

Human Resource Development and Success of Engineering Procurement Construction Project: What Role Engineering Education and Human Resource Competency can play?

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Abstract:

The current paper aimed to analyze the impact of engineering education (EE) on Human Resource Development (HRD) and Success of Engineering Procurement Construction Project (SEP) along with the mediating role of human resource competency (HRC). This study has been conducted on construction companies of Malaysia so, the data from 360 senior and middle level managers of selected companies was collected through structured questionnaire. The collected data was analyzed through quantitative data analytical software (SPSS and AMOS) through which the CFA and SEM were performed for hypotheses testing. Results of the study confirmed the significant positive role of engineering education HRD and SEP because increase in EE caused significant increase in HRD and SEP. Furthermore, findings have suggested that there is significant mediation of HRC between engineering education and HRD and between engineering education and SEP. These findings are of great importance for researchers, strategy makers and policy makers because they guide about the role of EE and HRC in enhancement of HRD and SEP.

Keywords: Human Resource Development, Success of Engineering Procurement Construction Project, Education, Human Resource Competency

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I. INTRODUCTION

The concept of human resource development refers to the idea of developing and utilizing human skills and knowledge by the development of an organization and the development and training of the employees of that particular organization with the goal of improvement and increase in the organizational performance (Jernsittiprasert, Siriattakul, & Wattanapongphasuk, 2019). The process of human resource development involves not only the development and training of individuals, but also the development and training of teams of individuals working in that organization (Wilton, 2016). These individuals and teams are trained with the core purpose of increase in individual and organizational performance of the company. Human resource development usually involves

the five most important factors i.e. personal development of a person, career development of an employee, team development of a team consisting of many individuals, organizational development of a company and training and development process of employees working in a particular organization (Waters & Craske, 2016). All these factors actually define and explain the whole process of human resource development.



Figure 1. Human Resource Development (Source: locusassignments.com)

Figure 1 shows different components related to human resource development. Engineering procurement construction EPC project can be defined as a set of products, services and construction works that are designed in order to produce a specific asset or object for its potential customer in a certain span of time. An EPC project can be difficult to understand and apply, containing vast knowledge and information, containing many components and systems and requiring huge human efforts and financial support (Sweller & Paas, 2017). An EPC project is not at all an easy concept as it involves a huge amount of complex, difficult, creative and technical information, knowledge and skills. An EPC project can be considered as a successful project if it is designed within the limit of specified budget, completed in a fixed span of time, shows better than expected results and results in the satisfaction of its potential customer. All these characteristics depict the EPC project success of an organization (Stein-Brzozowska et al., 2016). Engineering education provides necessary technical and managerial skills that are required by an organization to be utilized in their processes and practices or production as well as management with the core purpose of increase and improvement of organizational performance, growth and development of a particular company. An organization with the goal and objective of introducing innovative and latest technical procedures prefers to hire the individuals with engineering education and related experience. Human resource competency usually refers to the exceptional skills and abilities of project manager and the project team members. We can say that project team competency is based upon the competencies of project manager and the project team members (Steffen et al., 2015). The success of a project is basically dependent upon the competency of project manager, so it is very crucial to select the project manager with right amount of qualities, abilities, skills and knowledge about the project and related aspects. The most important

factors of a competent project manager include, decision making ability, sense of responsibility, leadership qualities, better knowledge and skills, experience about the project management and personal qualities of a manager (Sparrow, Brewster, & Chung, 2016). In the same fashion, project team members also play an important role in the success of a project throughout the period of project. There are several characteristics that make the project team members competent. These characteristics include technical knowledge and skills, communication skills, problem solving abilities, teamwork skills and commitment regarding to their job. All the above mentioned characteristics of project manager and project team members are essential for the achievement of success in a specific project (Shen, Tang, Yu, et al., 2017). A successful project that depends upon both, the project manager and the project team members, ensure the improvement and increase in the growth and development of that particular organization. Therefore it is necessary for the organization to effectively recruit the employees for their organizations.

