizes what has been repeatedly suggested as the top five most important soft skills that a fresh graduate is expected to demonstrate in Table I. The sequence of the soft skills is arranged as follows:

Based on Table I, comparison of the top five must-have soft skills for both employers and EAC/BEM – both parties essentially have a contrastive deviation from one another for the rest of the soft skills. The majority of the employers identified the remaining two expected soft skills as having task-related skills such as teamwork and independence. Contrary, EAC/BEM identified it as decision-making and lifelong learning, which are more academically driven skills. Some of the engineering employers' rationales for choosing teamwork and independence were further explained in the statements below:

> The teamwork spirit and how you collaborate with other team members because you're not working in your solo environment [. . .].

> For independence, I think if I'm a senior engineer, if graduates always come and ask me questions, I'll get very frustrated. So I think being independent is quite important as a graduate. I mean [you need to] think before you do [. . .].

> Because, in the oil and gas industry, you don't work alone, you need to integrate with your colleagues and be a team player, to understand what your people do and need. So, you need to be a team player and always communicate with your team to know what the team needs [. . .].

> Of course, you have to rely on teamwork as in my field, buildings don't get built by themselves [. . .].

> Independence is important because your boss or supervisors may not be able to supervise you 24/7 when you are performing a task [. . .] in the absence of your superior, you must know how to deal with different kind of situations [. . .].

The EAC/BEM's point of view in choosing decision-making and lifelong learning was described in the following statement:

> [. . .] problem-solving and decision making are also equally important at the end of the day if you can talk well, but you cannot solve the problem, it is pointless [. . .] so we want somebody can present well and knows his or her stuff, able to solve a problem, and most important is to make a decision; because engineers are required to do that [. . .].

> Because we have that life-long learning skills, we know where to look for information [. . .].

These findings are aligned with the findings from the research by Zaharim *et al.* (2012), where employers are more prone to choose skills that contribute to the productivity of tasks, such as communication skills and teamwork over lifelong learning, again which are more academic-driven. The inclination of trend towards task-driven skills could be due to the fact that many employers would presume that majority of the engineering graduates would already possess and be nurtured to be equipped with the attribute of lifelong learning, as a given soft skill upon graduating, as identified as one of the 12

Table I Malaysian industry operators and EAC/BEM pick on the top five must-have soft skills

Stakeholders	*1*	*2*	*3*	*4*	*5*
Industry operators	Problem solving and critical thinking	Communication skills	Analytical skills	Teamwork	Independence
Engineering Accreditation Council/ Board of Engineers, Malaysia	Problem solving and critical thinking	Analytical skills	Decision-making	Communication skills	Lifelong learning

programme outcomes that stipulated the attributes of an engineering graduate ought to achieve upon completing the programme in the Engineering Programme Accreditation Manual (Engineering Accreditation Council, 2012). On the other hand, teamwork and independence are more required by employers, as these attributes have not been fostered effectively in the IHLs, or it could be that students are not considering these attributes as important, although these attributes have also been identified as part of the 12 programme outcomes.

3.4 Academics' perspectives

Interestingly, there are also two different schools of thoughts, whereby a number of the academics also deemed that the industry is expecting graduates to be more work-ready rather than just having both technical knowledge and soft skills competencies. In other words, some academics strongly reckon that employers are looking for graduates who are trainable, eager and ready to learn from others and capable of working independently, as they recognize that what students learn in universities are different than the actual demand from the working environment, depicted in the following statements:

3.4.1 The equilibrium – emphasizing on both technical knowledge and soft skills competencies in graduates.

> I think most companies would expect you to have some basic technical skills [. . .] also, a lot of companies are emphasizing on soft skills during the interview. They want their workers to work with the team, so most of the time, these are the skills that help the students to climb the corporate ladder [. . .].
>
> [. . .] basic degree currently will land you a job, certain level of interpersonal skills, communication, presentation skills, the way you carry yourself [. . .] those are the soft skills, besides having a degree [. . .].

3.4.2 The work-ready – emphasizing on self-learning and work-ready graduates

> Generally, in terms of technical skills, I think the there is enough job training for them. But what they (industry) would expect from students is the ability to do self-learning and life-long learning [. . .].
>
> Basically, the industry is looking for students or graduates who can start to work with minimal need of training and with all the trait skills [. . .].
>
> The industry is expecting the local graduates to be work-ready [. . .].

In Table II, the top five must-have soft skills based on the academics' perspectives appeared to be a mixture of the employers and EAC/BEM's choice. This indirectly reflected on the different schools of thoughts that the academics have when it comes to giving their opinion on the expectation from engineering graduates as discussed earlier. A number of academics perceived that employers are looking for work-ready graduates rather than a graduate with minimum knowledge and skills. A concerning issue also arises whereby some of these academics mentioned that it is unreasonable for employers to have such expectations of the graduates, as mentioned in the following statements:

Table II Comparison of the top five must-have soft skills among industry operators, EAC/BEM, and academics

Stakeholders	*1*	*2*	*3*	*4*	*5*
Industry operators	Problem solving and critical thinking	Communication skills	Analytical skills	Teamwork	Independence
Engineering Accreditation Council/ Board of Engineers, Malaysia	Problem solving and critical thinking	Analytical skills	Decision-making	Communication skills	Lifelong learning
Academics	Problem solving and critical thinking	Communication skills	Lifelong learning	Teamwork	Independence

> While the industry needs to have an expectation, their expectation must be realistic. If they are expecting the fresh graduates to be able to perform immediately, then it's a very tall order. Basically, they should be someone who is trainable within three months time to operate normally, and in six months time, to operate fully as an engineer. But if they expect someone who can do everything on the first day of working is a tall order [. . .].

