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# The Prominent Dimensions of Entrepreneurial Skillset for Future Civil Engineering Graduates and Salient Factor That Promotes Its Development

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**ABSTRACT** The notion that ‘a host of entrepreneurial skills’ is instrumental in achieving successful completion of a construction project is presenting the emerging need for future civil engineering graduates to be equipped with entrepreneurial skills. However, the collective individual skills that reflect ‘a host of entrepreneurial skills’ for future civil engineering graduates and the salient factor that promote its development is ambiguous given that entrepreneurship per se is a multidimensional concept. Therefore, a quantitative study has been conducted to discover the collective individual skills that reflect ‘a host of entrepreneurial skills’ for future civil engineering graduate and the factor that promote its development. Partial Least Square Structural Equation Modelling (PLS-SEM) has been used as a method to analyse the data. The outcome of the study shows that ‘a host of entrepreneurial skills’ for future civil engineering graduates are reflected by 5 prominent and 1 non prominent dimensions of individual skills. Besides that the outcome of the study also identified constraint as the salient factor that promotes the development of the entrepreneurial skill set.

**INDEX TERMS** Entrepreneurial skills, civil engineering, prominent dimension of entrepreneurial skillset.

## I. INTRODUCTION

The Engineering Accreditation Council (2017) has highlighted that understanding the influence of business environment towards the process of industrial decision making in design, manufacturing, and application is important for future civil engineering graduates. In addition, practicing civil engineers also advised civil engineering educators to teach more business and management skills (Grigg et al, 2001). These requirements from the stakeholders can be associated with a notion that relates entrepreneurial skills with the successful completion of a project in the construction industry. The said notion proposes that ‘a host of entrepreneurial skills’ are instrumental in achieving the successful completion of a construction project due to the nature of the construction industry which is similar to the nature of entrepreneurial activities

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(Abd-Hamid, Azizan, and Sorooshian, 2015). This notion is presenting the emerging need for future civil engineering graduates to be equipped with ‘a host of entrepreneurial skills’ which was indirectly highlighted by the stakeholders. However, the collective individual skills that reflect ‘a host of entrepreneurial skills’ for future civil engineering graduates are ambiguous given that entrepreneurship per se is a multidimensional concept (Audretsch and Keilbach, 2004). As a consequence, the identification of potential factors that promotes the acquirement of a ‘host of entrepreneurial skills’ becomes complicated and introducing entrepreneurship principles and practices for engineering students may continue to be poorly understood (Entika et. al, 2018). This phenomenon is clearly addressing the need to discover the collective individual skills that reflect ‘a host of entrepreneurial skills’ for future civil engineering graduates and to identify factor that support its development. Hence, in order to discover the collective individual skills that reflect ‘a host of entrepreneurial skills’

for future civil engineering graduates and to identify factor that support its development, a quantitative study has been conducted.

## II. SIGNIFICANCE OF STUDY

The significance of this study lies in the contextual finding that thus far has not been reported by previous studies despite of the needs to have such information (Pyysiäinen et al, 2006). The lack of information on contextual finding such as presented in this study has caused available facts in entrepreneurial skill development is possibly being underutilised and unexplored in engineering education. In particular, one of the possibly underutilised and unexplored important facts in entrepreneurial skill development is the tendency of skills for entrepreneurship to be specific to the entrepreneurship activities (Chell, 2013). As a consequence of underutilising such important fact, issues concerning conventional academic training such as not equipping engineering students directly with entrepreneurial skills (Gross, 2000) can easily and unknowingly takes place in engineering education. In fact, it has been reported that, in the context of civil engineering students, entrepreneurship education is seen as not guiding civil engineering students to understand entrepreneurship in civil engineering practice (Entika et al., 2016). Thus, this study provides contextual finding which can contribute to the modification of the conventional academic training that can equip future engineering graduates directly with entrepreneurial skills.

## III. POTENTIAL FACTORS THAT PROMOTE ENTREPRENEURIAL SKILL DEVELOPMENT

The potential factors that will lead to entrepreneurial skills development in this study have been identified by adopting the framework of entrepreneurial learning advanced by Pittaway and Thorpe (2012). Taking into account that the occurrence of entrepreneurial learning process is believed to be able to lead to entrepreneurial skill development (Seuneke, Lans and Wiskerke, 2013), thus in this study factors that promote the occurrence of entrepreneurial learning are taken as the factors that also will lead to entrepreneurial skills development. Nevertheless, as there are possibly vast factors to be considered, in this study the factors that will be taken into account are based on the types of learning dictated in the framework of entrepreneurial learning advanced by Pittaway and Thorpe (2012). The framework of entrepreneurial learning advanced by Pittaway and Thorpe (2012) posited that entrepreneurial learning occurs by means of learning by doing and learning through crises. On this basis, factors that were being considered in this study are factors that promote learning by doing and factors that promote learning through crises.