Engineering education provides technical and managerial skills and knowledge in order to increase the human resource competency of both project managers and project team managers, which as a result increases human resource development and leads towards the EPC project successfulness and growth and development of the organization (Shen, Tang, Wang, et al., 2017). But, sadly in Malaysia, there have been insufficient reforms and improvements in engineering education and lack of engineers due to which the incompetent project managers and project team members are increasing resulting in decrease of human resource competency. This ultimately affects human resource development adversely and failures in EPC projects resulting in the decrease in growth and development of organizations (Salah & Moselhi, 2016). Other than Malaysia, this problem is also faced by other developed and under developed countries. If this problem is not solved as soon as possible it will have adverse effects on the growth and development of human resource of organizations in these particular companies. Therefore it is very crucial to solve this problem as early as possible so that the human resource development is increased and the chances of success of EPC projects are also increased. Several researches have been conducted in order to study the concepts of engineering education, human resource competency, human resource development and EPC project success. A very few studies also have discussed the impact of engineering education on human resource development and EPC project success but no researches have been conducted in order to study the mediating role of human resource competency between engineering education and human resource development and EPC project success. So a research

paper has recommended studying about the significant mediating role of human resource competency in this regard (Nguyen & Hadikusumo, 2018). This study has the following important objectives:

- To analyze the significant impact of Engineering Education on Human Resource Development in Organizations of Malaysia
- To analyze the significant impact of Engineering Education on Success of EPC Projects in Organizations of Malaysia
- To analyze the significant mediating role of Human Resource Competency between Engineering Education and Human Resource Development in Organizations of Malaysia
- To analyze the significant mediating role of Human Resource Competency between Engineering Education and Success of EPC Projects in Organizations of Malaysia

With the gradual economic growth and development of businesses and organizations in Malaysia, and with the change in the image of agricultural based country to industrial based country, different organizations in Malaysia have sensed the need of human resource development in their companies so that the individual employees and the teams of employees may perform better and result in the success of EPC projects and in further growth of these particular organizations (Ruparathna & Hewage, 2015). The scope of this study revolves around the benefits of engineering education in increase of human resource development and success of EPC projects through enhanced human resource competency. This study will provide detailed literature about the concepts of human resource development, human resource competency and EPC projects in Malaysia (Resnick, 2017). Other than that, this study will assist the organizations in improving their recruitment systems so that competent and skilled employees are hired and trained individually and in the form of teams as well. This study will also assist the government of Malaysia to make policies favorable for human resource development and human resource competency so that the chances of success of EPC projects can be increased.

II. LITERATURE REVIEW

Cognitive Learning Theory

Cognitive learning theory, introduced by Jean Piaget an educational psychologist, explains the concept of thinking and learning and also shows that how internal and external factors influence the process of thinking and learning. This theory explains the complete procedure of thinking and learning that includes the processing of information and stimuli and how people respond to that information and stimuli during the

process of thinking and learning (Pritchard, 2017). This theory also shows that people respond to the information and stimuli based on their already existing cognitive structure. This theory is actually an answer to the behaviorist theory that revolves around the fact that only external stimulus and the response of an individual to that stimulus can be observed and studied. According to behaviorist theory, internal processes of a human brain cannot be studied and measured as no one can see inside the human's brain. On the other hand, cognitive learning theory has denied the behaviorist theory and has explained that the internal processes of mind can be studied and measured effectively. Mere behaviors in response to the stimuli are not important, the reasons and processing behind that particular behavior is also very crucial. So this theory is more about the internal processes rather than the external and observable behavior (Pal, Wang, & Liang, 2017; Plomp et al., 2016). The mental processes involved in cognitive learning theory include the intake of stimuli, its processing in the brain and the output shown by an individual due to the input. These mental processes usually include attention, observation, perception, interpretation, organization, memorization etc. Another important aspect of this theory is the impact of internal and external factors on the mental processes of an individual during the process of thinking and learning. If the cognitive process is working normally, then the intake of stimuli and storage of information takes place effectively (Noe, Hollenbeck, Gerhart, & Wright, 2017). On the other hand, when the cognitive processes are not effective, there may be observed delays and difficulties in information storage function of brain. As human resource development, EPC projects and human resource competence involve different processes of learning of technical and managerial skills and knowledge, therefore we can use this theory of cognitive learning in order to explain all these processes effectively and their impacts on each other as well.

