Journal of Civil Engineering and Management
ISSN 1392-3730 / eISSN 1822-3605
2018 Volume 24 Issue 3: 223–237
https://doi.org/10.3846/jcem.2018.1691

IDENTIFYING THE CRITICAL SUCCESS FACTORS AND THEIR RELEVANT ASPECTS FOR RENEWABLE ENERGY PROJECTS; AN EMPIRICAL PERSPECTIVE

Rashid MAQBOOL[1*], Yahya RASHID[2], Saira SULTANA[3], Ye SUDONG[1]

[1]*School of Economics and Management, Beijing Jiaotong University, Beijing, China*
[2]*Industrial Engineering Department, Prince Sattam Bin Abdulaziz University, Al-kharj, Kingdom of Saudi Arabia*
[3]*Graduate School of Science and Technology, Kobe University, Nada-Ku, Kobe, Japan*

Received 18 January 2018; accepted 29 March 2018

Abstract. Owed to their enormous impact on the sustainable development of energy security, climate change, and the economy, multiple renewable-energy projects are carried out around the world, both in developed and in developing countries. Since the construction of renewable energy project is an entrepreneurial activity, there is a big concern about the success of such projects. Although pertinent literature suggests several methodologies to enhance the success of various projects, renewable-energy projects are still overlooked. This study identifies multiple critical success factors (CSFs), required for renewable-energy projects. Using a sample of 272 firms working on renewable energy projects in Pakistan, a quantitative and causal study was undertaken to identify the critical success factors (CSFs). Structural equation modeling (SEM) was applied to test and verify hypothesis. The results show that there is a strong direct dependency of project success over the proposed factors, however environmental factors are found to be the only predominant CSFs which show the significant indirect effect on project success. The study expected to contribute towards and widen up the existing knowledge base for the project performance of renewable energy projects by adding on the findings regarding critical success factors.

Keywords: critical success factors, renewable energy projects, project success, structural equation modeling, environmental factors.

Introduction

Renewable energy projects are built to provide non-depletable renewable energy resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat (Ellabban *et al.* 2014). These projects often provide energy in four important areas: electricity generation, air and water heating/cooling, transportation, and rural (off-grid) energy services (REN21 2010). According to Zhao *et al.* (2016), in order to meet the energy demands and reducing greenhouse gas emissions countries should force to vigorously promote renewable energy power generation. Renewable energy projects types of wind projects, solar power projects, bagasse power projects, thermal power projects and waste heat recovery power projects have been considered to be part in this research. Based on cost and benefit analysis, Bergmann *et al.* (2006) have also found these projects as most significant renewable energy projects in their research. Alongside few other factors have been also taken into account in their research, such as landscape quality, wildlife, air quality, and welfare implications of different investment strategies for employment and electricity prices.

The current study is conducted to identify the effects of critical success factors (CSFs) and their relevant aspects in the construction of Pakistani renewable energy projects. Pakistan is among the energy deficient countries, which is trying to increase its indigenous energy supplies to deal with severe energy crises at present. A lot of renewable energy projects aim to fulfil energy gap in Pakistan are under construction. Despite the need and importance, these projects also face many hurdles and challenges to complete including; political, technical, economic,

*Corresponding author. E-mail: *rashid@bjtu.edu.cn*

environmental and social aspects. Thus, the current study is an effort of the researchers to find critical success factors in the renewable energy projects of Pakistan.

Pakistan has abundance of renewable energy resources, but these resources have not been exploited properly. The country's first policy for renewable energy publicized in 2006; mid-term and long-term targets were settled including generation of 9700 MW of electricity from renewable energy resources by the year 2030, and electrification of 7874 off-grid and remote villages (AEDB 2010; GoP 2006). However, in spite of these ambitious targets, there is not much development made for the utilization of emerging renewable energy technologies in the country. The renewable energy sources like solar energy, wind energy, ocean energy, biomass energy, fuel cell technology, and geothermal energy can be utilized to overcome energy deficit in Pakistan (Amer, Daim 2011).

