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The Contributions of Professional Engineers at the Instituitions of Higher Learning

Zambri Harun [a], Mohamad Dali Isa [b], Zamri Mohamed [c]
and Shahrum Abdullah [d]

[a, d] *Department of Mechanical & Materials Engineering Universiti Kebangsaan Malaysia*
43600 UKM, Bangi, Selangor

[b]*Universiti Kuala Lumpur*
Malaysian Institute of Aviation Technology (UniKL MIAT)
43800 Dengkil, Selangor, Malaysia

[c]*Faculty of Mechanical Engineering*
Universiti Malaysia Pahang
26600 Pekan, Pahang

Abstract

This paper discusses the current contributions of professional engineers (P.Es.) who have obtained their competency qualifications prior to assuming their new careers at the institutions of higher learning (IHLs). Recent surveys conducted by recruitment agencies show a wide gap between engineering graduates' abilities and employers' expectations. This gap simply means a longer learning curve for trainee engineers expected by employers. However, most importantly, it seems that employers have to take on the job to bridge the gap. Providing training means incurring costs and resources. There are many schemes provided by multi-national company (MNC) however such schemes may not be options by small and medium enterprise (SME). Based on experience, discussion and observations, P.E.s contribute positively in the three core areas: 1) *teaching and learning 2) research and publication and 3) industrial linkage.*

Keywords: Professional Engineers, Instutitions of Higher Learning

1. Introduction

The stringent requirements made by the Engineering Accreditation Council (EAC) led by the Board of Engineers, Malaysia (BEM) for the *academic and support staff* have increased the number of professional engineers (P.E.s) at IHLs. The requirement of three staff with professional engineering qualifications for each engineering programme was not explicitly specified in the Engineering Programme Accreditation Manual (2007), however this requirement has been put into effect with a letter from the BEM in 2012. The requirement for 3 P.E.s for each engineering programme must be fulfilled by 2015.

In order to increase the number of staff with P.E. qualifications, the relevant engineering faculties or departments implement their own initiatives for staff to pursue P.E. qualifications. However, this pursuit often needs a coordinator and the final call lies with the candidates themselves. The IHLs could not depend on direct recruitment for this purpose as hiring P.E.s may involve changes in remuneration packages to attract them, which may not be possible with present IHL salary scheme. At the same time, there are not many engineers who are willing to have drastic changes in their careers. Nevertheless, engineering faculties are capable to increase staff with P.E.s qualifications via internal initiatives.

It is necessary to compare the roles and responsibilities of these engineers at their engineering entities against their jobs as lecturers before we discuss their contributions at IHLs. As professional engineers, ones have to abide by the conduct in Guidelines for Code of Professional Conduct (2004). The five pillars of codes are summarized as: P.E.s shall 1) keep the safety, health and welfare of the public at utmost important, 2) undertake assignments where he or she is an expert and proficient to the job descriptions, 3) issue statement only in an objective and truthful manner, 4) act for each employer faithfully and 5) conduct him or herself honorably, responsibly, ethically and lawfully to enhance the honor, reputation and usefulness of such profession.

Typical works at an engineering consultancy company are preparing design works for authority approvals prior to physical installation works. Under the pressure of the owner of the said installation, an engineer may have to give permission for a lower quality material. There is usually a band of material qualities. However, it is possible that a lower quality material is approved when the specifications do not explicitly show the low quality material is unacceptable. By approving the low quality material, the engineer has compromised with the quality of the installations and the installations may jeopardize people safety during operation. In this case, the engineer has violated pillar one of the code of conduct (Guidelines for Code of Professional Conduct, 2004).

As lecturers at IHLs, ones have to perform: 1) teaching - carry out lectures, give assignments, exams, mark and give grades to students, 2) supervising and coaching – lecturers usually have students assigned to them to be coached e.g. master project. In research, lecturers have students to be supervised to complete their research works, 3) researching – carry out experiments or simulations including applying grants and other administrative works related with research, 4) publishing – share the finding of the studies and learn about others' works at conferences, publish the work at reputable journals and 5) performing administrative jobs. There are a lot of administrative jobs, the most time consuming are usually related to compliance with quality standards.

A researcher conducting an experiment may find some of the results deviating from the ones published. Under pressure of not completing the works within the budget and time, the researcher could simply 'not show' the results that are not in agreement with the published data. However, as far as the academic community and public are concerned, the researcher is hiding some results. To some extent, this act is known as an *academic fraud* – deliberate deception, invention of data or omission of analysis. The examples above highlight the nature of works of an engineer as compared to a lecturer and how an engineer or a lecturer might compromise the integrity of their works. We find that, these two very different careers, when combined at IHLs, make very meaningful contributions not only to IHLs but also the nation.