Impact of Engineering Education on Human Resource Development

As human resource management involves different processes through which development of individuals and teams consisting of individuals are trained with technical skills and knowledge for their development as well as the development of the organization, engineering education plays an important and crucial role in this regard (Marsh, 2017; Nguyen & Hadikusumo, 2017). Engineering education enables individuals to use specific skills, knowledge and information in order to bring innovation in several processes involved in the production of products and provision of services. Engineering education not only provides skills and abilities to works individually in an effective way but also enables individuals to work in the form of teams and groups in order

to achieve some specific goal or purpose. Studies have shown that human resource management involves different factors such as personal development, career development, team development, organizational development and training and development (Kavanagh & Johnson, 2017). All these factors are influenced by engineering education. The personal development of an individual refers to the growth and development of an individual in terms of exceptional skills, knowledge and information that is essential for different processes of an organization. It also involves the skills such as decision making skills, problem solving abilities, communication skills etc. of an individual. Other than that, career development refers to the growth and development of an individual in the context of his/her job. To excel in a job and getting promoted to higher levels on the basis of performance of an employee, depicts the career development of that employee. Next factor, team development means that whether individuals included in a team are giving more output than they give individually or not (Kalyuga & Singh, 2016). Teamwork has become very important in the recent era as most of the tasks can only be done in the form of teams in organizations. Organizational development refers to the growth and development of an organization because of the innovative and latest techniques used by them for various processes and procedures involved in the production of products and provision of services (Harasim, 2017). Studies have shown that training and development of an employee refers to the actual training of employees with various skills and information that are necessary for the growth and development of that particular organization. In all these factors of human resource development, engineering education plays a crucial role in all respects. From all the above discussion, we can say that engineering education has significant impact on human resource development in organizations of Malaysia. This impact can be studied in reference to cognitive learning theory. We can generate the following hypothesis in this regard:

H 1: Engineering Education has significant impact on Human Resource Development in Organizations in Malaysia.

Impact of Engineering Education on Success of Engineering Procurement Construction Project

Engineering procurement construction EPC project refers to the set of products, services and construction processes that are specially designed in order to produce an object or asset for the customer in a fixed span of time. An EPC project is not really easy to understand and develop, it contains many complexities. An EPC project can be difficult to understand because it contains a huge amount of knowledge and information about that particular process through which product for the customer is produced (Downs & Stea, 2017;

Goldie, 2016; Habibi, Kermanshachi, & Safapour, 2018). An EPC system requires many minds to put forward their ideas and suggestions in this regard so that the chances of success of EPC project can be increased. In addition, studies have shown that EPC project is very costly and requires abundant financial support in order to make it effective and successful. An EPC project is considered to be successful if it is prepared within the range of allotted budget and allotted time. In addition, more efficient results than expected are also the indicators of success of an EPC project (Dachyar & Sanjiwo, 2018). From this information it is quite obvious that in order to develop an EPC project and to make it successful, many technical and managerial skills are required that can be obtained from engineering education, which can be observed through cognitive learning theory. The organizations willing to produce successful EPC projects must prefer the individuals with engineering education so that they can grow and develop effectively (Cumberland, Herd, Alagaraja, & Kerrick, 2016). As EPC projects usually involve teams of individuals working in collaboration with each other, engineering education also provides enough team working skills to individuals that can assist them in EPC project. The above discussion clearly shows that engineering education has significant impact on success of EPC projects in organization of Malaysia. We can generate the following hypothesis:

H 2: Engineering Education has significant impact on Success of Engineering Procurement Construction Projects in Organization of Malaysia.

Mediating Role of Human Resource Competency between Engineering Education and Human Resource Development