> [. . .] the industry doesn't understand the education system provides the minimum entry. Meaning that when the student graduates, the student actually has the minimum skill set and when they (graduates) go into the industry, they enter into the second phase whereby the industry needs to train the graduates [. . .].

As pointed out in the NGEB (2012), this may not be the actual reflection of the industry expectations, as employers do not insist on fresh graduates to be work-ready, but emphasized that a graduate should be at least equipped with appropriate basic knowledge and skills required for the job such as communication skills and willingness to learn. This is supported by some of following statements made by the employers:

> It was difficult two decades ago and it's nearly impossible today for fresh graduates to be able to instantaneously be pre-equipped, before arriving at the job. So [. . .] what are my expectations, I will just say that I will just expect fresh graduates to just have some of the minimal basic soft skills [. . .].

> [. . .] of course, the minimal of basic skills that – I mean expertise or competency that is reflective of the certificate of the paper that they bring [. . .].

> [. . .] I think normally if the company knows that they are going to hire a fresh graduate, I don't think they will expect them to have certain experience or certain special skills sets [. . .].

Therefore, as from what has been indicated, the area of mismatch between the expectation of the employers and the academics appeared to be derived from the misconception that the workforce and engineering industry are expecting graduates to be work-ready upon completing their engineering degree. To further understand the expectations, a review on the *Engineering Programme Accreditation Manual* (Engineering Accreditation Council, 2012) together with 12 different attributes illustrated in the table below prepared by the EAC Malaysia – BEM was conducted. The table below illustrates the expectations of the employers and of the academics.

As illustrated in Table III, there is a slight mismatch between stakeholders, whereby the mismatch does not only lie between employers and academics, as discussed earlier, but the mismatch appeared to be across all the relevant stakeholders. Besides, there are several graduate attributes, which are not emphasized by both stakeholders.

As such, this study identified that majority of the academics although agree that both the face-to-face and innovative technology components are deemed as important aspects of

Table III Engineering graduate attributes

No.	*Engineering graduate attributes*	*Industry operators' expectations*	*Academics' opinion in regards to the industry operators' expectations*
1	Engineering knowledge	✓	✓
2	Problem analysis	✓	✓
3	Design/development of solutions	✓	✓
4	Investigation	*X*	*X*
5	Modern tool usage	✓	*X*
6	The engineer and society	*X*	*X*
7	Environment and sustainability	*X*	*X*
8	Ethics	*X*	*X*
9	Communication	✓	✓
10	Individual and team work	✓	✓
11	Life long learning	✓	✓
12	Project management and finance	✓	*X*

today's graduates; a stronger preference was leaning towards the face-to-face aspect of interaction in the learning and teaching process. In contrast, a majority of the employers emphasized on the significance of modern usage tools in their day-to-day operations and would certainly expect fresh graduates to be equipped with it. However, it was also clear that employers were mindful in not setting a way and above expectations towards the fresh graduates in this aspect, as they did mention that having the basic technical skills of the related tools are sufficient, as more advanced training will be given upon joining the company.

Hence, in summary, a clear gap has been identified, which is how the IHLs continuously place great emphasis in graduates to embrace lifelong learning. Lifelong learning is a given, but graduates are found to be significantly lacking in terms of analytical skills which is an attribute highly sought after by employers today. In comparison, engineering graduate attributes found in the *Engineering Programme Accreditation Manual*, used by various IHLs in designing their programme outline, have omitted analytical skills as part of the main attributes. Despite EAC/BEM and the engineering employers are conducting the same orchestra, the academics are dancing to a different tune, which in return depicted the overall mismatch of supply and demand in Malaysia's scenario today.

4. Conclusion

In sum, the findings signify that there is, after all, a gap and mismatch between all the relevant stakeholders. With this mismatch drawn out clearly, all relevant stakeholders would be able to revisit and revaluate their existing strategy in addressing and producing quality graduates that are competent in today's global market. Silo-mentality of stakeholders directing each target groups could no longer be effective and sustainable despite each having used different strategies trying to achieve their own objectives. Through the finding, this research would, therefore, suggest all the relevant stakeholders (employers, accreditation bodies and academics) to work in unison for realignment by conducting frequent revision and updates on the manual to ensure relevancy of currently expected graduate attributes. Thereafter, cascading of information to IHLs for timely execution would bring about effective and efficient outcome through fruitful collaboration between all stakeholders. As the saying goes, "the whole is greater than the sum of its parts", collaboration may be the route to many more new possibilities.

