

PRELIMINARY STUDY ON THE PROMINENT ENTREPRENEURIAL SKILLS SET IN THE CONTEXT OF CIVIL ENGINEERING PRACTICE

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ABSTRACT

Despite the fact that the importance of acquiring entrepreneurial skills for future engineers has been widely discussed, yet the specific prominent entrepreneurial skills set with respect to a specific context of interest were often left unexplained. A similar phenomenon has occurred in the context of engineering practice and possibly implying that the prominent entrepreneurial skills set in the context of civil engineering practice still remain ill-defined. As the need for engineers to acquire entrepreneurial skills to meet the economic and workforce requirements has been widely recognised, thus identifying the prominent entrepreneurial skills set in the context of civil engineering practice is very important. The purpose of this paper is to discuss the prominent entrepreneurial skills set in the context of civil engineering practice in reference to the recommendations by the American Society of Civil Engineers (ASCE). This preliminary study was conducted by having interviews with civil engineering practitioners and thematic analysis was used to analyse the data. The findings have shown the prominent skills in the entrepreneurial skill set are mostly acquired in the managerial tracks in the civil engineering practice.

Keywords: *Entrepreneurial skill, civil engineering practice, prominent skill*

1. INTRODUCTION

The necessity for engineers to acquire entrepreneurial skills has been widely recognized (Duval-Couetil, Reed Rhoads, and Haghghi, 2010) due to the changing needs of economic, workforce and technology that have dramatically challenged the conventional nature of engineering practice (Duval-Couetil, Reed Rhoads, and Haghghi, 2010; Lienberg and Matthews, 2012). According to Bielefeldt (2013), engineers are expected to demonstrate entrepreneurship in order to compete in the global economy and they ought to be alert of the paradigm shift in the engineering practice that changes the ‘simple’ search solution into a proactive identification of market opportunities driven by technology and scientific advancements (Elia, Margherita, Secundo et. al, 2011). For that reason, universities are being put under pressure to produce engineering graduates that are not just merely competent in inventing new products but also to possess knowledge and skills of detecting opportunities, understanding influential economic factors and promoting and commercializing new technologies (Duval-Couetil, Reed Rhoads, and Haghghi, 2010; Besterfield-Sacre, Ozaltin, Shartrand et. al, 2011).

In the Malaysian Code of Practice for Programme Accreditation (COPPA), entrepreneurial skill has been listed as one of the competencies that must be attained by the engineering graduates upon the completion of their study (Malaysian Qualification Agency, 2008). Furthermore, the Malaysian Engineering Accreditation Council (EAC) expects future engineering graduates to acquire the competency in project management and finance (Engineering Accreditation Council, 2012), indicating an area where entrepreneurial skill acquirement is required in the engineering practice. As for the civil engineering graduates in particular, similar expectations can also be anticipated as indicated by the American Society of Civil Engineers (ASCE) in their vision 2025, which has advocated that future civil engineers should exhibit entrepreneurship attitude as one of the attitudes that is conducive for effective professional practice (American Society of Civil Engineers, 2007).

Despite the vast recognitions given to the importance of acquiring entrepreneurial skills for future engineering graduates (Duval-Couetil, Reed Rhoads, and Haghghi, 2010), the characteristics of the entrepreneurial skill set with respect to a specific context of interest, have not been properly understood (Pyysianinnen, Anderson, McElwee, and Vesala, 2006; Mohammad, Hussin and Buang 2014). The lack of understanding on the characteristics of the entrepreneurial skill set within a specific context raises the question of how entrepreneurial skills can be developed if the characteristics are ill-defined (Pyysianinnen, Anderson, McElwee, and Vesala, 2006). In regard to this issue, this preliminary study aimed to explore the entrepreneurial skill set in a specific context of engineering practice, from the perspective of civil engineering practitioners.

2. THE EFFECT OF CONTEXT TO THE ENTREPRENEURIAL SKILL SET

The entrepreneurial skill set for engineers has been posited to consist of multiple skills. The skills posited are teamwork skills, leadership skills, written and oral communication skills as well as contextual awareness which include understanding of market forces, recognizing opportunities, needs for new technologies and also knowing how to source out human, financial, and technical resources to introduce new technologies to the market (Besterfield-Sacre, Ozaltin, Shartrand et. al, 2011). However, this outlook of entrepreneurial skill set for engineers are stated without a clear reference to the context of where all of these skills are to be practiced. The work in the civil engineering practice is different from other engineering practice due to various factors such as the diverse roles in their practices, the involvement of public spending and regulations, private practices, large social component, impact on the construction and infrastructure industries and impact on environmental regulation (Grigg, Criswell, Fontane et. al, 2001). Therefore, there are possibilities that the entrepreneurial skill set in the context of civil engineering practice could be different from the entrepreneurial skill set posited for engineers in general, due to the specific context of practice; and this issue is not an isolated case as a similar issue also occurs in the entrepreneurship practice.