Human resource competency refers to the exceptional skills and abilities of individuals as well as teams consisting of individuals. These exceptional qualities and skills may be related to technical or managerial aspects. The project team competency mostly depends upon both the project manager competency as well as the project team manager competency. The project manager competency can be measured by various factors. Studies have shown that these factors include decision making ability of the manager, problem solving ability, leadership qualities, and experience in EPC projects (Creamer & Austin, 2017). All these factors are ensured by engineering education. The individuals having engineering education have enough skills that enhance the decision making capability of a manager in critical and difficult situations. This is the most important quality of a manager that makes him/her exceptional. In addition, the individuals having engineering education are trained and educated in such a way that they can easily solve difficult problems in seconds. This is another

important quality of a successful and competent manager. An engineer has effective leadership qualities and skills that make him able to control whole team of individuals in a positive and efficient way (Brewster, 2017; Brière, Proulx, Flores, & Laporte, 2015; Carley & Christie, 2017). All these properties that make a manager competent and successful can be obtained from engineering education. In the same way, project team members also have some exceptional qualities such as problem solving ability, skills and information about EPC projects and teamwork skills. Studies have shown that just like project managers, project team members can have problem solving abilities through engineering education. Other than that, skills and information about EPC projects can obviously be obtained from engineering education. Engineering education also provides enough skills and trainings to individuals so that they can work in the form of teams and groups to achieve a specific goal or objective for their organization. The learning process of these skills is in accordance with the cognitive learning theory (Bratton & Gold, 2017). So we can say that engineering education enhances the human resource competency which ultimately increases human resource development in an organization. From the above discussion we can conclude that human resource competency has significant mediating role between engineering education and human resource development. We can generate the following hypothesis:

H 3: Human Resource Competency has significant mediating role between Engineering education and Human Resource Development in Organizations in Malaysia.

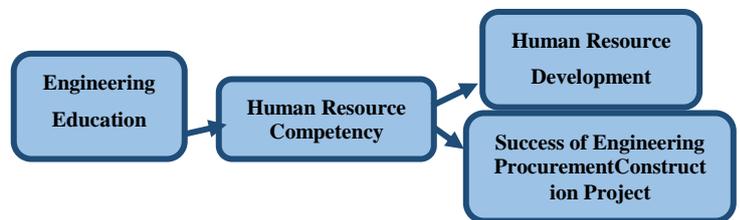
Mediating Role of Human Resource Competency between Engineering Education and Success of Engineering Procurement Construction Project

As human resource competency involves both the project manager and the project team members in the success of an EPC project, the study of roles of both of them is quite important in this regard (Ashby & Valentin, 2017). Project managers have some exceptional skills such as decision making, problem solving, leadership skills and experience in EPC projects etc. Similarly project team members have some exceptional skills such as problem solving, knowledge about EPC projects, communication skills and their teamwork abilities. Studies have shown that all these skills and qualities of project group managers and project team members ensure the success of an EPC project. All these qualities and skills can be obtained from engineering education. As EPC projects are very complex, containing a large amount of components related to the processes involved in a particular organization, a whole team consisting of several individuals is appointed in order to carry out that particular project (Albrecht, Bakker,

Gruman, Macey, & Saks, 2015). Team work has very crucial role in the success of EPC projects because these projects need people to work in collaboration with each other and contribute towards the success of these projects. Studies have shown that human resource competency provides requires teamwork abilities to individuals through engineering education. Team members can use these effective skills related to teamwork in EPC projects to maximize their outputs (Akkermans & Tims, 2017). So we can say that engineering education enhances the human resource competency that ultimately results in the success of EPC projects. From this discussion, we can conclude that human resource competency has significant mediating role between engineering education and success of EPC projects in organizations in Malaysia. We can generate the following hypothesis:

H 4: Human Resource Competency has significant mediating role between Engineering Education and Success of Engineering Procurement Construction Projects in Organizations in Malaysia.

Research Model:



III. RESEARCH METHODOLOGY

POPULATION AND SAMPLE

In this proposed study, researcher tried to examine the role of engineering education and human resource competency in human resource development and in success of engineering, procurement project. Data about the importance of engineering education and human resource competency over the project success has been collected from Malaysian population. Construction companies of Malaysia such as UEM group berhad, YTL corporation berhad and IJM corporation berhad have been constitutes the sampling frame of proposed study. The sample respondents such as senior manager and middle managers have been selected with simple random sampling technique for maintaining the balance of data set from these companies. Data set collection from these respondents have been considered more accurate because they can respond well about human resource development and success of projects under human resource competency and engineering education. As per idea of Klein (2015) sample size has been calculated is 360, among which survey questionnaire has been distributed. Some of responses have

been deleted because they were invalid and inaccurate that's why only 312 responses were considered valid.