Although there are a number of publications on critical success factors of projects (Ahimbisibwe *et al.* 2015; Bayiley, Teklu 2016; Chou, Pramudawardhani 2015; Cserhati, Szabo 2014; Ika, Donnelly 2017; Osei-Kyei, Chan 2015; Liu *et al.* 2014; Marzagão, Carvalho 2016; Mukhtar *et al.* 2017; Pal *et al.* 2017; Ribeiro *et al.* 2017; Shen *et al.* 2017; Williams 2016; Xavier *et al.* 2017; Yalegama *et al.* 2016; Yamin, Sim 2016; Zou *et al.* 2014), none of these studies focus comprehensively on this aspect of renewable energy projects, particularly in Pakistan's renewable power projects. The main emphasis of present research is placed on the identification of success factors and then prioritization of most critical factors contributing towards the success of renewable energy projects. The potential of renewable energy resources in Pakistan has been estimated by a number of researchers (Ahmed *et al.* 2016; Ali *et al.* 2015; Arshad, Ahmed 2016; Asif 2009; Awan, Khan 2014; Ghafoor *et al.* 2016; Gondal, Sahir 2010; Gondal *et al.* 2017; Hulio *et al.* 2017; Mirza *et al.* 2003; PMD 2004; Raja *et al.* 1996; Shahbaz *et al.* 2015; Shakeel *et al.* 2016; Sheikh 2009). However, their assessments were restricted to potentials and prospects of energy extraction from the renewable sources and their possible consumption. Very few studies focused on the possible challenges and barriers to the successful construction of renewable energy projects. Sahir and Qureshi (2008), for example, identify the barriers to the significant utilization of new and renewable energy resources potentials. Mirza *et al.* (2009) identified and discussed the major challenges to the development of renewable energy projects. The study of Chaudhry *et al.* (2009), addressed the important factors for the sustainable development of renewable energy projects in Pakistan, however these factors were limited to theoretical recommendations. None of these studies have described the significant success factors for the construction of renewable energy projects. Moreover, the critical success factors for these projects were also not identified. This study aims to fill the gap of renewable energy resources of Pakistan by identifying the significant success factors and deciding about most critical success factors for constructing the successful renewable energy projects. Considering the rising emphasis on the development of renewable energy from the Pakistani government and the international community, this study provides a valuable reference to formulate the effective strategies to gain maximum output from the renewable power industry.

1. Literature review

1.1. Critical success factors in construction of renewable energy projects

This part of the study examines a detailed analysis of previous empirical researches on critical success factors (CSFs) domain which assist the present study theoretically to infer the success factors for the renewable energy projects. Earlier empirical researches on critical success factors (CSFs), for instance Baccarini and Collins (2003), Ika *et al.* (2012), Standish (1994), Xu *et al.* (2011) and Zhao *et al.* (2010) are considered.

CHAOS report by Standish (1994) suggests the five critical success factors for construction projects which are; top management backing, client involvement, well-defined obligations, realistic expectations and sensible planning. Baccarini and Collins (2003) have conducted an empirical research based on a survey of 150 members of Australian Project Management Institute working in different project fields such as construction, telecommunications, information technology, defense, education etc. A total of 45.3 percent of the survey contributors were from the construction industry and they have identified 15 critical success factors necessary for project success. Among these critical success factors project understanding and competent project team were identified as predominant factors for project success. The important point observed in this research is no substantial abnormalities are noted in the responses collected from contrasting industries.

Zhao *et al.* (2010) have conducted a research for finding the critical success factors (CSFs) in BOT electrical power projects in China. This is the only empirical research in the field of renewable energy projects, assessing the critical success factors for thermal and wind power projects. Based on the survey results, five categories for critical success factors were identified including; project feasibility, project environment, project company, project contractor and project suppliers. Ika *et al.* (2012) have done their research on the critical success factors for world bank projects, which involve 2.7 percent of energy projects. The study was based on empirical findings of 147 different project fields, identified five clusters of critical success factors including; monitoring, coordination, design, training and institutional environment. Xu *et al.* (2011) have developed a set of critical success factors (CSFs) of energy performance contracting (EPC) for sustainable building energy efficiency retrofit (BEER) of hotel buildings in China. They have used semi-structured interviews and a questionnaire survey with practitioners and other professionals working on construction projects. The findings lead to 21 success factors under 6 clusters of critical success factors. These categories are: (1) project organization process; (2) EPC project financing for hotel retrofit; (3) knowledge and innovation of EPC, sustainable development (SD), and M&V; (4) implementation of sustainable development strategy; (5) contractual arrangement; and (6) external economic environment.