In term of learning by doing, two potential factors that can be presumed able to promote entrepreneurial learning process in the civil engineering practice are level of education and years of working experience. The reason behind this presumption is firstly, educational level has been reported

to have significant impact towards formal entrepreneurship (Jiménez, 2015). Secondly, years of working experience which reflect the vast amount of practice and training that a practitioner has indicate skills enhancement because skills are deemed enhanced through practice and training (Chell, 2013) which is important for entrepreneurial activities. As for learning through crises, another two factors were considered. These factors are the prominent crises in construction projects that often causes set back to the progress of the construction projects. The factors are constraints (Zakeri et. al, 1996; O'Brien and Fischer, 2000; Toklu, 2002; Chassiakos and Sakellaropoulos, 2005; Lau and Kong, 2006; Long and Ohsato, 2008; Murphy, Heaney and Perera, 2011) and uncertainties (Laufer and Cohenca, 1990; Ford, Lander and Voyer, 2002; Atkinson, Crawford and Ward, 2006; Abdul-Rahman et. al, 2006; Lau and Kong, 2006; Jusoff, Adnan and Nazli, 2008; Luu et. al, 2009; Afshar and Fathi, 2009) in construction projects. As the occurrences of these two factors are frequently reported thus, there is high possibility that the interaction with these crises, which are the contextual variables in construction projects, could lead to entrepreneurial skillset development. This presumption was made on the basis that the entrepreneur's set of skills is the outcome of the interactions between the entrepreneur's skills and contextual variables (Chell, 2013).

## IV. ENTREPRENEURIAL SKILLSET

Entrepreneurial skills in previous studies are often reported as a set of skill rather than an individual skill. For instance Chell (2013) and Kaur and Bains (2013) have reported at least 20 skills that entrepreneurs have. A study by Chell (2013) alone has reviewed more than 100 reports by other scholars that illustrated entrepreneurial skills as a set of skill. These findings are consistent with the belief that entrepreneurs are multi-skilled individuals which are sufficiently good at a broad variety of skills (Lazear, 2004). By reviewing reports from previous studies, it can be seen that there are 32 individual skills that were being highlighted at least once. According to Kaur and Bains (2013) the skills that entrepreneurs have are for the entrepreneurs to function profitably and these skills are strategic skills which are important for the survival and success of their business.

In order to be parallel with the conjectures and reports advanced by previous studies, in this study the entrepreneurial skills are viewed as a skillset that represent 'a host of entrepreneurial skills' for future civil engineering graduates. The definition of the entrepreneurial skillset in this study is adapted from the definition advanced by Kaur and Bains (2013). Thus, the entrepreneurial skillset in this study is being defined as a set of strategic skills for future civil engineering graduates to function profitably in their future practices which is important for the success of the construction project that they are involved in. As there are 32 individual skills that were being highlighted at least once in previous studies, hence the 32 individual skills will the entrepreneurial skillset

**TABLE 1. Individual Skills Highlighted at Least Once in the Entrepreneurial Skillset Reported in Previous Studies.**

Resources	Entrepreneurial skills																																		
	Divergent thinking skill	Creative thinking skill	Innovative skill	Business acumen	Absorptive capacity	Technical skill	Dynamic capabilities	Organisational skill	Delegation skill	Management skill	Financial skill	Operational skill	Goal setting skill	Adapting skill	Decision making skill	Strategic competence	Influencing skill	Motivating skill	Negotiation skill	Communication skill	Leadership skill	Networking skill	Teamwork skill	Marketing skill	Recognising opportunity skill	Environmental scanning skill	Judgment skill	Political skill	Risk propensity	Resourcefulness	Problem solving skill	Analytical skill			
Abdulwahed et al. (2013)			√																						√										
Besterfield-Sacre et al. (2011)																				√	√			√		√						√			
Plumly Jr. et. al (2008)		√	√									√				√			√	√	√		√	√	√				√					√	
Kaur and Bains (2013)		√	√			√	√	√	√	√		√	√	√	√	√	√	√	√	√	√		√	√	√					√		√	√		
Chell (2013)	√	√	√	√	√		√					√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	
Fitriati and Hemiati (2010)			√	√				√		√	√		√	√	√			√	√	√	√		√			√				√					
Mohamad, Hussin and Buang (2014)				√		√		√	√		√	√									√		√	√											

being considered in this study. The 32 individual skills are as shown in Table 1.

**V. THEORETICAL FRAMEWORK AND HYPOTHESES**

Building upon the entrepreneurial learning framework advanced by Pittaway and Thorpe (2012), the notion that the occurrence of entrepreneurial learning process can lead to entrepreneurial skill development (Seuneker, Lans and Wiskerke, 2013), and the notion that the entrepreneur’s set of skills is the outcome of the interactions between the entrepreneur’s skills and contextual variables (Chell,2013) as discussed in the previous sections, this study proposes that, in the context of civil engineering practice, factors that promote the occurrence of entrepreneurial learning will have positive influence on entrepreneurial skills development for practicing civil engineers. In this context, the factors that promote entrepreneurial learning in this study are the independent variables. As previous studies (highlighted in Table 1) have consistently reported that entrepreneurial skillset demonstrate multidimensionality therefore, the 32 individual entrepreneurial skills are being categorised into 6 dimensions based on the common themes of the individual entrepreneurial skills. The 32 individual entrepreneurial skills which were being categorised into 6 dimensions are the dependent variables. On this basis, the degrees of influence that the factors have in the development of each dimension of the entrepreneurial skills were investigated and this study proposes hypotheses as follow:

H1. Factors that promote entrepreneurial learning has positive influence on the development of the dimension of the idea generating skill of the entrepreneurial skillset

H2. Factors that promote entrepreneurial learning has positive influence on the development of the dimension of the knowledge application skill of the entrepreneurial skillset

H3. Factors that promote entrepreneurial learning has positive influence on the development of the dimension of skills

in facing difficulties and challenges of the entrepreneurial skillset

H4. Factors that promote entrepreneurial learning has positive influence on the development of the dimension of the information processing skills of the entrepreneurial skillset

H5. Factors that promote entrepreneurial learning has positive influence on the development of the dimension of the management and planning skill of the entrepreneurial skillset

H6. Factors that promote entrepreneurial learning has positive influence on the development of the dimension of the social skill of the entrepreneurial skillset

Based on these hypotheses, the relationships between the factors that promote entrepreneurial learning in the context of civil engineering practice and the dimensions of entrepreneurial skillset are illustrated in Figure 1.

**VI. METHODOLOGY**

This study adopts quantitative methodology and uses partial least square structural equation modeling (PLS-SEM) analysis to measure the influence of the factors that promote entrepreneurial learning on entrepreneurial skill development for practicing civil engineers.

**A. TARGETED RESPONDENT**

The targeted respondents of the study are practicing civil engineers. The practicing civil engineers are being chosen as the respondents in this study because their perspective and experience provide input that comes from their interaction with the factors in the construction industry that could lead to entrepreneurial skill development.

**B. INSTRUMENT**

The questionnaire items were adopted from literature (highlighted in Table 1) which has been further adjusted, verified and pilot tested. The overall Cronbach’s Alpha of the instrument was 0.933. The overall Cronbach’s Alpha is considered

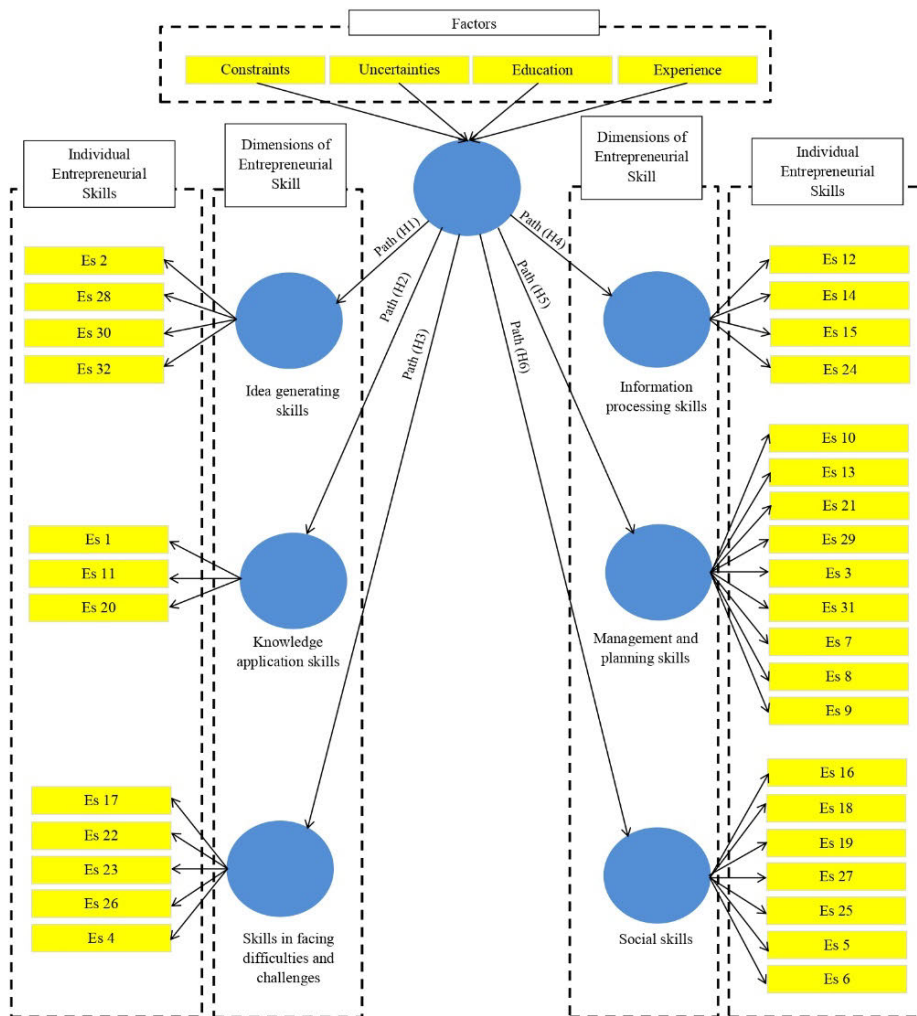


FIGURE 1. The Theoretical Framework of the Study.

acceptable considering that for cases where important decision needed to be made based on test score, the required Cronbach’s Alpha is between 0.9 to 0.95 (Nunnally, 1978). In this study, to determine whether the individual skills reflect the dimensionality of the entrepreneurial skillset, decision based on test score has to be made. The items of the instrument are as shown in the Appendix. A six-point Likert scale also has been used in the instrument.