DATA COLLECTION PROCEDURE

For the data collection, researcher has been used survey questionnaire because collected data is in numeric form which researcher can easily be analyzed statistically. Questionnaire has been originally designed in English language but it translated into native language for the understanding of the respondents. After collecting the responses, researcher used back translated method for converting back the questionnaire to English language for easily evaluation. For the verification of survey items, researcher accompanied pilot study in which researcher collect the perspectives of involved parties regarding the format, wording and ordering of questions. Moreover, content validity of scales has also been verified by industrial practitioner. After that researcher modified the questionnaire according to the collected feedback, then researcher administered the finalized questionnaire to the respondents of study. Online and self-administered techniques have been used for collecting the responses form respondents.

Reliability and Validity of Measures

Reliability and validity of measurement model have been evaluated by SPSS and AMOS respectively. Reliability has been assessed by SPSS, by examining two criteria such as Cronbach's α and composite reliability, its values have to be greater than 0.70 because internal consistency and desirable level of items reliability were only be ensured when its values greater than 0.70. Convergent and discriminant validity both have been assessed by AMOS but criteria to examined it are totally different such as convergent validity has been assessed by two criteria such as (1) items loading λ it values were stronger when it has been greater than 0.70 and (2) average variance extracted, its values were stronger when it has been greater than 0.50. Coming towards discriminant validity evaluation, it has to be ensured that AVE of variables of constructs should be greater than all other correlated constructs variance. Constructs can only be considered distinct from other constructs when square root of AVE is greater than inter-correlated coefficients of all other remaining constructs.

As every study have dependent variables, independent variables and explanatory variable, on which not previous study has been conducted. When all these variables accounted by the same measures which have been suggested by common raters (Donaldson & Grant-Vallone, 2002; Podsakoff, MacKenzie, Lee, & Podsakoff, 2003) than common method bias has been observed in the study. Researcher has to be vigilant while diagnosing the existence of CBM in the study because due to corruption of measures in same direction,

outcomes of study get contaminate (Podsakoff, MacKenzie, Lee, & Podsakoff, 2003). This proposed study has different set of variables such as engineering education, human resource competency, human resource development and success of engineering, procurement construction project. For running the diagnosing of test, all these variables will be taken into account. Harman's single factor test has been used for the checking of the risk of common bias method, the criterion on the bases of which test has been run is that if 50% of variance accounted for by single factor then common bias method existence has been ensured. Test results reported that proposed study has not been came across common bias method because 84% of variance interpreted by multiple factors and only 16% of variance interpreted by single factor.

MEASURES

For the measurement of the variables, all the related studies have been taken into consideration. After that researcher adapted few measures from these studies for the measurement of respective variables of proposed study. These measures are stated below.

A. Engineering Education

As it has already been stated that measures have been adapted from the previous studies that's why this variable has been measured by using the survey items used in the research work of (Jarrar & Anis, 2016). 12 survey items have been used for the measurement of engineering education, out of these survey items one is "I have learned that engineering has impact on society and on the environment". The scale which record the responses is 5-point Likert scale, respondents responded in the range 1-5, where 1 refers as strongly disagree and 5 refers as strongly agree.

B. Human Resource Competency

Human resource competency act as the mediating role in specific relationship of study, it has been measured by using 10 survey items. In these survey items research asked the respondents that how the HRC mediate the relationship of EE and HRD. Out of the 10 survey items, one is "HRC enables us in learning the techniques for performing the engineering procurement construction project". All of these measures have been adapted from the more related study of (Rodriguez, Patel, Bright, Gregory, & Gowing, 2002). These items responses have been recorded in 5-point Likert scale, in which responses ranges from 1 (strongly disagree) to 5 (strongly agree).

C. Human Resource Development

Human resource development as dependent variable has been measured by using 5 items scale, which have been adapted from the study of (Werner & DeSimone, 2011). These measures have been considered more accurate because they

have already been verified in previous literature. Out of 5 items, one survey item is “Our firm has developed strong network of individual development”. Respondents responses have been measured in the form of 5-point Likert scale, in which 1 stands for strongly disagree and 5 stands for strongly agree.