2. Methodology

The contributions of P.E.s at the IHLs analyzed by the authors are based on their experiences. The first three authors have experiences as professional engineers prior to their current work as lecturers at the IHLs. The first author has three years and a half working with an MNC company in a semiconductor manufacturing plant, Motorola. This is a technology company which has to respond very fast to market needs. Afterward the author worked in a construction company building large complex and infrastructures requiring a long list of authority approvals. Money trades off with installation time and quality. The second author has a wide range of experience in the aviation industry, ranging from engineering services to certification. Quality and safety can never be compromised in the industry. The third author worked at the national automotive plant Proton. Costs and quality play important roles, however the bottom line rests with customer preference; a wrong product can be a disaster for the company. Figure 1 shows general tasks of an engineer in a private entity.

Figure 1 shows that an engineer, depending on the nature of the works has the responsibility to the core engineering works, either in design, process, construction, this also includes equipment, installation, maintenance and etc. The main responsibility makes the bulk of the work i.e. 50%. The second responsibility is the trade-off between cost, quality and time. Engineers always have to refer to their supervisor when making decision with regards to this trade-off which makes 40% of their time. Adhering to standards, safety requirements and other administrative works can be annoying and these works make 10% of engineers' time.

Figure 2 shows the approximate breakdown of a lecturer's work at an IHL. The breakdown varies between research university (RU) and non-research-university. An RU is expected to conduct research, publish literatures and have their ratings increased in the worldwide academic rating bodies or agencies. RUs receive special grant from the government of Malaysia to conduct research. Nevertheless, lecturers at non RUs also have to perform in research; therefore research content of a lecturer's work always stands out as the largest task contributing 60%. The second task is teaching, this includes preparing course outline, lecturing, marking, assigning grades and supervising students. Teaching makes 30% of a lecturer's work-hours. Community services and industrial linkage makes 10% of lecturers' works. Industrial linkage complements research and teaching content (to be discussed in the next section).

This breakdown i.e. 60:30:10 for research:teaching:community usually applies for a lecturer's key performance index (K.P.I.).

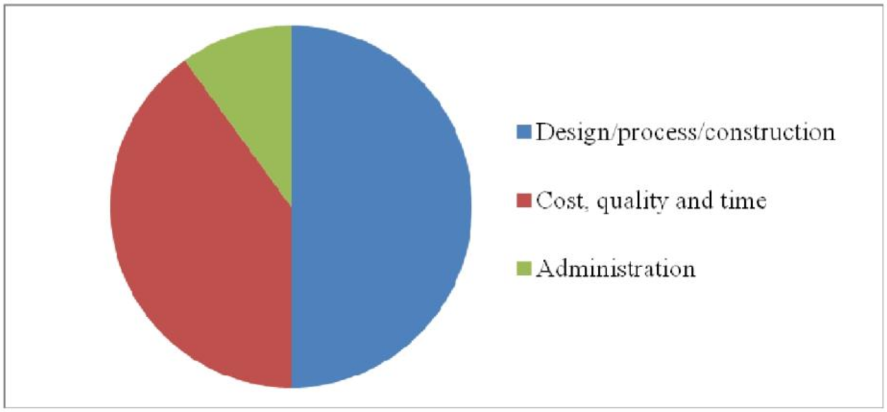

Figure 1: The approximate breakdown of engineers' work at a private firm

Administrative works are large i.e. 20%-30%; it practically consists of preparation for quality audit, health & safety activities, students-related activities and etc. Typically, lecturers do not have an assistant. Senior lecturers sometime depend on graduate research assistant (GRA) to assist them. However, administrative works do not appear in K.P.I., and in records only the distribution such as in Figure 2 apply.