Researchers have identified different factors to add value to project success; these areas include Project Manager, Team Members, Organization, and External Environment (Prabhakar 2008). Other factors are user participation, team skills (Wixom, Watson 2001); top management support, clarity of project mission, availability of technical resources (Thite 1999); project objectives, resources, and managerial support (White, Fortune 2002). After extensive literature reviews following factor categories were identified as success factors for construction of renewable energy projects.

1.1.1. Communication factors

Effective and concise communication is utmost necessary in forming an environment that delivers project success. It should inflate across all levels of project (Jugdev, Mathur 2012) and through all the phases of project life cycle (Baccarini, Collins 2003). Project success relies upon three factors and which are communication, communication, and again communication (Bairi, Manohar 2011). Delay is bearable if communicated timely and imparts constructive influence upon clients' psychological satisfaction in projects (Dvir *et al.* 1998; Verma 1995).

1.1.2. Team factors

The future of project management is wide open and requires a diverse geographical and cultural team to settle the challenges of tomorrow (Lewin 2001). Leaders of international organizations are zealous to identify the opportunities of collaboration with teams from all over the world (Globerson, Zwikael 2002). It is widely accepted that flexible management descends the project success of a minor level project while team behavior diminishes the set objectives of overall projects whereas documented discussions and previous project's reports were helpful for project team to recognize client's requirements (Dvir *et al.* 1998).

1.1.3. Technical factors

A project is successful over achievement of two goals; one is the extent to which it has attained its technical objectives within the specified parenthesis of costs and time. Professional and technical expertise and recognition of the client's importance amplifies customer satisfaction at the time of exchange whereas customer loyalty in future (Buchanan, Badham 2008). Construction projects happen to be more complex than software projects thus a lot of technical expertise required for successful outcomes.

1.1.4. Organizational factors

Organizations anticipate projects to be accomplished within budget, time, and with consumption of least resources. That is why they fail to spot the right track and prioritize projects in an inappropriate method (Gopalasamy, Mansor 2013). An organization must possess best process, method, or a technique that they defined as a methodology, more efficient and much effective, in running towards bigger goals. A best methodology involves good leadership that conveys clear and concise message to all stakeholders (Nastase 2009), nurture within organizational culture (Cooper 1998) and results into competitive advancement for project management (Pfeffer 1994).

1.1.5. Environmental factors

Businesses are getting more and more global with the swell in volatility of the business environment (Wixom, Watson 2001). Unpredictable environment makes it difficult to take decisions whereas a comparatively stable environment makes it easy to plan in a better way, along with client involvement, that ultimately leads to project success (Young, Poon 2013). Political and technological factors are important ingredients of the environmental factors to alter the project's destiny (Westerveld 2003), whereas environmental factor is identified as a macro factor (Hayfield 1979).

2. Hypotheses and causal model development

The given literature demonstrated five important categories as the success factors for renewable energy projects which includes; communication factors, team factors, technical factors, organizational factors and environmental factors. Thus, we may draw following hypotheses from literature to be tested here:

H1. Communication Factors affect Project Success.
H2. Team Factors affect Project Success.
H3. Technical Factors affect Project Success.
H4. Organizational Factors affect Project Success.
H5. Environmental Factors affect Project Success.

It has been said that generally 90% of a project manager's time is consumed communicating what is going to be done. The success of a project mainly relies on the productivity of its communication network. According to Rajkumar (2010), project communication is the "Project-Life Blood" and more effective communication is equal to better project management. Moreover, he demonstrates the factors which may have an effect on the communication plan for project success including; urgency of the information, technology, project staffing, project length and project environment. So, here while considering the diffusion innovation theory (Rogers 1976) we may hypothesize the mediating effect of team factors, technological factors, organizational factors and environmental factors in between communication factors and project success. The diffusion innovation theory analyzes how the project leaders adopt different ideas and how they made the decision towards it. The diffusion innovation theory assists the innovation and entrepreneurship, mainly depends on human capital. Since the construction of renewable energy project is an

