Engineering Education: Using Technical Attributes to Analyse the Employers' Expectation of Future Engineering Graduates in Malaysia

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Abstract: - This paper discusses a comprehensive study of employers' expectation of Malaysian engineering graduates towards assessing measurable qualities. To have better overview in this issue, a survey on the needs and expectations of Malaysian industries towards graduate engineers is conducted. In order to create a smoother transition from education to practice, some argue that engineering education should put more emphasis on the engineering-based knowledge. Thus, this study investigates the expectation of the majority of Malaysian industries towards future engineering workforce. For the purpose of this paper, only the technical or engineering-based attributes such as basic engineering knowledge, ability in theoretical and research engineering, technical competency in a specific engineering discipline and others are discussed. A total of 422 companies from various industries in Malaysia were chosen for the face-to-face interview sessions using a set of questionnaires. The respondents were mainly come from high ranking personnel in their firm. The outcomes of this study will later be considered as a revision guideline for the engineering education curricula of Malaysian Institutions of Higher Learnings.

Key-Words: - Engineering graduates, Expectations, Employer, Malaysia, Technical attributes.

1 Introduction

What do industries expect of engineering graduates? At the present, there is a perception among industries in the United States of America that engineering students are not adequately prepared to enter the workforce [1]. There is an argument that the current engineering education does not provide enough emphasis on teamwork, communication, knowledge retention and the ability to synthesize and make connections between courses and fields [2].

In order to create a smoother transition from education to practice, some argue that engineering education need to give more emphasis on teamwork, communication, knowledge retention and the ability to synthesize and make connections between courses and fields [2]. Emphasises on developing these professional skills are also highlighted in [3]. Specialised technical courses might be more appropriately covered in more advanced postgraduate programs as this will encourage continual professional development as expected of professional engineers [4].

A comprehensive survey was conducted on the expectations of Malaysian industries towards future graduate engineers from Malaysian Institutions of Higher Learnings. Among the objectives of the survey is to investigate the employer expectation as regards to future engineering graduates towards assessing measurable qualities. In addition, the study has an aim to look into employer expectations towards engineering labour force and graduates over short and long terms.

2 Methodology

A total of 422 companies from various industries were selected randomly and purposively using convenience sampling based on firms where engineering students normally undergo industrial placements. The breakdown of selected companies according to industry is shown in Table 1. Data collection was carried out through face-to-face interviews using a set of questionnaires. The interviewed respondents were mainly high ranking personnel in the firm.

Table 1: Distribution of respondents

Industry	No. of Responses	%
Healthcare, Social, Entertainment & Leisure	39	9.2
Education & Consulting	70	16.6
Commerce, Trade, Finance, Agriculture & Food	55	13.0
Communication, IT, Defence, Security, Transport	43	10.2
Engineered Materials, Energy & Natural Sources	102	24.2
Built Environment	113	26.8
TOTAL	**422**	**100**

3 Results and Discussion

In this study, the level of expectation of employers towards a particular attribute (refer to Table 2) related to types of knowledge, skills and experience possessed by engineering graduates in their workplace required answers on a 5-point Likert's scale. As for instance, questions which required answers such as 'Most Important, Important, Neutral, Not Important and Not Important at All'. In order to simplify the 5-point scale, answers belonging to the first two categories are grouped as 'Important', while those belonging to the last two categories are grouped as 'Not Important'.

Of the thirteen attributes listed in Table 2, this paper will only discuss those considered as the technical attributes, i.e. A, B, C, E, G and K. Figure 1 shows the level of satisfaction of employers of such attributes towards their engineering workforce. The responses signify the vitality of knowledge, skills and experience that should be owned by engineering graduates for future employment. This is shown by percentages of the 'Important' level, which are varied between 73.2% and 86.6%. These values were obtained for all the attributes related to knowledge, skills and experience. From this figure, Attribute C (*competency in application and practical oriented engineering*) gave the highest value of employers' expectation of the engineering personnel, i.e. at the 86.7%. However, Attribute B (*competency in theoretical and research engineering*) showed the lowest level of importance, i.e. 73.2%.

