

The relationship between critical success factors and success criteria in construction projects in the United Arab Emirates



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ABSTRACT

In this research, it was attempted to examine the relationship between critical project success factors and success criteria in construction projects. The study targeted the United Arab Emirates construction market in particular. The success factors were evaluated by their influence and contribution to the actual performance of the construction project on eight criteria. 33 indicators were identified through literature review and grouped into five distinct factors. The partial least squares (PLS) technique was applied to analyze the causal relationships between constructs using the software application Smart-PLS 2.0. The paper revealed the influence of each success factor towards the success criteria of construction projects in the by valuing their standardized structural path. The results illustrate that the Human related factors have the highest influence on the success criteria of construction projects in the UAE. This result provides useful information necessary to help construction involved parties better understand their strengths and weaknesses and then take the related actions necessary to improve and develop their strategies toward projects success.

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1. Introduction

The construction industry embodies one of the most significant sectors and is measured as one of the key contributors to the socio-economic growing of a country (Elawi et al., 2016). Throughout the last decade, and owing to the importance of construction, numerous studies have studied factors that support successful completion of construction projects, particularly those factors that have more impact on project success than others (Tabish and Jha, 2012; Ihuah et al., 2014; Kandelousi et al., 2011; Gunduz and Yahya, 2018; Gudienė et al., 2013a; 2013b; Ogwueleka, 2011; Yong and Mustafa, 2012; Cserhāti and Szabó, 2014). The construction industry provides a greater challenge to retain its scheduled time, budgetary cost, and appropriate quality (Elawi et al., 2016). Several studies have focused on success criteria for projects; however, none of the earlier conducted studies have investigated relation between the critical success factors and success criteria in the construction industry in particular.

Hence, this study used Structural Equation Modeling (SEM) to evaluate the effect of critical success factors on success criteria.

This paper, therefore, tries to explore the relationships between different critical success factors listed in explainable categories and success criteria in the context of construction industry in the United Arab Emirates.

2. Literature review

2.1. Critical success factors

Critical success factors in construction industry have been extensively discoursed in the literature for several decades by numerous researchers such as Rockart (1982), Boynton and Zmud (1984), Sanvido et al. (1992), Chua et al. (1999), and Yu and Kwon (2011). However, the term of 'critical success factors' was first used by Rockart (1982) and defined as those factors predicting success on projects. Toor and Ogunlana (2009) defined CSFs as "certain element which significantly contributes to, and is vital for the success of a project" while Jin et al. (2012) defined these particular factors the more critical to project success than others. Yong and Mustafa (2013) pointed out that these CSFs vary from country to country depending on the existing environment that is often changing with policy and industry's environment changes. They concluded

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that there is no standard set of procedures that can be applied to all industry fields at all times.

Number of studies examined the influence of human related factors such as Project manager's competency as well as Project team members' competency (Cserháti and Szabó, 2014; Gudiené et al., 2013a; 2013b; Nguyen et al., 2004; Tabish and Jha, 2012; Toor and Ogunlana, 2009; Belassi and Tukel, 1996; Chan et al., 2004; Ihuah et al., 2014). Other body of research examined the influence of human classified factors that may they have on the construction project; i.e., good leadership of project manager (Cserháti and Szabó, 2014; fortune and White, 2006; Hyväri, 2006; Ihuah et al., 2014; Kandelousi et al., 2011), top management support (Belassi and Tukel, 1996; Gudiené et al., 2013a; Ihuah et al., 2014; Tabish and Jha, 2012), commitments of project participants in meeting the project goal (Cserháti and Szabó, 2014; Jha and Iyer, 2007; Nguyen et al., 2004; Tabish and Jha, 2012), good coordination between project participants (Jha and Iyer, 2007; Cserháti and Szabó, 2014; Tabish and Jha, 2012; Gudiené et al., 2013b; Ihuah et al., 2014), troubleshooting (Gudiené et al., 2013b; Ihuah et al., 2014; Pinto and Slevin, 1987; Toor and Ogunlana, 2009), decision making effectiveness (Thi and Swierczek, 2010; Fortune and White, 2006; Gudiené et al., 2014; Iyer and Jha, 2006), and top management support (Cserháti and Szabó, 2014; Belassi and Tukel, 1996; Gudiené et al., 2013a; Ihuah et al., 2014; Tabish and Jha, 2012). Some researchers studied the project procurement factors (Chan et al., 2004; Chua et al., 1999; Munns and Bjeirmi, 1996; Jaselskis and Ashley, 1991) such as the effect of comprehensive contract documentation (Chua et al., 1999; Nguyen et al., 2004; Toor and Ogunlana, 2009; Cserháti and Szabó, 2014), competitive procurement process (Chan et al., 2004; Cheung et al., 2012; Li et al., 2005), transparency in procurement process (Chan et al., 2004; Gudiené et al., 2013a; Li et al., 2005) and Appropriate risk allocation and risk sharing (Gudiené et al., 2013b; Ihuah et al., 2014; Li et al., 2005). Others investigated the impact of project management factors such as development of a good project plan (Chan et al., 2004; Gudiené et al., 2013a; Ihuah et al., 2014; Toor and Ogunlana, 2009), or adequate use of communication among project participant that might attribute to the project success (Cserháti and Szabó, 2014; Jha and Iyer, 2007; Nguyen et al., 2004; Tabish and Jha, 2012), clarity of project goal to the project team (Cserháti and Szabó, 2014; Ashley et al., 1987; Pinto and Slevin, 1987; Chan et al., 2004; Toor and Ogunlana, 2008), effective project monitoring and control system (Gudiené et al., 2013a; Ihuah et al., 2014; Jha and Iyer, 2007) and project team motivation (Chua et al., 1999; Gudiené et al., 2013b; Hwang and Lim, 2012). Various researchers considered project characteristics as contributed factor toward project success (Doloi et al., 2011; Gudiené et al., 2013a; 2013b). Project size, value, type, complexity, urgency and density are the most characteristics of construction projects that were investigated (Belassi