In the entrepreneurship practice, different scholars tend to define it using different skill sets. For instance, some scholars refer to entrepreneurial skill as a set of skills of identifying, capturing and developing opportunity to create business and social value through transformation invention into successful innovation (Abdulwahed, Balid, Hasna et. al, 2013). Another group of scholars however, refer to entrepreneurial skill as skills in communication (both oral and written), creative thinking, leadership, analytical, strategic long term planning, teamwork, negotiation, new product development, technological innovation, opportunity recognition, market entry, legal requirement of new businesses and ability to create linkage from vision to action (Plumly, Marshall, Eastman et. al, 2008). These differences in the entrepreneurial skill set posited by different scholars could be shaped by various factors but it is also possible that these entrepreneurial skill sets could be characterised by the context where the entrepreneurial skill set is applied. Skills (in general) are deemed to be meaningless without any reference to its context (Chell, 2013) as contextual factors play an important role in facilitating or inhabiting the occurrence and the intensity of entrepreneurial behaviour for technology students (Fayolle, Gailly and Lassas-Clerc, 2006). It is thus probable that the context where the entrepreneurial skill is being practiced has indeed played a very significant role in shaping the entrepreneurial skill set characteristics, and therefore, context should not be overlooked.

3. SIGNIFICANCE OF STUDY IN ENGINEERING EDUCATION

Engineering schools have been reported offering entrepreneurship programmes more than other schools in the higher learning institutions (Bell, Callaghan, Demick et. al, 2004; Duval-Couetil, Kisenwetherm Tranquillo et. al, 2015). This indicates clearly the significant role of entrepreneurship education in developing entrepreneurial skills of the future engineering graduate. Entrepreneurship education is expected to develop skills, attributes, attitudes, and behaviours characteristics of entrepreneurial individuals (Galloway, Anderson, Brown et. al, 2005; Fayolle, Gailly and Lassas-Clerc, 2006) and expected to convey entrepreneurial

knowledge which is inclusive of entrepreneurial concepts, skills, and mentality (Ahmad, 2013). Nevertheless, in Malaysian higher learning institutions, it has been reported that the entrepreneurship course offered to higher learning students (including engineering students) has not been able to achieve the expected outcome (Cheng, Chan and Mahmood, 2009).

One of the reasons being highlighted was due to the low level of understanding of why the entrepreneurship course is being offered to students who are not taking business related courses (Cheng, Chan and Mahmood, 2009). This finding possibly indicates the consequences of ill-defined characteristics of entrepreneurial skill set within a specific context and lack of contextualisation of the entrepreneurship course offered to the higher learning institution students. Therefore, by conducting a preliminary study to explore the prominent entrepreneurial skill set in the context of civil engineering practice, the characteristics of the entrepreneurial skill set in a specific context can be observed and compared to the entrepreneurial skill sets posited by scholars for engineers in general. Thereafter, the differences or similarities between the two entrepreneurial skill sets can be identified. Besides that, the context where the entrepreneurial skill set is being applied can also be observed. By having this finding, a clearer view towards contextualising entrepreneurship course into the context of engineering student is possible to be made.

4. METHODOLOGY

4.1 Method

In this preliminary study, an interview survey (Creswell, 2012) using semi-structured interview method was used to gather information from the experiences of the practicing civil engineers. The interview sessions were conducted via email (Ivankova and Stick, 2006) due to the difficulty of making appointments with the practicing civil engineers. Purposive sampling (Creswell, 2012) was used to identify the suitable respondents based on the criteria that these practicing civil engineers must have enrolled at least once in an entrepreneurship course during their undergraduate studies.

4.2 Respondents

The respondents that were involved in the interview survey in this study were formerly civil engineering students who have enrolled at least once in the entrepreneurship course during their undergraduate studies and these respondents were from the first badge of engineering students who were required to take the entrepreneurship course in the year 2008. All of these practicing civil engineers have at least four years working experience with two of them are master degree holders, specializing in geotechnical and environmental engineering. One of them has been working at the contractor firm for six years where the job mainly focuses on construction management. The other practicing civil engineer has five years working experience at both consultant and contractor firms with the main job scope is related to structural design as well as construction management. The third practicing civil engineer has four years working experience in the area of road maintenance and environmental impact assessment.

4.3 Data analysis

Thematic analysis has been adopted as the method used in analysing data of this study. Thematic analysis is a method used to search for themes that emerge as being important to the description of the phenomenon (Fereday and Muir Cochrane, 2006). The analysis begins with coding process where the object of the coding process is to make sense out of the collected data (Creswell, 2012). Thereafter the themes which are also called categories will form the major idea of the database (Creswell, 2012). In this study, there are two themes that will be discussed in the findings of this study.