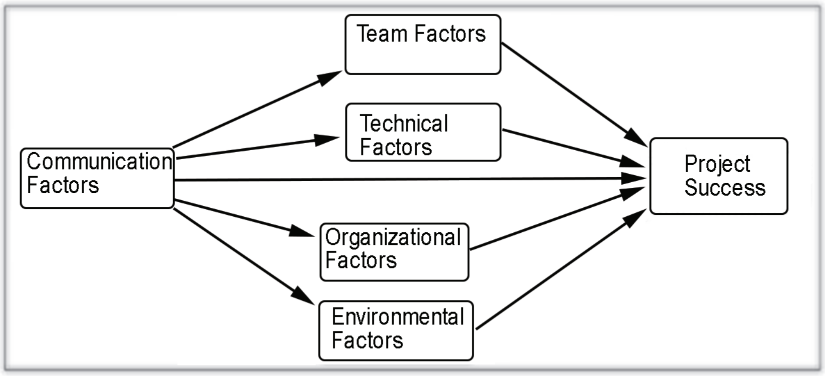

Figure 1. The research model

entrepreneurial activity, accordingly the development of a conceptual model determining CSFs for renewable energy projects is heavily depends on diffusion innovation theory. According to the theory, innovations should be widely adopted in order to attain development and sustainability. Thus:

H6. Team Factors mediates the relationship in between Communication Factors and Project Success.

H7. Technical Factors mediates the relationship in between Communication Factors and Project Success.

H8. Organizational Factors mediates the relationship in between Communication Factors and Project Success.

H9. Environmental Factors mediates the relationship in between Communication Factors and Project Success.

On the bases of literature review and theories following causal model in Figure 1 is drawn to be tested in this study.

3. Research methodology

The process suggested by Saunders *et al.* (2015) was pursued for current research design, which consists of seven steps. Post-positivism was drawn on as epistemological stance, since it intends to objectivity as an ideal, but is aware of the subjectivity stemming from the subjects marked for collecting the data. According to Biedenbach and Müller (2011), post-positivism recognizes trends as a substitute of generalizations. A deductive approach was drawn for a vigorous research design that comprises of new empirical evidence along-with existing theory. A questionnaire survey design was used to gather quantitative data in a cross-sectional way from a large range of respondents, so as to achieve the extensive analysis of the derived theory. Research method for the current study is given in Figure 2.