and Tukel, 1996; Chan et al., 2004; Gudiené et al., 2013a; Ademiluyi, 2010; Hyväri; 2006). Furthermore, various researchers supported project environmental as an external factor influences on the construction project process includes virtually everything outside the project, including physical environment problems like location, soil works, availability of surrounding infrastructure and others (Park, 2009; Gudiené et al., 2013a; Tabish and Jha, 2012; Gunduz and Yahya, 2018), natural climates problems like winds, rains, high humidity and high temperature (Amade et al., 2015; Chan et al., 2004; Tabish and Jha, 2012; Gunduz and Yahya, 2018), economic and financial problems like price, local currency value (Pourrostam and Ismail, 2012; Alzara et al., 2016; Durdyev et al., 2017), bureaucratic interference (Nguyen et al., 2004; Phua, 2004), unexpected geological condition and increases in price for materials and labors (Chan et al., 2004; Tabish and Jha, 2012; Gunduz and Yahya, 2018), late delivery of materials and equipment (Akogbe et al., 2013; Aziz and Abdel-Hakam, 2016; Doloi et al., 2011) and shortage of labor (Ugwu and Kumaraswamy, 2007; Ogwueleka, 2011).

From the preceding studies, a number of variables affecting the success of the construction project were identified and accordingly CSFs can be grouped under five main categories. These include human-related factors, procurement-related factors, project management related factors, and project characteristics related factors and Project environmental related factors. Table 1 presents the factors selected from previous literature with the corresponding references.

2.2. Project success criteria

The valuation of project success may vary and depends on the evaluator perception (Thi and Swierczek, 2010). Although success criteria and success factors in general are different in nature, the two issues are highly interconnected (Yong and Mustafa, 2013).

According to Nguyen et al. (2004), success criteria is defined by "the measures by which success or failure of a project or business will be judged whereas success factors are those inputs to the management system that lead directly or indirectly to the success of the project or business". Ahadzie et al. (2008) highlighted that there is no reliable explanation of the term project success. However, it is agreed that the criteria on which project is considered successful must be decided at the early stages of project commencement to avoid any differences might be raised between project teams. According to Bakar et al. (2011), projects can be judged if a number of predefined activities concluded in accordance to specific objectives.

Alzahrani and Emsley (2013) emphasised on the conventional success measures or the so-called iron triangle of time, cost, and quality to be the leading performance indicator in construction projects. Project success criteria differ from project to project

and depend on people judgment (Müller and Turner, 2007).