D. Success of Engineering Project

In the proposed study, success of engineering, procurement construction project act as dependent variable, it has been measured on the bases of survey items which have been adapted from the work of such authors, who have conducted the similar study in previous literature. 4 survey items have been adapted from the work of (Chan, Scott, & Chan, 2004) and one of these survey items is “The project outcomes have been achieved by meeting all the technical requirements”. 5-point Likert scale identified as most suitable scale for measurement of such items, in this scale respondents asked to choose the option from 1 strongly disagree to 5 strongly agree.

Hypothesis testing

Researcher has to test the relationship among the hypotheses of study because rejection and acceptance status of hypotheses has been reported on the basis of the negative and positive relation respectively. Structure equation modeling under AMOS has been performed for hypothesis testing. The approach has been used for running the diagnostics of the SEM is covariance-based approach. Researcher checked the relationship among the hypotheses such as impact of engineering education on human resource development and success of engineering, in mediating role of human resource competency. Acceptance or rejection status of hypotheses has been reported on the bases of direct, indirect and total effect and relative significance and t-statistics values.

IV. RESULTS

This paper investigated the influence of engineering education (EE) on HRD and success of engineering procurement construction project (SEP) along with the mediating role of human resource competency (HRC) in this relationship by analyzing the data of 312 valid responses after screening blank or missing responses. Most of those responses were reported by female respondents (i.e. 56.7%) as compared to male respondents (that were 43.3%). Most of those respondents were having educational level of intermediate (46.5%) and graduation (42.6%) while 7.4 percent respondents were having educational qualification till high school or below and only 3.5% respondents reported their qualification as Masters. The age of most of respondents was between 20-25 years (74%) while the respondents with age group of 26-35 years were 15.4%, 36-45 years were 3.2%, 46-

55 years were 0.6%, 56-65 years were 3.8% and more than 66 years were 2.9% of total respondents. These demographic estimates are suggesting that most part of the sample used in the current analysis consists of young and female respondents and respondents having graduation as well as intermediate degree.

1) Descriptive Statistics

The current analysis considered 312 valid responses for the analysis on which the descriptive analysis was firstly performed to check the adequacy and normality of the data (see table 1).

Table 1
Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness	Std. Error
EE	312	1.00	5.00	3.4426	1.10684	-.613	.138
HRD	312	1.00	5.00	3.5564	1.10277	-.791	.138
SEP	312	1.00	5.00	3.5625	1.14928	-.765	.138
HRC	312	1.00	4.90	3.5622	1.08701	-.821	.138

Results of descriptive analysis confirmed the normality and appropriateness of the current data of studied variables i.e. EE, HRD, HRC, and SEP. The means, minimum values and maximum values of all these variables ranging from 1 to 5 are confirming that there is no outlier in their data because 1-5 was rating scale of EE, HRD, HRC, and SEP. Furthermore, the skewness of all these variables ranging from -1 to +1 is further approving normality of the data. The standard deviation of all studied variables is also suggesting that there is acceptable variation in the data. Furthermore, the suitability of this data is also confirmed because KMO for it is 0.951 which is more than 0.6 (see table 2). The p-value in “KMO and Bartlett's Test” is 0.00 so, the current data is suitable as well.

Table 2
KMO and Bartlett's Test

Kaiser-Meyer-Olkin Sampling Adequacy.	Measure of	.951
Bartlett's Test of Sphericity	Approx. Chi-Square df	11779.461 465
	Sig.	.000

2) Convergent validity and Discriminant validity

The internal consistency of the data has been checked through CR, AVE and MSV while the discriminant validity of the data

has been checked through correlations (see table 3). The value of CR for all four studied variables is more than 0.9 which should be greater than 0.7 so, the composite reliability of all these variables is giving favorable results. The AVE for HRC, EE, SEP and HRD are all more than 0.5 which mean that more than 50% variation in the data has been explained by these variables. Furthermore, the MSV of all four variables is <AVE. Hence, the requirements for convergent validity are fulfilled.