Besides, this study also recommends for a different pedagogical method to be adopted in relation to how engineering programmes were conducted in the past. As we march deeper into the digital era, the existing pedagogy should consider utilizing educational technology tools as a platform to aid in the process of information transmission based on updated graduate attributes across all stakeholders. Consequently, the findings and suggested solutions should enable all stakeholders to respond and act effectively to address the mismatch between supply and demand in graduates' employability.

Note

1. The engineering programme structure, extracted from different universities' undergraduate handbook 2014/2015, indicated that the engineering course structures are based on the 12 graduate attributes stipulated by Engineering Accreditation Council (EAC) and Board of Engineer Malaysia (BEM). Engineering undergraduates are also required to undergo 10-12 weeks of internship training during the third or the fourth year of their studies. This internship training only required a pass grade and no indication of feedback from internship supervisor is required or emphasized. On the same note, the handbook does not indicate any strategic industrial partners where their students will be assigned during that period. The engineering degree will then be awarded upon students completing all the required units (including a pass grade in the internship training) throughout their 4-year programme with a minimum of grade C or a CGPA of 2.0 and above.

References

Buntat, Y., Jabor, M.K., Saud, M.S., Syed Mansor, S.M.S. and Mustaffa, N.H. (2013), "Employability skills element's: difference perspective between teaching staff and employers industrial in Malaysia", *3rd World Conference on Learning, Teaching and Educational Leadership – WCLTA 2012*, Vol. 93, pp. 1531-1535, doi: 10.1016/j.sbspro.2013.10.077.

Colaizzi, P.F. (1978), "Psychological research as the phenomenologist views it", in Valle, R.S. and King, M. (Eds), *Existential Phenomenological Alternatives for Psychology*, Oxford University Press, New York, NY.

Engineering Accreditation Council (EAC) (2012), *Engineering Programme Accreditation Manual*, available at: www.eac.org.my/web/document/ (accessed 6 January 2015).

Guilbeau, E.J. and Pizziconi, V.B. (1998), "Increasing student awareness of ethical, social, legal, and economical implications of technology", *ASEE Journal of Engineering Education*, Vol. 87 No. 1, pp. 35-46.

Husain, M.Y., Mokhtar, S.B., Ahmad, A.A. and Mustapha, R. (2010), "Importance of employability skills from employers' perspective", *International Conference on Learner Diversity 2010*, Vol. 7, pp. 430-438, doi: 10.1016/j.sbspro.2010.10.059.

Husserl, E. (1931), *Ideas: General Introduction to Pure Phenomenology*, translated by Carr, D., Northwestern University Press, Evanston, IL.

Malaysia Higher Education Indicator – Indikator Pengajian Tinggi Malaysia (2013), available at: www.mohe.gov.my/web_statistik/Indikator_Pengajian_Tinggi_Malaysia_2013.pdf

Mohanty, J.N. (1989), *Transcendental Phenomenology: An Analytic Account*, Basil Blackwell, Oxford and Cambridge, MA.

Mohanty, J.N. (2008), *The Philosophy of Edmund Husserl: A Historical Development*, Yale University Press, New Haven, London.

National Graduate Employability Blueprint (NGEB) 2012-2017 (2012), available at: http://jpt.mohe.gov.my/PENGUMUMAN/GE%20blueprint%202012-2017.pdf (accessed 21 July 2015).

Nguyen, D.Q. (1998), "The essential skills and attributes of an engineer: a comparative study of academics, industry personnel and engineering students", *Global Journal of Engineering. Education*, Vol. 2 No. 1, pp. 65-75.

Saunders, M., Lewis, P. and Thornhill, A. (2009), *Research Methods for Business Students*, 5th ed., Pearson Education.

Singh, P., Thambusamy, R.X. and Ramly, M.A. (2014), "Fit or unfit? Perspectives of employers and university instructors of graduates' generic skills", *Procedia – Social and Behavioral Sciences*, Vol. 123, pp. 315-324, doi: 10.1016/j.sbspro.2014.01.1429.

UNESCO (2006), "A multi-stakeholder approach to address graduate unemployment", available at: http://unesdoc.unesco.org/images/0015/001529/152959e.pdf

UNESCO (2012), "Graduate employability in Asia", available at: http://unesdoc.unesco.org/images/0021/002157/215706E.pdf

Zaharim, A., Ahmad, I., Md Yusoff, Y., Omar, M.Z. and Basri, H. (2012), "Evaluating the soft skills performed by applicants of Malaysian engineers", *Procedia – Social and Behavioral Sciences*, Vol. 60, pp. 522-528, doi: 10.1016/j.sbspro.

Further reading

Hanapi, Z. and Nordin, M.S. (2014), "Unemployment among Malaysia graduates: graduates' attributes, lecturers' competency and quality of education", *International Conference on Education & Educational Psychology 2013 (ICEEPSY 2013)*, Vol. 112, pp. 1056-1063, doi: 10.1016/j.sbspro.2014.01.1269.

Corresponding author

Alena Y.T. Tan can be contacted at: alena.tan@monash.edu