Table 1: Project success factors

Factor	Dimension	Dimension description	References
Human (HUM)	HUM1	Project manager's competency	(Cserhádi and Szabó, 2014; Gudiené et al., 2013a; 2013b; (Nguyen et al., 2004; Tabish and Jha, 2012)
	HUM2	Project team members' competency	Toor and Ogunlana, 2009; Belassi and Tukul, 1996; Chan et al., 2004; Gudiené et al., 2013a; Ihuah et al., 2014)
	HUM3	Good leadership of project manager	(Cserhádi and Szabó, 2014; fortune and White, 2006; Hyväri, 2006; Ihuah et al., 2014; Kandelousi et al., 2011)
	HUM4	Commitments of project participants in meeting the project goal	(Cserhádi and Szabó, 2014; Jha and Iyer, 2007; Nguyen et al., 2004; Tabish and Jha, 2012)
	HUM5	Trouble shooting	(Gudiené et al., 2013b; Ihuah et al., 2014; Pinto and Slevin, 1987; Toor and Ogunlana, 2009)
	HUM6	Good coordination between project participants	(Jha and Iyer, 2007; Cserhádi and Szabó, 2014; Tabish and Jha, 2012; Gudiené et al., 2013a; 2013b; Ihuah et al., 2014)
	HUM7	Top management support	(Cserhádi and Szabó, 2014; Belassi and Tukul, 1996; Gudiené et al., 2014; Ihuah et al., 2014; Tabish and Jha, 2012)
	HUM8	Decision making effectiveness	(Thi and Swierczek, 2010; Fortune and White, 2006; Gudiené et al., 2014; Iyer and Jha, 2007)
Procurement (PROC)	PROC1	Comprehensive contract documentation	(Chua et al., 1999; Nguyen et al., 2004; Toor and Ogunlana, 2009; Cserhádi and Szabó, 2014)
	PROC2	Competitive procurement process	(Chan et al., 2004; Cheung et al., 2012; Li et al., 2005)
	PROC3	Transparency in procurement process	(Chan et al., 2004; Gudiené et al., 2013a; 2013b; Li et al., 2005)
	PROC4	Appropriate risk allocation and risk sharing	(Gudiené et al., 2013a; Ihuah et al., 2014; Li et al., 2005)
Project management (PM)	PM1	Development of a good project plan	(Chan et al., 2004; Gudiené et al., 2013b; Ihuah et al., 2014; Toor and Ogunlana, 2009)
	PM2	Effective control system	(Cserhádi and Szabó, 2014; Ashley et al., 1987; Pinto and Slevin, 1987; Chan et al., 2004; Toor and Ogunlana, 2008)
	PM3	Adequate use of communication among project participant	(Cserhádi and Szabó, 2014; Jha and Iyer, 2007; Nguyen et al., 2004; Tabish and Jha, 2012)
	PM4	Clarity of project goal to the project team	(Cserhádi and Szabó, 2014; Ashley et al., 1987; Pinto and Slevin, 1987; Chan et al., 2004; Toor and Ogunlana, 2008)
	PM5	Effective project monitoring	(Cserhádi and Szabó, 2014; Ashley et al., 1987; Pinto and Slevin, 1987; Chan et al., 2004; Toor and Ogunlana, 2008)
	PM6	Project team motivation	(Chua et al., 1999; Gudiené et al., 2013a; 2013b; Hwang and Lim, 2012)
Project characteristics (PC)	PC1	Project size	
	PC2	Value of a project	
	PC3	Complexity and uniqueness of project activities	(Belassi and Tukul, 1996; Chan et al., 2004; Gudiené et al., 2013a; Ademiluyi, 2010; Hyväri, 2006)
	PC4	The type of project (new, existing, maintenance)	
	PC5	The urgency of project outcome	
	PC6	Density of project	
Project environmental (PE)	PE1	Physical environment	(Park, 2009; Gudiené et al., 2013b; Tabish and Jha, 2012; Gunduz and Yahya, 2018)
	PE2	Natural climates	(Amade et al., 2015; Chan et al., 2004; Tabish and Jha, 2012; Gunduz and Yahya, 2018)
	PE3	Economic and financial problems	(Pourroostam and Ismail, 2012; Alzara et al., 2016; Durdyev et al., 2017)
	PE4	Bureaucratic interference	(Nguyen et al., 2004; Phua, 2004)
	PE5	Unexpected geological condition	
	PE6	Unexpected prices raises for labor	(Chan et al., 2004; Tabish and Jha, 2012; Gunduz and Yahya, 2018)
	PE7	Unexpected prices raises for materials	
	PE8	Late delivery of materials and equipment	(Akogbe et al., 2013; Aziz and Abdel-Hakam, 2016; Doloi et al., 2011)
	PE9	Shortage of labor	(Ugwu and Kumaraswamy, 2007; Ogwueleka, 2011)

However, several researchers agreed to define project success as the completion of a project within the constraint of predefined set of measures include (Alias et al., 2014; Mukhtar et al., 2017; Müller and Jugdev, 2012; Cserhádi and Szabó, 2014; Thi and Swierczek, 2010; Ahadzie et al., 2008; Jha and Iyer, 2007; Toor and Ogunlana, 2009):

- Completion of project on schedule
- Completion of project on agreed budget
- Completion of project in accordance to agreed quality specifications
- The project satisfies the client needs
- The projects satisfy the team members needs