5. FINDINGS

The findings of this study are categorized into two sets of data. The first finding consists of prominent entrepreneurial skills in the civil engineering practice and the second finding highlights the context of civil engineering practice, where the entrepreneurial skill set of the practicing civil engineer are being applied. The first finding is categorized according to the two main tracks of civil engineering practice; the technical and managerial tracks (Grigg, Criswell, Fontane et. al, 2001). The prominent entrepreneurial skill set will also be identified by two dimensions of entrepreneurial skill set; know-how and know who elements (Mohammad, Hussin and Buang 2014). Know-how elements are inclusive of skills in management, production and technical, financial, marketing, human resource management and organizational management and business start-up while know-who elements are related to the networking (Mohammad, Hussin and Buang 2014).

5.1 The entrepreneurial skill set of the practicing civil engineer

Most of the prominent entrepreneurial skills in the civil engineering practice are identified in terms of the managerial track of civil engineering practice. As shown in Table 1, there are seven entrepreneurial skills that were identified in the managerial track of civil engineering practice. The skills mainly consist of 'know-how' rather than 'know-who' elements. In fact, the only 'know-who' element in the identified entrepreneurial skills in the managerial track of the civil engineering practice is the social skill.

Table 1: Entrepreneurial skill in managerial track of civil engineering practice

No.	Code	Practitioner	Example of quotation
1	Social skill	Practitioner B	<i>Communication and interpersonal skills are required for us to discuss smoothly as construction projects involve various types of people in order to achieve mutual understanding and vision of the project.</i>
3	Financial skill	Practitioner B	<i>Practicing civil engineer needs to understand the market and business pattern in the context of construction industry as well as to understand the economic pressure within the construction industry</i>
		Practitioner C	<i>Financial management is crucial in advising client on the cost of every option.</i>
		Practitioner	

No.	Code	Practitioner	Example of quotation
		C	<i>In the civil engineering practice, we (practicing civil engineers) need to estimate the construction cost for our client.</i>
4	Decision making skill	Practitioner C	<i>Civil engineers should be able to make decision on site especially during critical time.</i>
5	Risk taking skill	Practitioner A	<i>It is important for engineers (in general) to be open to take risks.</i>
		Practitioner A	<i>Engineers in general would have to take risks, which is one of the elements of entrepreneurial skills, in their practices.</i>
		Practitioner B	<i>At work, it is important that we solve problems instead of running away from it.</i>
		Practitioner C	<i>Practicing civil engineer should be daring and courageous enough to take up responsibilities and to face challenges in their works.</i>
6	Positive thinking skill	Practitioner A	<i>Besides that, I also think that it is important that engineers (in general) can think positively.</i>
		Practitioner B	<i>We should be optimistic that we can learn from mistakes and do right in the future.</i>
7	Creative thinking skill	Practitioner A	<i>So, it is important that as an engineer (generally), we should have 'thinking out of the box' skill.</i>

As for the prominent entrepreneurial skills in the technical track of civil engineering practice, the entrepreneurial skill identified are mainly related to 'know-how' elements. As shown in Table 2, there are two entrepreneurial skills identified in the technical track of civil engineering practice.

Table 2: Entrepreneurial Skill in technical track of civil engineering practice

No.	Code	Practitioner	Example of quotation
1	Problem solving skill	Practitioner A	<i>Engineer's job (in general) is to help evaluate a problem and to help solving it.</i>
		Practitioner B	<i>We should take every opportunity to learn as much as we can especially new things and learning from failures in order to perform well.</i>
2	Learning skill (or absorptive capacity)	Practitioner C	<i>Learning skill is important because practicing civil engineers need to always continue on learning new techniques and new construction method in their practice.</i>

5.2 The context of civil engineering practice

The second finding of this study shows the nature of the context of civil engineering practice where the identified prominent entrepreneurial skills are being practiced by the practitioners.

Table 3: The context of civil engineering practice

No.	Code	Practitioner	Example of quotation
1	Non-Homogeneous nature of work	Practitioner B	<i>The environment and requirement of the task assigned to us pushes us to change our way of thinking to be willing to adapt to the diverse nature of work.</i>
		Practitioner B	<i>In the construction industry, we work with people of different expertise, different level of knowledge and different position.</i>
		Practitioner C	<i>Design stage and construction stage can be different from one another.</i>
2	Multidisciplinary task	Practitioner B	<i>It is important to be open-minded to handle cross disciplinary tasks in order to attain a broader perspective in the civil engineering practices in the construction industry.</i>
		Practitioner C	<i>A big project will require a team of workforce that may come from several parties such as developer or client, architect, quantity surveyor, contractor, sub-contractor and other possible people that may involve in the construction project.</i>
3	Various specialisations.	Practitioner A	<i>Changing companies changed my job scope. From road maintenance to environmental impact assessment.</i>
		Practitioner B	<i>Now with the current company I'm working with, my job scope is a bit different then the company I worked with before.</i>
		Practitioner C	<i>Changing companies do change my scope of work. The scope of work is highly depending on the project you handle.</i>