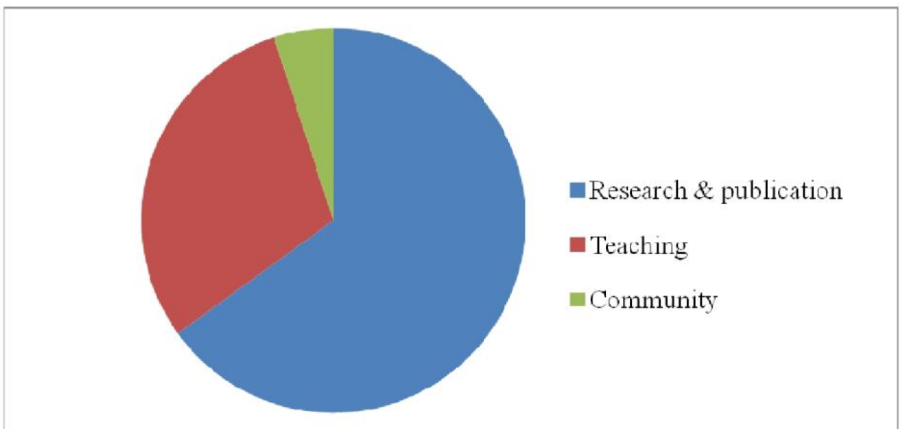

Figure 2: The approximate breakdown of lecturers' work at an IHL

The differences highlighted in figures 1 and 2 show that engineers and lecturers works are very different. These differences are however to be appreciated when engineers with different background, enter the academic community.

3. Analysis and Discussion Based on Experience

3.1 Teaching and learning contribution

A previously industry-based professional engineer working as a lecturer can contribute much to the learning process. Having gained prior work experience that relates to the practical aspects of academic courseworks offered in university, the engineer can often link the know-how in industry to the theoretical aspects of an engineering course. This can avoid misleading information from the instructor who had never worked in the field before but by simply relaying information from books and internet. It was also observed from the students that they are very interested to hear about what the engineers really do in the real world. This can attract students' interests in the academic aspects of their courses once they know how important the theories are in order to become good engineers in the future. Once the students become motivated, the learning process therefore can be improved.

Professional engineers cum lecturers also can assist their colleague in enhancing industrial knowledge and standard practice. One way is by sharing the practical information gained outside to their teaching peers. Often lecturers without practical experience are also very interested to learn from the practical side of engineering. From this, the information can be passed to the students who are not directly in contact with the professional engineers. The benefit can be to the extent that the lecturer without practical experience can pursue the certification themselves under the guidance of their certified peers. It is normal for a lecturer with P.E. qualifications to be appointed within a department to supervise and monitor the progress of peer lecturers in their pursuit of these qualifications. Therefore, lecturers with professional qualifications actively improve the standing of other lecturers as well.

Professional engineers are required to undergo certain hours of Institution of Engineer's Malaysia approved training in a year. This means they always have to upgrade their knowledge by through these continuous learning processes to maintain the certification. This knowledge can be passed on to their colleagues and students who subsequently benefit from such processes indirectly. The continuously changing engineering requirement and environment necessitate engineers to be able to adapt themselves to meet the standard. The same also applies to the engineering students and lecturers; they have to be updated with the local engineering guidelines and practices. It must be addressed here that the academic courses offered in universities rely on books that are published few years earlier or even some decades back. Although some lecturers update the course contents themselves, these activities must be in parallel with the current practice adopted by the regulating body, in this case the Board of Engineers, Malaysia. All of the said arguments support that the teaching professional engineers elevate the level of teaching and learning at universities.

3.2 Research and publication contribution

Research and publication is the one single large task often accounts for more than 50% of a lecturer's K.P.I. A P.E. who has accumulated experience in the industries and used to designing, installing and commissioning may find it easy to relate an on-going research with the industry needs. Below are three scenarios highlighting the ease for an IHL to conduct collaborative with the industries.

Computational Fluids Mechanics (CFD) is one approach to calculate or predict fluids behaviour, either in open or close areas, small chamber or large compartment, laminar or turbulence, heated or cool environment. A lot of articles are published, however there is too big a gap in making this knowledge realized in practical installations. In any large complex, normal fire protection systems are not adequate or suitable to be used. The normal fire protection system in a standard lecture hall for example would include heat and smoke detectors, sprinkler system and hose reels. However, when the height of the hall is higher than 18m, like many modern, futuristic exhibition halls nowadays, sprinkler system becomes ineffective. Another method to make the occupants and properties in the hall safe is via using the *performance- based approach* (PBA). PBA utilizes simulations to calculate or predict smoke and heat behaviour in an event of fire, often by CFD. Although there are many CFD experts in Malaysia, these simulations are produced by engineers in the developed countries.

Local research related to aerospace often has insignificant effect to industrial problems. Many local researchers only focus research on fundamental. For example, natural fibre is often considered by local researcher as a potential replacement to traditional fibre used in advanced composite system. However in reality, the natural fibre as now it is formed and blend cannot compete with mechanical properties enjoyed by traditional fibre. In contrast, many competent and experience aerospace engineers acknowledge the poor resistance of traditional composite in handling the impact. Even a bird as small as sparrow can induce severe damage to composite structure upon impact giving the impression that the current technology of composite is poor in handling through the thickness loading. This is one example of the industrial experience that can be shared with academic organization if the P.E.s are employed by the universities. The P.Es could also bring some value added ideas to the direction of research conducted by universities. The direction of research could be more focused on the local industrial needs, as it will bring values, cost downturn and support from both local and private agencies.