- Completion of the project safely
- Absence of conflict among the project parties
- Achieving the goals of project

2.3. The relationship between success criteria and success factors

The recent available literature put more attention on exploring the relationships among success criteria and success factors for various types of projects. For construction projects, according to Cserhádi and Szabó (2014), human related factors such as project team competencies and skills in term of technical expertise as well leadership capabilities,

troubleshooting, commitments and coordination, and management support can play a crucial role toward conducting successful organizational event project. Furthermore, [Kandelousi et al. \(2011\)](#) pointed out that human factors related to project manager's leadership style, communications skills, coordination and consistence of a project team can have considerable support on success for different types of projects and in particular for infrastructure construction type.

[Toor and Ogunlana \(2009\)](#) discovered that thorough planning prior execution phase and effective monitoring measures during the implementation of construction activities are very essential and shall carefully considered as their absence or inadequacy will result in cost overrun and hence impact project success. In addition to that, various researchers pointed out that clarity of project goal to the project team can greatly influence the project outcomes ([Cserhádi and Szabó, 2014](#); [Ashley et al., 1987](#); [Pinto and Slevin, 1987](#); [Chan et al., 2004](#); [Toor and Ogunlana, 2008](#)). Furthermore, [Yong and Mustaffa \(2013\)](#) pointed out that lack of developed project plan and inadequate communications are considered as important shortcomings that obstruct project success.

According to [Toor and Ogunlana \(2009\)](#), since most of the construction projects are awarded to the lowest bidder as per followed awarding procedures in construction industry, inadequate contractor experience with lowest bidding amounts could have adverse impact on project success. [Naguyen et al. \(2004\)](#) believed that the procurement style includes comprising the selection of the right project partners either as a contractor or designer. They realized that every construction project has its own different natures, needs and specialties, which can only be conducted by bidders who have prior similar experience. Moreover, they emphasized that awarded bidders should have adequate capabilities and sufficient resources to accomplish the project successfully. Accordingly, they highlighted that adopting competitive and transparent process are important to select the right bidder to conduct project activities, within budget, quality and according to the set of identified specifications. Moreover, [Akanni et al. \(2015\)](#) highlighted the importance of different types of risks inherent within construction industry and their role toward project success. [Chen and Chen \(2007\)](#) highlighted the impact of sharing risks as a mitigation action toward success.

[Alias et al. \(2014\)](#) realized that project related factors include type, nature and complexity and size of the project can lead to success. [Cserhádi and Szabó \(2014\)](#) pointed out that project success is sensitive to complexity. They stressed that high complexity projects need more attention by project team to avoid failure. [Gudienė et al. \(2013a, 2013b\)](#) examined the impact of project related factors such as size, value, type, uniqueness, urgency and complexity of a project on project success in Lithuania construction domain. Their study

concluded that project related factors impact on construction project success. [Thi and Swierczek \(2010\)](#) studied project characteristics on project success performance indicators of cost, time, technical performance and customer performance in the context of Vietnam construction industry; their study revealed that project characteristics such as size, value, uniqueness, density, urgency and type influence project performance.

[Alaghbari et al. \(2007\)](#) and [Sambasivan and Soon \(2007\)](#) stressed that the developers or project owners shall ensure their financial competency during the project implementation overall duration. They recognized that cash flow related problems impact and transfer to the parties in contractual chain and will likely lead to project failure. Furthermore, [Sambasivan and Soon \(2007\)](#) highlighted the importance of external environmental issues such as natural climates problems and how they can impact project success. Similarly, [Omran et al. \(2012\)](#) discoursed that price fluctuation and weather inclement are among external factors that should be taken into consideration during the construction phase to ensure project success. Different authors attribute success of project to external factors of physical environment and to resources related issues such as labor and material availability in the local market, late delivery of material and equipment ([Tan and Ghazali, 2011](#); [Alvani et al., 2014](#); [Tabish and Jha, 2012](#)).

3. Research rational

It can be observed from the available literature that lists of critical success factors used by several researchers are classically large and encompass numerous factors under several groups such as human related factors, project procurement related factors, technical related factors, project management related factors, project characteristics related factors, and project environmental factors. Very few studies tried to discover the relationships between critical success factors and success criteria. In other words, around the world most researchers studied different identified critical success factors for other fields of industry but rarely focus on the interrelationship between CSFs and success criteria in infrastructure construction project. Although several examples can be found in the literature in which researchers investigate different issues pertain to CSFs such as the inter-relationship and their ranking, such studies in the Arabian region are very few. More importantly, no studies on these lines have been conducted in the United Arab Emirates. This paper, therefore, tries to explore the relationships between different critical success factors listed in explainable categories and success criteria in the context of construction industry in the United Arab Emirates. Hence, by filling the gap by examining the relationship between CSFs and success criteria, it is expected that the findings will provide the body of knowledge as well the

researcher with an up to-date understanding and information to build up proper strategies toward better performance of the construction industry.