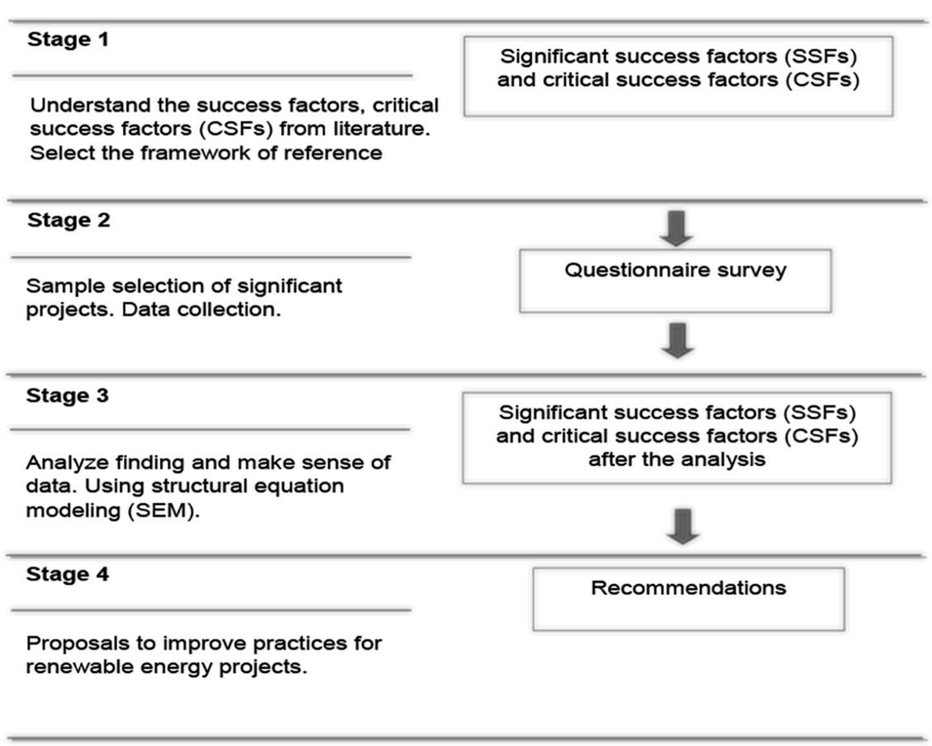

Figure 2. The research method

3.1. Questionnaire development

In current study, six variables are being studied which includes 1 independent variable i.e., communication factors, one dependent variable i.e., project success and 4 mediating variables, namely: 1) team factors, 2) technical factors, and 3) organizational factors, and 4) environmental factors. All the items for CSFs (independent and mediating variables) constructs were identified by previous studies (Li 1997; Prabhakar 2008; Sudhakar 2012; Zhao *et al.* 2010; Fang, Zeng 2007) whereas researchers gave them definitions according to the literature available. In the later phase, project success was measured through Muller and Turner (2010) definition of project success by utilizing the scale used by Maqbool *et al.* (2017). The questionnaire was based on five-points Likert Scale, in which 1 being "strongly disagree" and 5 being "strongly agree". A five-points Likert Scale rather than seven-points Likert Scale and nine-points Likert Scale was chosen for a number of reasons, one being that it increases response rate and response quality along with reducing respondents' "frustration level" (Babakus, Mangold 1992; Devlin *et al.* 1993; Hayes 1992).

3.2. Variables and their measure

3.2.1. Measure of Communication factors

For communication factors, the undertaken scales were from the studies of Li (1997), Prabhakar (2008) and Sudhakar (2012). Communication factors has seven dimensions, namely: 1) communication, 2) leadership, 3) relationship between client and project leadership, 4) reduce ambiguity, 5) maximize stability, 6) cooperation and 7) balance flexibility and rigidity. These construct dimensions were measured through 11 items on five points Likert Scale.

3.2.2. Measure of Team factors

For team factors, seven dimensions include: 1) team capability/competence, 2) teamwork, 3) select right project team, 4) project team coordination, 5) task orientation, 6) team commitment, 7) team empowerment (Prabhakar 2008; Sudhakar 2012). These construct dimensions were measured through 8 items on five points Likert Scale.

3.2.3. Measure of Technical factors

Technical factors was measured using Prabhakar (2008) and Sudhakar (2012) scales that comprised of eight dimensions: 1) technical tasks, 2) troubleshooting, 3) technical uncertainty, 4) technical implementations problems, 5) integration of tasks, 6) technology support, 7) quality testing and 8) removing legacy systems. These were measured by 9 items on five points Likert Scale that ranged from strongly disagree to strongly agree.

3.2.4. Measure of Organizational factors

For measuring the organizational factors, developed scales of Sudhakar (2012) were adopted that are: 1) top management support, 2) realistic expectations, 3) organizational politics, 4) financial support, 5) power, 6) market intelligence, 7) personal recruitment, 8) business process re-engineering, 9) reducing a cost base, 10) increasing efficiency, and 11) attrition. These were measured (11 items) on five points Likert Scale that ranged from strongly disagree to strongly agree.

3.2.5. Measure of Environmental factors

For environmental factors, scales were adopted from Zhao *et al.* (2010), Fang and Zeng (2007), Sudhakar (2012). Environmental factors has eight dimensions, namely: 1) stability of political situation, 2) continuity of policies, 3) policy of paying foreign currencies, 4) credit management system, 5) domestic interest rate, 6) domestic capital markets and credit rating, 7) legal environment, and 8) community involvement. It was measured by 9 items on five points Likert Scale.

3.2.6. Measure of Project success

To measure project success, scales developed by Muller and Turner (2010) and Maqbool *et al.* (2017) were used, which included the dimensions of on scheduled time, on budgeted cost, desired quality and satisfaction of stakeholders. Project success was measured by 9 items on five points Likert Scale that ranged from strongly disagree to strongly agree.

3.3. Population, sample and sampling technique

The project team members including project managers of various construction firms working on renewable energy projects in Pakistan were the "unit of analysis" for this study. These respondents did not have experience of a single project rather every individual responded with respect to his/her own project experience.

For pilot testing 20 responses were chosen. Nunnally and Bernstein (1994) suggested that for reliable results Cronbach's alpha should be maintained at least 0.7 for each construct because it means that all the items are measuring the same phenomenon within the latent construct (Davcik 2014; Hair *et al.* 2014). Initially, Cronbach's alpha for the organizational factors was calculated to be 0.59 which later on rose to 0.733 with the exclusion of item No. 12, 31 and 35 that reduced total items of the questionnaire to 54 for further data collection. Roughly 450 individuals were contacted through personal visits to construction organizations and at project sites to contribute in the study. Overall of 277 respondents submitted their views out of which 5 were identified as void (incomplete) and were neglected. Remaining 272 responses were selected as a sample size that made a total response rate of 60.44%. Demographic details of the survey respondents are presented in the Table 1.