Automotive industries have established themselves in the Malaysian economy. Many automotive vendors and economic sectors have benefited from the automotive research and development as well as manufacturing. Universities also have placed themselves in the automotive research map by having automotive centres and offering automotive courses to students. Often the case, the students are required to complete a final year project that is regarded as the closest to industry practice a university course can be. Many students would perform studies related to the automotive components and manufacturing processes to pass their course. However, many of these studies were already performed in industry and have no direct relation to the current interest by automotive industries. Having engineers from the automotive sectors as lecturers can improve this process by passing their experience on the current problem in automotive industries. They will be able to seek opinion from their contact in automotive industries as well. This will increase the relevance of the automotive courses and undergraduate final year project done at universities while increasing their future job prospect.

3.3 Community/Industrial linkage contribution

Industrial linkage complements teaching & learning and research & publication. In order to *enforce* stronger ties with the industries, the EAC required IHL to provide evidences of participation of academic and support staff with continuous quality improvement process, industrial exposure and on-going participation of the industry advisors in discussions and forums and collaborative projects. These requirements are specified in Appendix C of the Engineering Programme Accreditation Manual (2007). P.E.s at IHLs are still in contact with their peers in the industries, therefore conducting visit, arranging talks to students and performing collaborative research are easier.

In the developed countries, the United States for example, industrial linkages co-exist to complement business and universities. The Ivy-League universities are in collaborations with high-tech companies for the latest state of the art and cutting edge technologies while the community college are in collaborations with the local business and community requirements which are more technical in nature (Hernes, G. and Martin, M., 2000). These types of collaborations do not seem to follow in developing countries where business entities are still struggling with other more pressing issues and universities with their own objectives especially to increase their ratings and producing quality work force.

The Johor Bahru Sentral (JBS) is a train terminal, integrated with the Customs, Immigration and Quarantine Complex, where there are bus and lorry processing bays, and areas for tens of thousands of motorcycles passes. These areas, together with their plant rooms are set to be a source of noise to the surrounding neighbourhoods. However, a local expert who is also an academician in the noise and comfort was hired for noise control. It turns out to be a great success, where the consultancy and installations costs were minimal, yet the specifications were met (The statement of needs ICIQ Complex, 2003).

Universiti Kuala Lumpur Malaysian Institute of Aviation Technology (UniKL MIAT) is second author's employer. The university does not only collaborate with industries as traditionally engaged by universities in Malaysia but also allow an industry to be formed and become part of university business. Centre for Aerospace Design (CAeD) Sdn Bhd is a classic example of university being an active industry player by engaging extensive aerospace design activities. Currently, the CaeD has ten engineers who are competent and used to work with various aerospace design companies such as the Malaysia Airline System (MAS), Airod, CTRM, General Electric, Aviation Design Centre and Department of Civil Aviation (DCA). Besides being committed engineers for CAeD, they are also engaged with teaching the undergraduates at UniKL MIAT. The regular exposure with current industrial needs in aviation, has had positive impact to the quality of teaching. Since some of them are P.Es, (a total of three), the training ground or platform for new engineers to obtain the status of profesional engineer qualification within

UniKL MIAT is readily available. The students also will gain in term of acquiring latest and updated aviation technologies from these engineers as they are experienced and current in terms of engineering knowledge required by the industries.

Universiti Malaysia Pahang has collaborated with local automotive player such as Proton and Perodua for years and more recently has an understanding with Mercedes-Benz Malaysia. For example, Proton has approached several local universities in researching some of the aspects of automotive products. Perodua for instance donated some of their robots for teaching at the university. This collaboration gives benefits to both sides where the university able to link their academic courses with the industry while the industry can outsource some of the research works to the university. Another win-win aspect is the university is assisted by the industry in sending their lecturers for practical training while the engineers at the industry can further their academic qualifications through flexible university course catered for working professionals. This explains the benefits of unversity-industry linkage that can enhance the quality and mobility of professionals and students.

4. Conclusion

Lecturers-professional engineers experiences from three distinct backgrounds are shared. From these scenarios, lecturers with P.E.s certificates actively promote to better quality of lecturers work-pillars which are the research & publication, teaching & learning and community services. The public and the nation directly benefit from such qualities.

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