4. Research methodology

The research objectives are to evaluate the influence of CSFs on success criteria toward infrastructure development in the United Arab Emirates. The research is quantitative in nature, because a quantitative approach enables the researcher to conduct experimental procedures and quantitative techniques to test the hypotheses or the causal relationship between the variables (Golafshani, 2003). The study follows a survey design approach because it allows some statistical analysis to be performed to test the correlation and the effect between variables (Yin, 2009). In addition, questionnaire survey provides a cost effective method of collecting data (Jin et al., 2012). The questionnaire survey was constructed based on the findings of the literature reviewed conducted on previous researches. The questionnaire contains three parts. Part A consists of questions regarding the general information about the respondents and their companies. Part B, which consists of 8 questions, is aimed at evaluation of the level of importance of the project success criteria. Part C, which consists of 5 sections and 41 questions, is aimed at evaluating the significance level of the selected CSFs.

In this study, prior conducting the full scale survey, a pilot study with thirty construction professionals was implemented to get opinions on the study questionnaire. The aims of a pilot survey are to assess the questionnaire and as a result endorse that it is clear and understandable, that the expected gathered data would be precise, and that meaningful data analysis can be conducted subsequently (Mukhtar et al., 2017).

Following the pilot survey and subsequent refinement of the questionnaire, a questionnaire survey was conducted, which represented the primary data gathering way in this study. Since the size of population could not be ascertained, the sample size for survey research can be determined by using "equation 1" (Saunders et al., 2009):

$$Sample\ size = \frac{(minimum\ sample\ size\ required \times 100)}{Average\ percentage\ response\ rate\ expected} \quad (1)$$

This study used Smart-PLS 2.0 embedded in structural equation modeling (SEM). The use of this software has a requirement in terms of sample size (Hair et al., 2011). Hair et al. (2011) pointed out that the minimum sample size to use PLS is 80 responses. According to Iacobucci (2010), "In terms of bias reduction and even just getting the model to run, some authors found that the added benefit that with three or more indicators per factor, a sample size of 100 will usually be sufficient for convergence, and a sample size of 150 will usually be sufficient for a convergent and proper solution." However, for the

purpose of sampling, and considering an average estimated response rate of 40% based on obtainable average rate in similar researches in the construction field, a total of 375 questionnaire sets were distributed among professionals working in randomly chosen construction organisations as a minimum sample required to achieve the objectives of the current study. The targeted population of this survey was all professionals who hold a position with an owner, consultant/engineering and contractor organisations and have been involved in infrastructure construction projects in the United Arab Emirates. As a result of total number of 315 completed questionnaire sets were received back with a response rate of 90%. Collected questionnaires were analyzed using Statistical Package for Social Science (SPSS) software version 23 for evaluating the demographic information of the respondents as summarized in Table 2.

Table 2: Demographic information of respondents

Group	Frequency	Percentage
Experience		
5-12 years	91	28.9
13-20 years	163	51.7
More than 20 years	61	19.4
Age		
21-30 years	32	10.2
31-40 years	102	32.4
41-50 years	117	37.1
51-60 years	43	13.7
Above 61 years	21	6.7
Area		
Construction Management	50	15.9
Architectural	19	6
Civil and Structure (C and S)	125	39.7
Mechanical and Electrical (M and E)	102	32.4
Quantity Surveyor (QS)	19	6
Role		
Client/Owner	113	35.9
Consultant/Engineering	39	12.4
Contractor	163	52.7
Education		
Diploma	18	5.7
Bachelor degree	234	74.3
Master degree	52	16.5
Ph.D.	11	3.5

A Cronbach's coefficient (α) was calculated to test the reliability and the internal consistency of the received 315 responses. The Cronbach's α was calculated for success criteria at 0.908 and at 0.908, 0.855, 0.915, 0.906 and 0.94 for success factors of HUM, PROC, PM, PC and PE respectively. These values indicated an adequate degree of internal consistency.