**C. DATA COLLECTION**

The sampling strategy adopted in this study was convenience sampling strategies where readily accessible, willing and available respondents were selected (Creswell, 2012; Fellow and Liu, 2015). The usage of convenience sampling strategies was due to the likelihood of low response rate (Creswell, 2012) which occurred during the pilot test of this study. Low response rate involving data collection from industry is not unusual as it has been reported that response rate of less than 20 percent is not uncommon (Fellow and Liu, 2015) where it can be as low as 5.91 percent due to lack of participation

from the industry (Dulaimi et. al., 2003). In this study, at the end of data collection, a total 51 questionnaires were returned and 46 questionnaires were useable for data analysis which is 8.98 percent response rate. Although the response rate is low, nonetheless, the amount of questionnaire is deemed acceptable as it has been emphasised that a minimum of 30 samples are required for analytical analysis (Bailey, 1994) and samples greater than 30 samples are considered adequate (Creswell, 2012).

**D. SELECTION OF DATA ANALYSIS**

In this study, Partial Least Square Structural Equation Modeling (PLS-SEM) was selected in view that the recommended range of sufficient respondents for the analysis is posited to be within the range of 20 to 100 respondents and it is considered as nonparametric data analysis (Chin and Newsted, 1998). Furthermore, this study explores the theoretical extensions of the notion that the occurrence of entrepreneurial learning process can lead to entrepreneurial skill development in the context of civil engineering practice which is exploratory

**TABLE 2. Factor Loadings of the Model.**

Code	Reflective Items	Factor Loading	Constructs (Categories)
Es2	Divergent thinking skill	0.799	Idea generating skills
Es28	Creative thinking skill	0.655	
Es30	Innovative skill	0.706	
Es32	Business acumen	0.721	
Es1	Absorptive capacity	0.710	Knowledge application skills
Es11	Technical skill	0.700	
Es20	Dynamic capacity	0.726	
Es12	Marketing skill	0.700	Information processing skills
Es14	Recognising	0.671	
Es15	opportunity skill	0.761	
Es24	Environmental scanning skill Judgment skill	0.768	
Es22	Political skill	0.670	Skills in facing challenges or difficulties
Es26	Resourcefulness	0.704	
Es4	Problem solving	0.632	
Es17	Analytical skill	0.714	
Es5	Influencing skill	0.749	Social skills
Es6	Motivating skill	0.736	
Es16	Negotiation skill	0.639	
Es18	Communication skill	0.708	
Es9	Management skill	0.757	Management and planning skills
Es3	Operational skill	0.805	
Es10	Goal setting skill	0.707	
Es21	Adapting skill	0.727	
Es29	Decision making skill	0.637	
Es31	Strategic competence	0.746	

in nature and has rendered the structural equation modeling in this study to consist of many model relationships (Hair et. al, 2019). The structural equation modeling in this study consist many model relationships because the focus of this study is to explore the influence of factors that promote entrepreneurial learning on the development of each dimension of the entrepreneurial skillset for practicing civil engineers.

**VII. ANALYSIS**

The analyses of this study consist of analysis of the measurement of the model, structural model assessment and Two Tailed-t test. The following sub sections discuss the analyses.

**A. THE ANALYSIS OF THE MEASUREMENT OF THE MODEL**

In order to ensure convergent reliability of the model, the reflective items of the model was assessed by making sure that the factor loading for each item is acceptable. According to Hair et. al (1998), any items in the model with factor loading that is less than 0.6 should be dropped from the model. After amendments were made to the model, the outcome of the assessment of the reflective items is as shown in Table 2. At this stage of the analysis, 7 reflective items have been dropped to ensure convergent reliability of the model.

The next assessment was to evaluate the reflective construct of the model which is indicated as the categories or dimension of the entrepreneurial skillset in the model. At this step, assessment on average variance extracted (AVE), composite reliability, Cronbach’s Alpha, Heterotrait-Monotrit (HTMT) and confidence interval were conducted to ensure construct reliability and validity. The construct reliability and validity of the model are as shown in Table 3.

**TABLE 3. The Construct Reliability and Validity.**

Construct	Average variance extracted (AVE)	Composite Reliability	Cronbach’s Alpha
Idea generating skills	0.521	0.812	0.815
Information processing skills	0.527	0.816	0.815
Knowledge application skills	0.507	0.755	0.756
Management and planning skills	0.535	0.873	0.873
Skills in facing difficulties or challenges	0.464	0.775	0.771
Social skills	0.503	0.802	0.800

According to Chin (1998) and Fornell and Lacker (1981), convergent validity is ensured when the average variance extracted (AVE) of each construct is above 0.5. From Table 3, it can be seen that the construct of skills in facing difficulties or challenges has the average variance extracted (AVE) less than 0.5. Nevertheless, Fornell and Lacker (1981) pointed out that the construct that has average variance extracted (AVE) of 0.4 is still acceptable on the condition that the composite reliability of the construct should be far above 0.6. On this basis, the construct of skills in facing difficulties or challenges is considered still acceptable as the composite reliability of the said construct is far above 0.6.