Table 2: List of attributes used for this study

A	*Ability to acquire and apply knowledge of engineering fundamentals.*
B	*Having the competency in theoretical and research engineering.*
C	*Having competency in application and practical oriented engineering.*
D	Ability to communicate effectively, not only with engineers but also with the community at large.
E	*Having in-depth technical competence in a specific engineering discipline.*
F	Ability to undertake problem identification, formulation and solution.
G	*Ability to utilise a systems approach to design and evaluate operational performance.*
H	Ability to function effectively as an individual and in a group with the capacity to be a leader or manager as well as an effective team member.
I	Having the understanding of the social, cultural, global and environmental responsibilities and ethics of a professional engineer and the need for sustainable development.
J	Recognising the need to undertake lifelong learning, and possessing/acquiring the capacity to do so.
K	*Ability to design and conduct experiments, as well as to analyse and interpret data.*
L	Having the knowledge of contemporarry issues.
M	Having the basic entrepreneurial skills

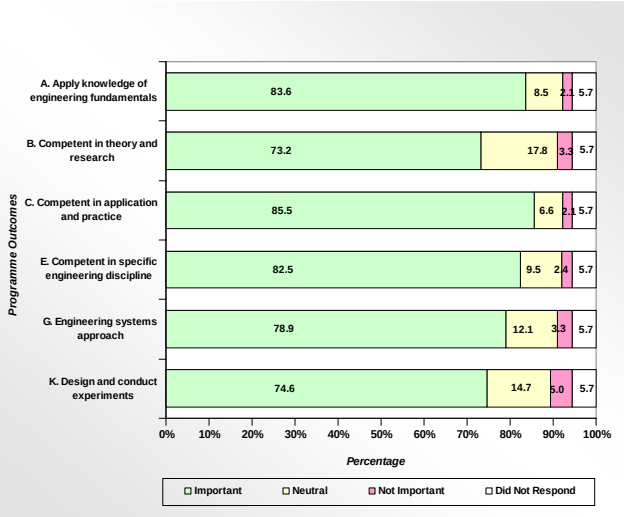

Figure 1: Employers' expectation on technical attributes of engineering workforce

The information of Figure 1 can then be expanded to detail information for six main industrial sectors, as listed in Table 1. Detail results showing the distribution for these industrial sectors are presented in Figure 2 to 8.

Figure 2 shows the responses of the employers' expectation of the workforce regarding to the a*bility of engineering graduates in acquiring and applying knowledge of engineering fundamentals* (attribute A). As predicted, all industrial sectors required their engineering workforce must be equipped with knowledge of engineering fundamentals. The education and consulting sector provide the hingest response at 88.6% compared to other sectors. However, some companies in the sector of commerce, trade, finance, agriculture and food expected the basic knowledge of engineering fundamentals is less important for their workforce. Thus, this sector gave the lowest score in evaluation of this attribute, i.e. at 74.5%.

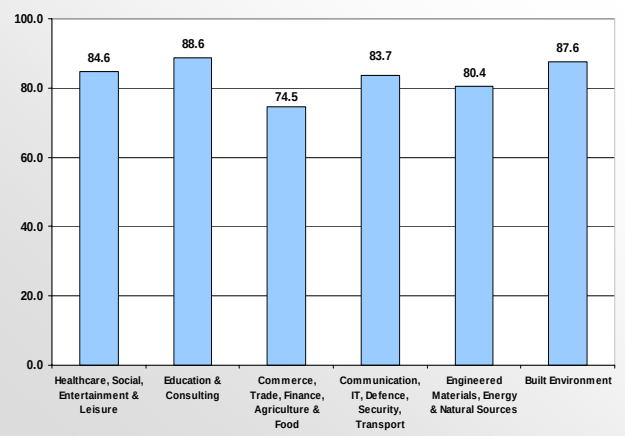

Figure 2: Engineering graduates expectation by industries with respect to Attribute A

Refering to the expectation of Attribute B (Figure 3), all sectors gave the response on the importance of having engineers which are competence in theoretical and research engineering. The overall score for this attribute is between 60% and 80% of the respondents. The Healthcare, Social, Entertainment & Leisure sector gave the highest score at 79.5%. Referring to the lowest score, the similar trend of Attribute A can also be observed in this attribute. The commerce, trade, finance, agriculture and food sector have the lowest score of 61.8% responses.