Structural equation modelling can be thought of as an extension of standardized regression modelling. According to Tabish and Jha (2012) Structural equation models are ideally suitable for several research issues in the construction engineering field as well in construction management. Several researchers pointed out that SEM is a single statistical test that includes both measurement model (confirmatory factor analysis) and structural model (regression or path analysis) (Kline, 2011; Tabish and Jha, 2012). According to Hair et al. (2016), SEM combines two kinds of

models: A measurement model and a structural model. The measurement model addresses the reliability and validity of the variables within the latent constructs, and the structural model is concerned with modeling the relationships amongst the latent constructs by telling the amount of explained and unexplained variance (Hair et al., 2016). Assessment of the structural model attentions firstly on the overall model fit, followed by the size, direction and significance of the hypothesized parameter estimates, as shown by the one-headed arrows in the path diagrams (Hair et al., 2016). The structural model was assessed by examining the coefficient of determination (R2) values and path

coefficients (Hair et al., 2011). According to Hair et al. (2011), R2 values express the amount of variance that can be described by the exogenous constructs. R2 values of .75, .50, and .25 were considered substantial, moderate, and weak, respectively (Hair et al., 2011).

5. Research hypothesis

Following the thorough and intensive literature review, the codes and description of the research hypotheses are presented in Table 3.

Table 3: Research hypotheses

Code	Description	Path
H1	Human factor (HUM) is positively related to Project Success Criteria (PSC)	HUM → PSC
H2	Procurement factor (PROC) is positively related to Project Success Criteria (PSC)	PROC → PSC
H3	Project management factor (PM) is positively related to Project Success Criteria (PSC)	PM → PSC
H4	Project characteristics factor (PC) is positively related to Project Success Criteria (PSC)	PC → PSC
H5	Project environmental factor (ENV) is positively related to Project Success Criteria (PSC)	ENV → PSC

6. Hypothetical model

Before the implementation of SEM method for the study analysis, a theoretical model is needed to show the relationship of the acknowledged success factors with success criteria. A total of 41 items for the five independent factors of success factors on the success criteria as an independent factor with 8 indicators were investigated, the five independent factors were categorized into 5 groups named as Human factors with 8 items, Procurement factors with 4 items (also known as manifest variable), Project management containing 6 items, Project characteristics with 6 items, and Project environmental factors with 9 items. Based on this, a theoretical model is developed as portrayed in Fig. 1. Using SmartPLS v2.0 software, the Hypothetical model shown Fig. 1 is used to model the effect of identified critical success factors (CSFs) on success criteria (SC) of construction project. The groups of CSFs are known as exogenous latent variables while the items are relative manifest variables. The description of the exogenous latent variables and relative manifest variables of the model as presented in Table 1.

7. Data collection and analysis

The partial least squares (PLS) technique was applied to analyze the causal relationships between constructs using the software application Smart-PLS 2.0. The PLS approach was selected because the research itself was exploratory in nature (Hair et al., 2011). The two step approach was utilized in data analysis, as suggested by Henseler et al. (2009). The first step involves the analysis of the measurement model, while the second step tests the structural relationships among the latent constructs. The two-step approach aims at establishing the reliability and validity of the measures before assessing the structural relationship of the mode.

In determining links between manifested or observed and latent or unobserved variables, the measurement model or confirmatory factor analysis (CFA) is used. The measurement model could therefore be said to describe the method in which latent or unobserved variables are evaluated in terms of the manifest variables (Ho, 2006). In the CFA models construct was assessed for its reliability and validity. Reliability is assessed using Cronbach’s alpha, Composite reliability (CR) and average variance extracted (AVE), whilst for validity using construct, including convergent and discriminant. Fig. 2 depicts the overall CFA model.

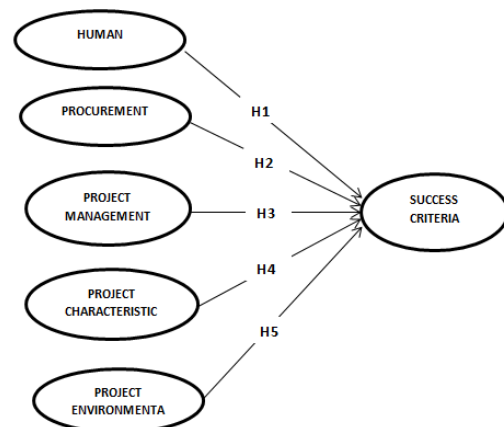


Fig. 1: Hypothetical model

Table 4 represents the result of Cronbach’s alpha and convergent validity for the Overall CFA model. As shown in Table 4, the results of assessing the standardized factor loadings of the model’s items indicated that the initial standardized factor loadings of items were all above 0.6, ranged from 0.6907 to 0.9163. Once the uni-dimensionality of the constructs was achieved, each of the constructs was assessed for their reliability. Reliability is assessed using average variance extracted (AVE), composite reliability (CR) and Cronbach’s alpha.