As for the composite reliability of the reflective construct, it can be seen that the lowest composite reliability of the model is 0.755 which is above 0.7. According to Turetken et. al. (2011), when the construct’s internal composite reliability is above 0.70, reliability of the construct is verified. Thus, the outcome of the assessment of the composite reliability of the reflective construct suggested that the reliability of the reflective construct is verified.

In term of the Cronbach’s Alpha of the reflective construct of the model, the threshold advanced by Nunally (1978) has been adopted where acceptable Cronbach’s Alpha should not be less than 0.7. The outcome of the analysis as shown in Table 3 shows that all of the Cronbach’s Alphas of the reflective construct of the model are acceptable.

Another assessment which is also required to check the reliability and validity of the reflective construct is the

assessment of Heterotrait-Monotrait (HTMT) ratio and confidence interval of the reflective construct. The acceptable Heterotrait-monotrait (HTMT) ratio is pointed out to be not more than 0.90 (Gold, Malhotra and Segars, 2001). As shown in Table 4 it can be seen that the Heterotrait-Monotrait (HTMT) ratio of the reflective construct are mostly above 0.9.

**TABLE 4. The Heterotrait-Monotrait (HTMT) Ratio of the Constructs or Categories of Entrepreneurial Skills.**

	Idea generating skills	Information processing skills	Knowledge application skills	Management and planning skills	Skills in facing difficulties or challenges	Social skills
Idea generating skills						
Information processing skills	0.964					
Knowledge application skills	0.915	0.991				
Management and planning skills	0.892	0.917	1.109			
Skills in facing difficulties or challenges	0.960	0.889	1.099	1.074		
Social skills	0.853	0.994	1.016	0.874	0.962	

This occurrence is not uncommon for a type of model such as the model in this study due to the multidimensionality of the model. Mathwick, Malholtra and Rigdon (2001) have addressed that a model that has multidimensionality will face difficulties in establishing discriminant validity. However, by conducting bootstrapping, confidence interval can be constructed for the Heterotrait-Monotrait (HTMT) ratio to test whether the confidence intervals contain the value '1.00' which indicates lack of discriminant validity (Henseler, Ringle and Sarstedt, 2015). As shown in Table 5, none of the confidence interval of the Heterotrait-Monotrait (HTMT) ratio of the reflective construct contain the value '1.0' and therefore discriminant validity can be suggested (Bagozzi, Richard and Heartherton, 1994; Mathwick, Malholtra and Rigdon, 200; Henseler, Ringle and Sarstedt, 2015).

In term of the collinearity test of the model, it was conducted by evaluating the variation inflation factor (VIF) of the model. Ruiz et. al (2010) advanced that the cut off value for variation inflation factor (VIF) is ranging between 5 to 10. Taking the variation inflation factor (VIF) of 5 as the cut off value, it can be seen the variation inflation factor (VIF) of the model which has the value of 1.0, is far below the cut off value. The outcome of this test suggests that the model has achieved results which are not bias. It should be noted that, the accepted results of the measurement of the model in this

**TABLE 5. The Confidence Interval of the Heterotrait-Monotrait (HTMT) Ratio of the Constructs or Categories of Entrepreneurial Skills.**

	Idea generating skills	Information processing skills	Knowledge application skills	Management and planning skills	Skills in facing difficulties or challenges	Social skills
Idea generating skills						
Information processing skills	0.964					
Knowledge application skills	0.915	0.991				
Management and planning skills	0.892	0.922	0.927			
Skills in facing difficulties or challenges	0.802	0.892	0.998	0.995		
Social skills	0.656	0.888	0.883	0.672	0.834	

study were achieved after the formative item of the factor of uncertainties was dropped from the model.

**B. STRUCTURAL MODEL ASSESSMENT**

The assessment of the goodness of fit of the model was carried out in order to observe the level of discrepancy of the model. In conducting the assessment of the goodness of fit for partial least square structural equation modelling (PLS-SEM), it should be understood that there is no standard goodness of fit statistic has been pointed out but examining the coefficient of determination ( $R^2$ ) and the effect size ( $f^2$ ) of the model are highly recommended (Hair, Ringle and Sarstedt, 2011). In addition to that, the assessment on standardised root mean square residual (SRMR) of the model also has been deemed important (Henseler, Hubona and Ray, 2016). Taking into account the recommended assessments, the goodness of fit of the model in this study was assessed by examining the coefficient of determination ( $R^2$ ), the effect size ( $f^2$ ) and the standardised root mean square residual (SRMR) of the model in order to evaluate the level of discrepancy of the model.