For Attribute C (Figure 4), the highest responses of 89.4% were obtained from the questionnaires, which was produced by the built environment sector. Higher in respondents response was expected and it is due to the importance of the in application and practical oriented engineering knowledge in the real situation. Since this sector is mainly linked with the construction (may also relate to the civil engineering works), the experience of practical engineering knowledge is very important in appointing engineers from fresh engineering graduates. It is very important in order to create a group towards a company success.

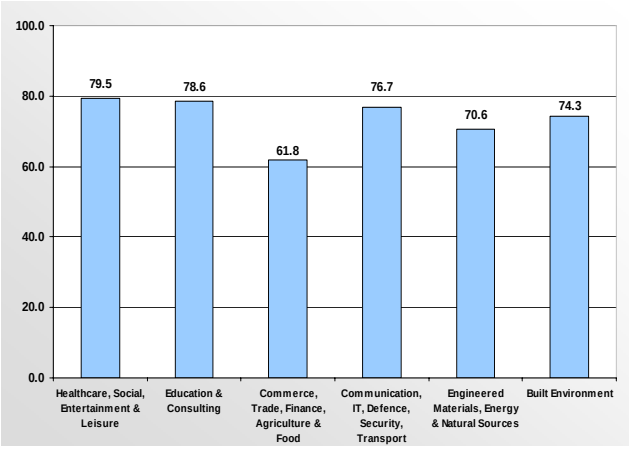

Figure 3: Engineering graduates expectation by industries with respect to Attribute B

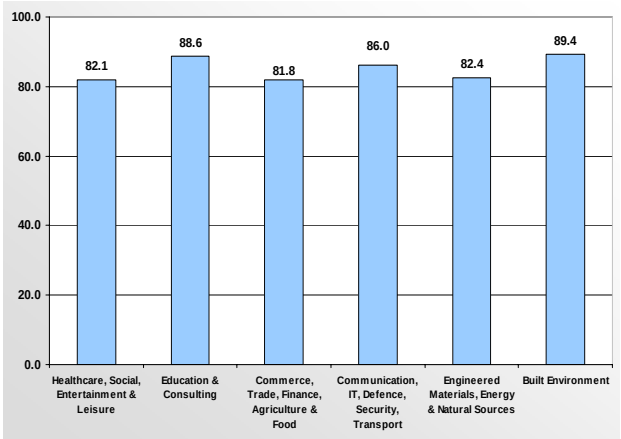

Figure 4: Engineering graduates expectation by industries with respect to Attribute C

For Attribute E (*Having in-depth technical competence in a specific engineering discipline*), as the findings were illustrated in Figure 5, the score produced by the respondents are above 70.9%. Similar to other attribute, the built environment sector produced the highest score of responses, i.e. at 87.6%.

For Attribute G (Figure 6), the education and consulting gave the highest score of 85.7% compared to other sectors. Higher score obtained from this sector was found for this category because most industries show the interest in engineering graduates having ability in utilising a systems approach to design and evaluate operational

performance. On the other hand of Attribute G, the commerce, trade, finance, agriculture and food sector showed the lowest importance level with the value of 70.9%.