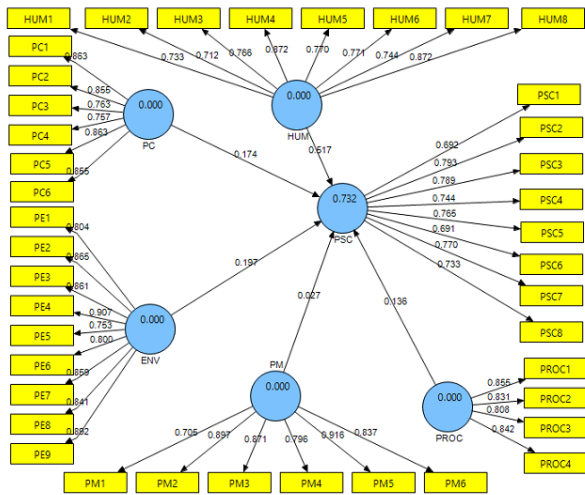


Fig. 2: The overall CFA model

Table 4 shows that the AVE values were 0.6116, 0.6846, 0.712, 0.7056, 0.6964 and 0.5595 for Human (HUM), Project Characteristics (PC), Project Environmental (PE), Project Management (PM), Procurement (PROC) and Project Success Criteria (PSC) respectively. All of these values were above the cut-off 0.5 as suggested by Hair et al. (2016).

The composite reliability values presented in Table 4 exceeded the recommended value of 0.6 for all constructs as recommended by Bagozzi and Yi (1988). Similarly, the Cronbach's Alpha values for all factors as listed in Table 4 were all beyond the threshold of 0.7 as recommended by Nunnally et al. (1967). Thus, indicate that the data gathered from the survey were interrelated and the five-point Likert scale used for measuring the factors is reliable.

Table 4: Results of reliability and validity

Construct	Item	Factor Loading	Average Variance Extracted (AVE)	Composite Reliability (CR)	Internal Reliability Cronbach's Alpha
Human (HUM)	HUM1	0.7333	0.6116	0.9261	0.908
	HUM2	0.7116			
	HUM3	0.7655			
	HUM4	0.8719			
	HUM5	0.7701			
	HUM6	0.7710			
	HUM7	0.7444			
	HUM8	0.8719			
Project Characteristics (PC)	PC1	0.8629	0.6846	0.9285	0.9069
	PC2	0.8547			
	PC3	0.7628			
	PC4	0.7574			
	PC5	0.8629			
	PC6	0.8547			
Project Environmental (PE)	PE1	0.8040	0.712	0.9569	0.949
	PE2	0.8652			
	PE3	0.8612			
	PE4	0.9067			
	PE5	0.7535			
	PE6	0.8002			
	PE7	0.8586			
	PE8	0.8411			
	PE9	0.8924			
Project Management (PM)	PM1	0.7049	0.7056	0.9346	0.915
	PM2	0.8974			
	PM3	0.8711			
	PM4	0.7960			
	PM5	0.9163			
	PM6	0.8365			
Procurement (PROC)	PROC1	0.8553	0.6964	0.9017	0.8553
	PROC2	0.8311			
	PROC3	0.8081			
	PROC4	0.8424			
Project Success Criteria (PSC)	PSC1	0.6916	0.5595	0.9102	0.8871
	PSC2	0.7928			
	PSC3	0.789			
	PSC4	0.7440			
	PSC5	0.7654			
	PSC6	0.6907			
	PSC7	0.7700			
	PSC8	0.7329			

According to Hair et al. (2016), the cross-loadings are usually the first method to evaluate the discriminant validity of the items. That is, an indicator's outer loading on the related construct should be greater than any of its cross-loadings on other constructs. Further, as shown in Table 5, the correlations were less than the square root of the average variance extracted by the indicators,

demonstrating good discriminant validity between these factors (Hair et al., 2016). Upon examining convergent validity and discriminant validity of the measurement model, it can be concluded that measurement model was reliable and valid.

After validating the measurement model, the structural model assessment can be conducted by identifying the relationships amongst the constructs.

The structural model provides details on the links between the variables as well it includes testing the models predictive capabilities (Hair et al., 2016).