Table 3

Convergent Validity and Discriminant Validity

	CR	AVE	MSV	HRC	EE	SEP	HRD
HRC	0.938	0.751	0.305	0.866			
EE	0.918	0.785	0.241	0.491	0.886		
SEP	0.937	0.789	0.352	0.552	0.369	0.888	
HRD	0.944	0.772	0.352	0.527	0.421	0.593	0.879

The discriminant validity is proved through correlations. It is indicated in table 3 that HRC has the highest correlation with HRC itself, HRD has the highest correlation with HRD itself, SEP has the highest correlation with SEP itself, and EE has the highest correlation with EE itself so, the discriminant validity is obvious from these results.

3) Model Fitness (CFA)

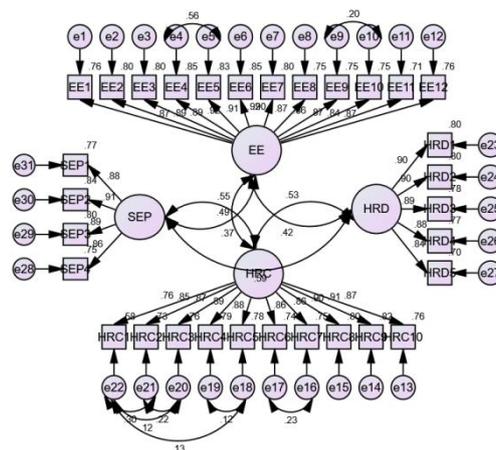
To check the model fitness, CFA was performed in which key indicators named as “CMIN/DF, GFI, IFI, CFI, and RMSEA” were considered to make a decision about model fitness (see table 4).

Table 4
CFA

Indicators	Threshold range	Current values
CMIN/DF	Less than or equal to 3	2.790
GFI	Equal or greater than .80	.821
CFI	Equal or greater than .90	.936
IFI	Equal or greater than .90	.936
RMSEA	Less than or equal to .08	.076

The CMIN/DF for this model is 2.790, GFI is 0.821, CFI is 0.936, IFI is 0.936 and RMSEA is 0.076 that are all meeting the threshold values of these indicators so, it is concluded that the current model is a good fit.

Figure 1. CFA



4) Structural Equation Modeling

The proposed hypotheses of this study have been tested through SEM by estimating the direct, indirect and total effects of EE on HRD and SEP (see table 5).

Table 5
SEM Results (Effects)

Total	EE	HRC
HRC	.474***	.000
SEP	.350***	.470***
HRD	.406***	.405***
Direct	EE	HRC
HRC	.474***	.000
SEP	.127**	.470***
HRD	.214**	.405**
Indirect	EE	HRC
HRC	.000	.000
SEP	.223***	.000
HRD	.192**	.000

Note: *** indicates p-value <0.001, ** indicates p-value<0.01, * indicates p-value <0.05.

Results of SEM are revealing that all proposed effects of this study are true because all these effects have been significantly supported by results. The impact of EE on HRD as well as SEP is significant and positive with total effect size of 0.406 and 0.350 respectively. However, these total effects of EE on HRD and SEP are not wholly direct effects of EE on HRD and SEP because there are significant indirect effects of EE on

HRD and SEP as well. These indirect effects are mediated by HRC because EE also has a significant positive impact on HRC which has an ultimate significant impact on HRD as well as SEP. Therefore, the impacts of EE on HRD and SEP are supported significantly through these results and the mediation of HRD in both these relationships has also been supported through empirical findings. Figure 2 is representing the screenshot of SEM taken from AMOS during analysis.

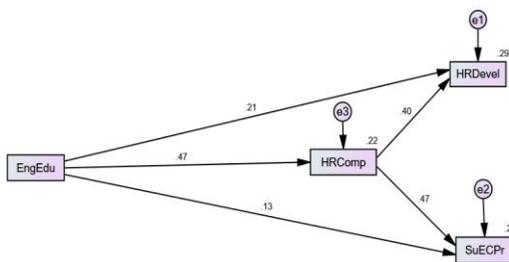


Figure 2. SEM

V. DISCUSSION

The aim of this study was to know about that how engineering education which provides a company with a ability of professional practices of engineering and provides the company with the ability to perform activities to stay ahead in this ever changing era of innovation and competition that, how it can develop the minds of the human resource and contribute to the success of engineering procurement construction project (Abele et al., 2015). The study has incorporated human resource competency as a mediator between human resource development, success of engineering procurement construction project and engineering education. This study was conducted by collecting data with the help of distributing questionnaire. The results obtained for, the questionnaire was retesting by applying different techniques and analysis was conducted (Bucciarelli & Kuhn, 2018). The results of the analysis revealed different results which will be discussed one by one in this chapter. The study first emphasized the relationship between engineering education and human resource development. This research proposed that, “engineering education has a significant and positive impact on human resource development (Martin, 2015). “this hypothesis is accepted as the human resource and their minds are developed as long as required training at resources are provided according to the need of time and the need of the