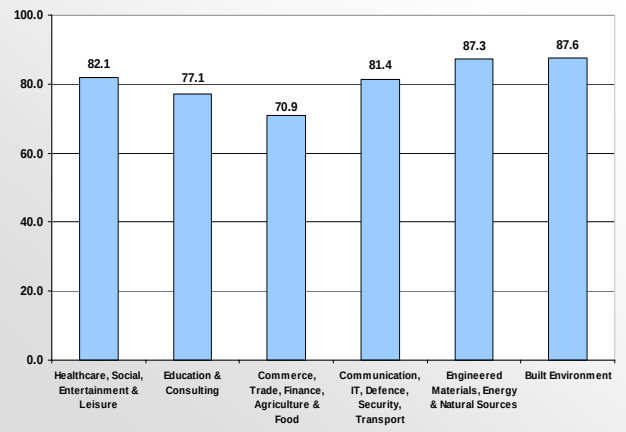

Figure 5: Engineering graduates expectation by industries with respect to Attribute E

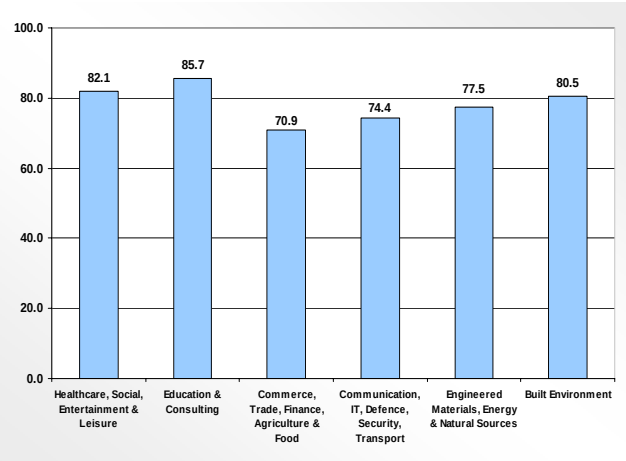

Figure 6: Engineering graduates expectation by industries with respect to Attribute G

In Figure 7 (Attribute K), finally, the variation of the important responses was 65.5% to 82.1%. This can also be considered as a good expectation from industries as the knowledge of design and conduct the relevant experiments can be used to enhance the practical oriented capability. According to the selected Malaysian employers, the familiarity in data interpretation is also useful it can be considered as a must to future engineering workforce. For this result, the Healthcare, Social, Entertainment & Leisure sector gave the lowest score of 65.5%, indicating the basic knowledge in design and data interpretation is less important to be applied in this sector.

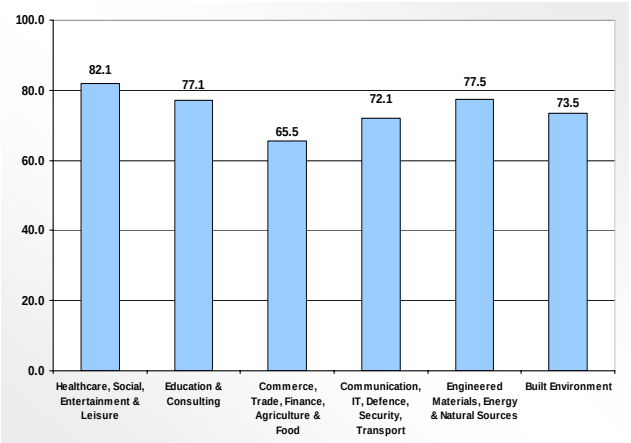

Figure 7: Engineering graduates expectation by industries with respect to Attribute K

4 Conclusions

This paper discussed the expectations of employers from 422 companies in Malaysia with respect to the technical or engineering-based attributes of their current engineering workforce. The study is important as it can be used to measure the expectations of Malaysian industries towards the future Malaysian graduate engineers. In general, the employers' expectations of their engineering workforce with respect to the non-technical attributes can be considered as fair, scoring from about 60% to 90% importance level, with Education and Consulting sector consistently rating their engineering workforce highly. However, the Healthcare, Social, Entertainment & Leisure sector gave the lowest score of 61.8%, indicating the minimal application of engineering-based attributes in this sector. The outcomes of the comprehensive survey work will be considered in an exercise to improve the engineering education curricula and their deliveries of Malaysian Institutions of Higher Learning.

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