For the assessment of the coefficient of determination ( $R^2$ ) in particular, the adjusted values of coefficient of determination ( $R^2$ ) were taken into consideration due to the recommendation advanced by Henseler, Hubona and Ray (2016) which has pointed out that the adjusted values of coefficient of determination ( $R^2$ ) takes into account the model complexity and sample size. The coefficient of determination ( $R^2$ ) and the effect size ( $f^2$ ) of the construct or categories of the entrepreneurial skills are as shown Table 6.

The assessment of the coefficient of determination ( $R^2$ ) of the model is based on the rule thumb that the coefficient of

**TABLE 6. The  $R^2$  and  $f^2$  of the Construct or Categories of Entrepreneurial Skills.**

Construct	Adjusted Coefficient of determination ( $R^2$ )	Effect size ( $f^2$ )
Idea generating skills	0.116	0.157
Information processing skills	0.138	0.186
Knowledge application skills	0.224	0.318
Management and planning skills	0.286	0.438
Skills in facing difficulties or challenges	0.274	0.408
Social skills	0.045	0.071

determination ( $R^2$ ) of 0.75, 0.50 and 0.25 are respectively indicating substantial, moderate and weak level of predictive accuracy (Hair, Ringle and Sarstedt, 2011). From Table 6, it can be seen that the adjusted coefficient of determination ( $R^2$ ) of the model is within the range of weak level of predictive accuracy. As for the effect size ( $f^2$ ) of the model, the assessment based on the rule of thumb that the effect size ( $f^2$ ) of 0.02, 0.15, and 0.35 which respectively indicates small, medium and large effects (Cohen, 1988) shows that the effect size ( $f^2$ ) of the model is mostly in the range of moderate to large effect size.

The outcome of the assessment of coefficient of determination ( $R^2$ ) and effect size ( $f^2$ ) of the model indicates that there is tendency that discrepancy would occur in the model. Thus, to further examine the level of discrepancy, evaluation of standardised root mean square residual (SRMR) was conducted. For standardised root mean square residual (SRMR), Hu and Bentler (1999) recommended that the value of standardised root mean square residual (SRMR) which do not results in type I (incorrect rejection of an acceptable model) or type II error (incorrect rejection of an acceptable model) is value that do not exceed 0.09. The analysis of the partial least square structural equation modelling (PLS-SEM) of this study shows that the standardised root mean square residual (SRMR) of the model is 0.084 which justify that the discrepancy in the model do lead to the rejection of the model and hence indicate a good fit. Thus, with the evaluation of coefficient of determination ( $R^2$ ), the effect size ( $f^2$ ) and the standardised root mean square residual (SRMR) of the model, it is suggested that the goodness of fit of the model has been established.

**C. TWO TAILED-t TEST**

The final assessment in the analysis of the model is the Two Tailed-t Test. The Two Tailed-t Test was conducted to test the hypotheses stated in Section VI at significance level of 5 percent where t-values greater than 1.96 were considered as significance (Lowry and Gaskin, 2014). The outcomes of the analysis are as shown in Table 7, Table 8 and Table VI and the discussion is in the following section.

**TABLE 7. The t-values of Formative Items.**

Formative Items	t-values
Constraints	3.522
Experience	1.190
Education	0.631

**TABLE 8. The t-values of Reflective Items.**

Dimensions of Entrepreneurial Skills	Code	Entrepreneurial Skills	t-values
Idea generating skills	Es2	Divergent thinking skill	8.656
	Es28	Creative thinking skill	5.974
	Es30	Innovative skill	7.566
	Es32	Business acumen	8.328
Knowledge application skills	Es1	Absorptive capacity	10.512
	Es11	Technical skill	7.583
	Es20	Dynamic capacity	8.293
Information processing skills	Es12	Marketing skill	8.326
	Es14	Recognising opportunity skill	5.025
	Es15	Environmental scanning skill	12.310
	Es24	Judgment skill	10.953
Skills in facing challenges or difficulties	Es22	Political skill	6.536
	Es26	Resourcefulness	8.161
	Es4	Problem solving	7.914
	Es17	Analytical skill	7.524
Social skills	Es5	Influencing skill	7.550
	Es6	Motivating skill	8.821
	Es16	Negotiation skill	5.820
	Es18	Communication skill	6.717
Management and planning skills	Es9	Management skill	11.641
	Es3	Operational skill	12.826
	Es10	Goal setting skill	6.167
	Es21	Adapting skill	7.763
	Es29	Decision making skill	5.010
	Es31	Strategic competence	7.800

**VIII. RESULTS AND DISCUSSION**

Based on the analysis of the partial least square structural equation modeling (PLS-SEM), it can be seen that the factors that promote entrepreneurial learning which was based on the theory of entrepreneurial learning advanced by Pittaway and Thorpe (2012) are significantly formed by the factor of constraint as shown in Table 7.

This result indicates that in the context of civil engineering practice, the factor of constraint is the salient factor that promotes entrepreneurial learning as the result of the Two Tailed-t test for the rest of factors yield t-values that are less than 1.96.

As for the categorisation of individual entrepreneurial skills, the results of the Two Tailed-t test shows that, each dimension in the model is significantly represented by the individual skills that were being categorised into their respective dimension as the t-values for each individual skill is greater than 1.96. This result demonstrate that the entrepreneurial skillset for future civil engineering graduates consists of 6 dimensions which were represented by a total of 25 individual entrepreneurial skills as shown in Table 8.