present time is to provide innovative engineering education for the smart working of human resource (Chao, Chen, & Chuang, 2015). It is not wrong to say that engineering education enhances the human resource development. The second hypothesis that the study proposed was that, “the engineering education has a significant and positive impact on success of engineering procurement construction project.” This hypothesis is accepted. According to the study of (Devadiga, 2017), success of the engineering procurement construction project is purely related with the relevant engineering education and with the proper amount of knowledge and awareness. These projects can be completed with a better success rate and utilizing efficient ways of completing tasks. The third hypothesis suggested by this study was that, “human resource competency plays a significant and positive mediating role between the engineering education and the human resource development.” According to the study of (Horváth, 2016), it was concluded that human resource competency which involves a combine defect of knowledge special skills special abilities and innovative attributes which are observable as well as measurable in the humans play a very vital role in increasing the engineering education and enhancing the human resource development process. The study proposed another hypothesis was that, “human resource competency significantly and positively impacts as mediator between engineering education and success of engineering procurement construction projects.” The study by (Karabulut- Ilgu, Jaramillo Cherez, & Jahren, 2018), suggested that human resource competency which has elements like knowledge which is critical to the success of the individual and the success of the organization, skills which are very important for dexterity dealing with the operations of a firm unique abilities which are important and are affiliated with the performance of traditional tasks in the organization (Martínez-Núñez, Fidalgo-Blanco, & Borrás-Gené, 2015). It is believed by the past studies as well that human resource competency highly contributes when proper engineering education and awareness is applied in the process (Lima, Andersson, & Saalman, 2017). Both of these abilities increase the rate of success of engineering procurement construction projects (Newstetter & Svinicki, 2015).

VI. CONCLUSION

The aim of this study was to know about that how engineering education which provides a company with a ability of professional practices of engineering and provides the company with the ability to perform activities to stay ahead in this ever changing era of innovation and competition that, how it can develop the minds of the human resource and contribute to the success of engineering procurement construction project. The study has incorporated human resource competency as a mediator between human resource

development, success of engineering procurement construction project and engineering education. This study was conducted by collecting data with the help of distributing questionnaire. This study was conducted in Vietnam and the fifty respondents were selected as a sample. The questionnaire comprised upon forty-three multiple choice questions and all the items were measured on a seven-point Likert scale from which only forty-three responses received were valid and authentic. Structural equation modeling technique was used in this study with the application of SPSS software and AMOS was also utilized to analyze the relationship between the given variables. The results of the analysis showed that there exists positive and important relationship between engineering education and human resource development, success of engineering procurement construction projects. Moreover, the study concluded that human resource competency plays a vital a significant mediating rile between the engineering education and human resource development, success of engineering procurement construction project.

VII. IMPLICATIONS OF THE STUDY

This study has outstanding practical implications because of the theoretical importance by increasing the knowledge about the importance of human resource competency and human resource development. This study can be implemented practically in order to support the business strategies of the organization and human resource competency and engineering education will contribute in shaping those business strategies as well. In the policymaking process the study has recommended to add engineering education in the policies of the organization for the development of human resource development for the development of human resource and for the increasing the success rate for the project. This study has put and emphasis on the process of training of human resource purely for the construction industry which can be implemented anywhere in the construction industries of the world.

VIII. LIMITATIONS AND FUTURE RESEARCH INDICATIONS

As modeling and theorizing the current model worldwide was a very difficult and complex task to perform the study is very confined to and individual country. So, the research needs to be rechecked in several other countries before the actual implementation as a standard study. As the study focused on the projects of the construction. But, only focused on the single department. So, the results need to be applied to other sectors like, finance, service and accounting departments as well for the generalization of the results on the whole industry.

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