6. DISCUSSION

6.1 The characteristics of the identified prominent entrepreneurial skills

The first finding of this preliminary study shows that there are nine skills identified as the skills in the prominent entrepreneurial skill set of the practicing civil engineers. Seven of the skills are identified in the managerial track of the civil engineering practice while the other two skills are identified in the technical track of the civil engineering practice. The only 'know-who' element

of entrepreneurial skills in the prominent entrepreneurial skill set of the practitioners is the social skill, which is in the managerial track of the civil engineering practice. The social skill of the practitioners is taken as a 'know-who' element of entrepreneurial skills because the practitioner clearly states that the construction project will involve various people. To achieve mutual understanding and vision is seen as a key element for the practitioners to develop networking in the construction project. In addition to building that professional networking, the practitioners also aimed to develop friendly business relationship in the networks:

“Besides, friendly business to business relationship is one of the ways we can have favour from others or at least making one aspect of job a bit easier.”

Meanwhile, the entrepreneurial skill that has been given main emphasis by the practitioners in the managerial track of the civil engineering practice is the risk taking skill. According to one of the informants, during the construction process, civil engineers will be confronted by unforeseen constraints and thus they need to be prepared to take risks in their work:

“Many unforeseen site constraint will occur when your project starts to run.”

Besides that, financial skill is another skill that has been highlighted by the practitioners. According to the practitioners, financial skill is not only beneficial in terms of managing the financial aspect of the project, but it has a significant effect on other aspects of the project as well:

“...to find the best and more practical way to construct or build project.”

“... perhaps the job will be hard on us and most probably delay will occur and leads to lost in profits and time consuming.”

Positive thinking skill is another skill considered essential by the practitioners as it is common that they will face setbacks:

“We should also become open-minded towards accepting our failures...”

The other entrepreneurial skills in the managerial track may not be frequently highlighted by the practitioners but it does not imply less important. These entrepreneurial skills are included in the prominent entrepreneurial skill set, with the consideration that the background of the informants is unique. By doing so, the prominent entrepreneurial skill set will cover wider aspects of entrepreneurial skills acquired in the civil engineering practice.

As for the technical track in the civil engineering practice, the learning skill or absorptive capacity has been given more attention than the problem solving skill by the practitioners. The key reason shared by the practitioners is for improving themselves and their performances at work:

“...be optimistic that we can learn from mistakes and do right in the future”

“Learning new techniques or construction methods or attending courses and seminars.”

Since the finding has shown that most of the skills in the prominent entrepreneurial skill set are in the managerial track of the civil engineering practice, the characteristics of the prominent entrepreneurial skill set are highly influenced by the nature of the managerial track of the civil engineering practice rather than being characterised by the technical track of the civil engineering practice. This finding not only identifies the prominent entrepreneurial skill set of the practitioners but also shows that entrepreneurial skills are mainly required in the managerial track of the civil engineering practice.

6.2 The characteristics of the context of civil engineering practice

The second finding of this preliminary study shows the nature of the context of civil engineering practice, which is characterised mainly by three key characteristics; non-homogeneous nature of work, multidisciplinary task and various specialties. These characteristics strongly indicate that the context of civil engineering practice is shaped by diversity in terms of nature of work, involvement of multidisciplinary expertise and various specialisations in the civil engineering practice. The diversity in the context of civil engineering practice clearly shows the broad scope of work that the practicing civil engineers need to cope with in their workplace and this nature of the context of practice is possibly the key reason that differentiates civil engineering practices from other engineering practices.

7. CONCLUSIONS

The finding of this study has shown that the prominent entrepreneurial skill set of the practicing civil engineers is different from the entrepreneurial skill set posited for engineers by scholars and it is mainly practiced in the managerial track of civil engineering practice. Hence, the prominent entrepreneurial skill set being explored in civil engineering practice is highly characterized by the managerial track of civil engineering practice. The prominent entrepreneurial skill set of the practicing civil engineers consists of ‘know-how’ elements of entrepreneurial skills except for social skill that was categorized as the ‘know-who’ element. As the nature of the context of civil engineering practice strongly indicates diversity in terms of nature of work, involvement of multidisciplinary expertise and various specializations in the civil engineering practice, the entrepreneurial skill set of the practicing civil engineer could possibly consist more than the nine skills that have been identified and explored in this study. As this preliminary study only seeks to explore the prominent entrepreneurial skill set of the practicing civil engineers, further in-depth and detailed study may be needed to discover other entrepreneurial skills that may not be in the group of prominent entrepreneurial skill set, but could be essential in specific areas of civil engineering practice.

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