**TABLE 9. The Results of Two Tailed-t Test for all Hypotheses at Significance Level of 5 Percent.**

No	Hypothesis	t-values	Accept	Reject
H1	Factors that promote entrepreneurial learning has positive influence on the development of idea generating skill dimension of the entrepreneurial skillset	2.143	√	
H2	Factors that promote entrepreneurial learning has positive influence on the development of knowledge application skill dimension of the entrepreneurial skillset	3.145	√	
H3	Factors that promote entrepreneurial learning has positive influence on the development of information processing skills dimension of the entrepreneurial skillset	2.222	√	
H4	Factors that promote entrepreneurial learning has positive influence on the development of skills in facing difficulties and challenges dimension of the entrepreneurial skillset	3.270	√	
H5	Factors that promote entrepreneurial learning has positive influence on the development of social skill dimension of the entrepreneurial skillset	1.383		√
H6	Factors that promote entrepreneurial learning has positive influence on the development of management and planning skill dimension of the entrepreneurial skillset	3.295	√	

In terms of the hypotheses testing, the result of the Two Tailed-t test shows that at significance level of 5 percent, all of the dimension of the entrepreneurial skillset yield t-values that are greater than 1.96 except for t-value for the dimension of social skill as shown in Table VIV. This indicates that factors that promote entrepreneurial learning which significantly form by the factor of constraint do not have significant positive influence on the development of social skill dimension of the entrepreneurial skillset. Therefore, in the context of practicing civil engineer, the social skill dimension of the entrepreneurial skillset can be considered as not prominent as it's development does not significantly influence by the salient factor that promote entrepreneurial learning in the context of civil engineering practice. Table VIV shows the outcome of the hypotheses testing using Two Tailed-t test.

Nevertheless, this do not indicate that the social skill dimension of the entrepreneurial skillset is not important

but it is implying that in the context of civil engineering practice where the factor of constraint is salient, the development of social skill dimension of the entrepreneurial skillset is not prominent. Thus this finding suggest that in practice, the entrepreneurial skillset development for practicing civil engineer inclined towards other dimensions of entrepreneurial skillset. Even so, it should be acknowledged that as this study adopts nonparametric approach in the data analysis, therefore this finding should not be generalised. Instead it is presenting a case which requires further investigation and exploration.

As for the discovery of prominent dimensions of the entrepreneurial skillset, this finding highlights the prominent constituents of entrepreneurial skillset for future civil engineering graduates which consist of 5 prominent dimensions. Meanwhile the discovery of salient factor that promote entrepreneurial learning which subsequently will be leading to the development of entrepreneurial skill portrays the key element in civil engineering practice. However it should be understood that again, this finding is presenting a case as the results were the outcome from nonparametric analysis.

Therefore the findings of this study are very specific and it highlights a specific case for entrepreneurial skillset development in the context of civil engineering practice and also for future civil engineering graduates.

## IX. CONCLUSION

This study explores the extension of the notion that the occurrence of entrepreneurial learning process could lead to entrepreneurial skill development (Seuneke, Lans and Wiskerke, 2013). By adopting the framework of entrepreneurial learning advanced by Pittaway and Thorpe (2012), the influence of factors that promote entrepreneurial learning towards entrepreneurial skill development was explored in this study. The context of this study is civil engineering practice. The data analysis approach in this study adopts the nonparametric approach and employed Partial Least Square Structural Equation Modeling (PLS-SEM) analysis.

The findings of this study discovered that there are 5 prominent dimensions of entrepreneurial skillset namely; the dimension of idea generating skills, knowledge application skill, information processing skills, skills in facing difficulties and challenges and management and planning skill. The findings of the study also discovered that, in the context of civil engineering practice, the salient factor that promotes the occurrence of entrepreneurial learning which could lead to entrepreneurial skill development is the factor of constraint. Even so, the factor of constraint does not positively influence the development of the entrepreneurial skillset in term of the dimension of social skill.

As a conclusion, the findings of this study presented a case for entrepreneurial skillset development in civil engineering practice whereby the salient factor is constraint. This case however is not suitable for the development of the dimension of social skill of the entrepreneurial skillset as the salient



factor do not positively influence its' development. Therefore, the application of the case presented through the finding of this study is limited for the development of the prominent dimensions of the entrepreneurial skillset for practicing civil engineers and further investigation is required to discover a suitable case for the development of the dimension of social skill of the entrepreneurial skillset. This case presented by the findings of the study can be embedded in projects for civil engineering students in order to directly equip them with entrepreneurial skillset but with modification that took the development of the dimension of social skill of the entrepreneurial skillset into account.