Table 5: Discriminant validity of CFA Model

	ENV	HUM	PC	PM	PROC	PSC
ENV	0.844					
HUM	0.175	0.782				
PC	-0.035	0.079	0.827			
PM	0.14	0.106	0.152	0.84		
PROC	0.107	0.151	0.103	0.148	0.835	
PSC	0.071	0.096	0.201	0.011	0.08	0.748

According to Hair et al. (2016), the key criteria of the structural model assessment in PLS-SEM are significance of path coefficient, the value of coefficient of determination (R square) and the predictive relevance (Q square). The value of coefficient of determination (R square) for Project Success Criteria (PSC) was 0.731. This indicates, 73.1 percent of variations in Project Success Criteria (PSC) are explained by its five predictors (i.e., Human factor (HUM), Project Characteristics (PC), Project Environmental (PE), Project Management (PM) and Procurement (PROC)). According to Hair et al. (2011) and Henseler et al. (2009), R square values of 0.75, 0.50, or 0.25 for endogenous latent can be respectively considered as substantial, moderate, or weak. Since the R square value of the developed model in this research is much higher than 0.50 which shows that the model has an explaining power very close to substantial status. Furthermore, the value of predictive of relevance (Q2) for Project Success Criteria (PSC) was 0.1341, far greater than zero, which refers to predictive relevance of the model as suggested by Chin (2010). In sum, the model exhibits acceptable fit and high predictive relevance. In the assessing of the path coefficient value, it is perceived that all structural paths show that all were statistically significant as their p-values were all less than the standard significance level of 0.05 with values of 0.517, 0.136, 0.0270, 0.173 and 0.197 for HUM, PROC, PM, PC and ENV respectively. Thus, the hypotheses H1, H2, H3, H4, H5 and H6 were supported.

By comparison of path coefficient values, HUM factor has the highest coefficient value of 0.517, which means that it shares high value of variance with respect to project success criteria have the largest impact on project success criteria. This finding is supported by the literature, Ihuah et al. (2014) and Gudiené et al. (2014) highlight the importance and the crucial impact of the project manager's competencies, good leadership and decision-making effectiveness toward success completion of projects. Furthermore, several researchers pointed out the significance role of coordinating capabilities between all concerned project parties as this facilitate and narrow any raised gap between them (Jha and Iyer, 2007; Cserhádi and Szabó, 2014; Tabish and Jha, 2012; Gudiené et al., 2013a; 2013b; Ihuah et al., 2014). In addition, and in line with this research finding, Gudiené et al. (2013a, 2013b) stated that project

team member capabilities and their abilities for trouble shooting play a cornerstone rule in meeting project goals and achieve success. Furthermore, Tabish and Jha (2012) pointed out that project team member skills are very important to ensure proper corrective actions when necessary toward project success. Moreover, this finding is in agreement with several researchers that successful construction project largely depends top management support (Cserhádi and Szabó, 2014; Belassi and Tukel, 1996; Gudiené et al., 2014), and other researchers concur with this view (Ihuah et al., 2014; Tabish and Jha, 2012). Chen et al. (2012) found that lack of commitment is a main risk to project success. In addition, poor awareness of Commitments of project participants in meeting the project goal is further reason for the project to fail which is in line with this study finding (Gudiené et al., 2013a; 2013b; Ihuah et al., 2014; Toor and Ogunlana, 2009).

8. Conclusion

This paper examined the relationship between critical project success factors and success criteria in construction projects. The study targeted the UAE construction market in particular. The assessment of the influence of success factors on success criteria is influenced by several factors. Based on the summary of previous studies and field surveys, this study has identified 33 indicators and grouped into five distinct groups: (i) Human, (ii) Project Characteristics, (iii) Project Environmental, (iv) Project Management, and (v) Procurement. These factors were evaluated by their influence and contribution to the actual performance of the construction project on eight criteria; schedule, budget, quality, client satisfaction, team member satisfaction, safety, absence of conflict and achieving goal.

The paper revealed the influence of each success factor towards the success criteria of construction projects in the United Arab Emirates by valuing their standardized structural path. Based on the results, Human related factors has the highest influence on the success criteria of construction projects in the United Arab Emirates, followed by Project environmental related factors, and then project characteristics.

The five identified CSFs should be thoroughly understood and carefully realized by decision makers and concerned companies or organisations in the United Arab Emirates, as it has been recognized that the success OF construction projects contributes positively to the socio-economic stand of the country. The research results can help construction projects policy makers in the United Arab Emirates to understand factors that play critical role toward successful outcomes for construction projects. Accordingly, the success factors that keep showing up as the most significant may draw policy makers' attention. The CSFs recognized in this study can also provide necessary assistance to construction project managers in

adopting careful measures while select participating personnel as well as implementing proper project management actions that lead to the success of the project. This will enhance the performance of construction markets and the requirements of success. In addition, the findings from this study can offer foundations for appraising all types of construction projects in the United Arab Emirate.

Compliance with ethical standards

Conflict of interest

The authors declare that they have no conflict of interest.

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