## APPENDIX

### Items in the Instrument of the Study

- 1) **Construct of Factors that Promote Entrepreneurial Learning**
  - 1.1 Level of Education
  - 1.2 Years of Working Experience
  - 1.3 Frequency of Encountering Uncertainty in Construction Project (Very rare – Very frequent)
  - 1.4 Frequency of Encountering Constraint in Construction Project (Very rare – Very frequent)
2. **Items for measuring Entrepreneurial Skills (Self-Assessment)**  
(Strongly Disagree- Strongly Agree)
  - 2.1 **Absorptive Capacity (E1)**: I consider myself possess a broad range of knowledge (from basic knowledge to knowledge of most recent scientific or technological development) that I can utilize in areas related to my work.
  - 2.2 **Divergent Thinking Skill (E2)**: It is very often that I am able to compare and combine different ideas in a new way that give alternatives to how I can solve problems in projects than I am handling.
  - 2.3 **Operational skill (E3)**: It is very often that I am able to combine and transform various resources used in the construction project to improve the flow of work involved in the construction project I am handling.
  - 2.4 **Problem-solving skill (E4)**: It is very often that I am able solve unclear problems in more than one way.
  - 2.5 **Influencing skill (E5)**: I am frequently able to help other people to view complicated circumstances under positive light that enable them to see such circumstances in a productive way.
  - 2.6 **Motivating skill (E6)**: I consider myself very competent in motivating people that I work closely with by using different approach according to each person's needs.
  - 2.7 **Organisational skill (E7)**: I consider myself very competent in leading, coordinating, controlling, planning schedule, work monitoring and organizing internal and external resources in the construction project.
  - 2.8 **Delegation skill (E8)**: I consider myself very competent in carefully considering the nature of the task as well as individuals' capabilities before deciding to whom I should delegate.
  - 2.9 **Management Skill (E9)**: My superiors very often turn to me when handling complicated tasks related to project management.
  - 2.10 **Goal setting skill (E10)**: I consider myself to be very competent in setting goals for the projects or work assigned to me.
  - 2.11 **Technical skill (E11)**: I consider myself to be very competent in applying techniques, skills, and modern engineering tools in my work.
  - 2.12 **Marketing skill (E12)**: I consider myself to have good understanding about current marketing practice in the construction industry.
  - 2.13 **Financial skill (E13)**: When I am assigned with the task of estimating the cost of a project, it is very often, I proposed a budget estimation that is satisfying to my client and my superior.
  - 2.14 **Skill in Recognising Opportunity (E14)**: I consider myself very alert to opportunities and competent in making full use of the opportunities that presence in the project that I am handling.
  - 2.15 **Environmental Scanning Skill (E15)**: My superior will turn to me when there is a need to acquire external environmental information to assist decisions making process related to strategies applied in the project.
  - 2.16 **Negotiation Skill (E16)**: I consider myself very competent in making sure the outcome of the negotiating process to be profitable to all of parties involve in the negotiating process.
  - 2.17 **Analytical Skill (E17)**: I consider myself to be very competent in analyzing the consequences of the decisions to be made before carefully making next move forward when confronted by complex circumstances.
  - 2.18 **Communication Skill (E18)**: I am likely to be able to deliver my ideas effectively not only to engineers but other professionals who involved in the project with confidence in both oral and written communication.
  - 2.19 **Leadership Skill (E19)**: I am frequently assigned by my superior to lead a team of colleagues in handling any task in my work place.
  - 2.20 **Dynamic capabilities (E20)**: I consider myself to be competent in applying knowledge and skill appropriately at different stages of the projects and drive the progress forward effectively.
  - 2.21 **Adapting Skill (E21)**: I consider myself as competent to cope with circumstances that constantly changing in the projects that I am handling.
  - 2.22 **Political Astuteness (E22)**: I consider myself to be very competent in developing a large network at work with those who are influential at work that will help me to get things done successfully.
  - 2.23 **Risk-Propensity (E23)**: I consider it is likely that I am competent in managing risk and shoulder responsibilities when the project that I am handling is in the conditions of uncertainty.

- 2.24 **Judgment capabilities (E24):** My superior very often turns to me when making judgment to distinguish the main issues from secondary issues before making decisions.
- 2.25 **Teamwork skill (E25):** It is very likely that I participate actively when working in a team by making sure others are participating together comfortably.
- 2.26 **Resourcefulness Skill (E26):** I consider myself to be very competent to bring in resources needed in the project I am handling even when the situation is difficult, stressful, challenging and demanding.
- 2.27 **Networking Skill (E27):** I consider myself very competent in enlarging my networking acquaintances while maintaining good relationship with existing ones.
- 2.28 **Creative Thinking Skill (E28):** According to my experience, it is highly likely that I will come out with creative solutions when confronted by problems in my work.
- 2.29 **Decision making Skill (E29):** I consider myself to be very competent to take prompt decisions especially when there are sudden changes in the project that I'm handling.
- 2.30 **Innovative Skill (E30):** According to my experience, it is likely that the idea I suggested in my workplace show originality and ingenuity.
- 2.31 **Strategic Competence (E31):** According to my experience, it is likely that the strategies that I used to achieve the objectives of the work assigned to me will succeed.
- 2.32 **Business Acumen (E32):** I consider myself competent in developing idea that allows commercial opportunity for the project that I am handling by utilizing the suitable resources, making plan and think ahead.

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