4. Results and discussion

4.1. Data analysis techniques

Data analysis involved the data compilation, it's screening, descriptive analysis, and respondents' demographics statistics, assessing data reliability and analyzing the

Table 1. Respondents' demographics

Characteristics	Category	Frequency	Percentage
Gender	Male	218	80.15%
	Female	54	19.85%
Educational background	PhD/Master	77	28.31%
	Bachelor	132	48.53%
	< Bachelor	63	23.16%
Experience	>15 years	133	48.90%
	10–15 years	108	39.71%
	5–10 years	31	11.39%
Designation	Project director	36	13.24%
	Project manager	95	34.93%
	Functional manager	79	29.04%
	Team leader	52	19.12%
	Other	10	3.68%

correlation. Correlation and regression analysis were used to test the study hypotheses. Correlations were studied through SPSS 20 whereas regression and mediation relations were studied by structural equation modeling with the help of AMOS 18. Structural equation modeling (SEM) is maintained, in part, to examine more complex models in a single analysis as a replacement for testing isolated regression analyses (Xiong *et al.* 2015). The technique of SEM determines indirect effect tests via above methods for defining significant analysis. Additionally, the approach of SEM analysis provides model fit information that offers evidence regarding the uniformity of the hypothesized mediational model. Measurement error could be another possible apprehension in mediation testing due to attenuation of relationships and the approach of SEM can solve this issue by eliminating error from the data of associations between the variables (Davcik 2014).

4.2. Data screening, normality, and reliability of the data

Before starting data analysis, the survey data was vigilantly checked for outliers, missing values, normality, and multicollinearity. It was found that not a single value fell beyond the limits (as of Q1 –1.5IQR, Q3 + 1.5IQR); consequently, no outliers were found within the whole data. According to Tabachnick and Fidell (2012), there are three ways to deal with missing data including; imputation, list wise deletion and pair wise deletion. For this study, imputation method was used to avoid the loss of meaningful data. Very few missing values were found in the data – hardly 1 or 2 in most of the variables' items. Data non-normality was also clarified by performing the kurtosis and skewness. The values found were within the range of –2 and 2 as per the suggestion of Tabachnick and Fidell (2012) for normal data distribution.

Construct validity of the variables was tested by using the exploratory factor analysis (EFA) via principle components. Factor analysis was done through Varimax rotation for grouping the independent, mediating and dependent constructs. Those items were retained which contain correlation values between 4–8 within a construct group, and communalities more than 0.5. Cronbach's alpha was performed to check the reliability of the measurement scales, and the value for each separate construct was found at minimum 0.7. The reliability analysis performed for present research remained 0.7 and above, which is fine as per the suggested guidelines of Nunnally and Bernstein (1994) and Andertson and Gerbing (1998). For present research, entire data was within satisfactory range.

4.3. Descriptive

Table 2 demonstrates the descriptive statistics of the constructs. Among all the constructs, project success exhibited the maximum uniformity amongst the items ($\alpha = 0.902$), showing that it can be run as a sole index. The Mean score ($M = 4.25$, $SD = 1.03$) indicates that project success is the most important concern for the stakeholders, i.e. project success can be well guaranteed if stakeholders work collected as a team with substantiated mutual objectives and established procedures for collective problem solving (Larson 1995). Moreover, dependent variable, communication factors also found within range with ($\alpha = 0.0886$, $M = 4.22$, $SD = 1.06$). Furthermore, mediation factors were also found to be in the acceptable ranges: team factors ($\alpha = 0.837$, $M = 4.01$, $SD = 1.17$), technical factors ($\alpha = 0.813$, $M = 3.72$, $SD = 1.39$), organizational factors ($\alpha = 0.46$, $M = 4.02$, $SD = 1.01$), and environmental factors ($\alpha = 0.897$, $M = 4.19$, $SD = 1.056$), showed good reliability.

Table 2. Descriptive statistics

Variable	Mean	S.D	Skewness	Kurtosis	Cronbach's α	Items
Project success	4.2534	1.03268	0.176	1.035	0.902	9
Communication factors	4.2163	1.06324	–0.276	–0.183	0.886	11
Team factors	4.0116	1.17443	–0.157	–0.545	0.837	8
Technical factors	3.7164	1.39165	–0.052	–0.721	0.813	9
Organizational factors	4.0211	1.01461	–0.237	0.387	0.746	11
Environmental factors	4.1945	1.05635	–0.204	0.368	0.897	9

Hence, the subsequent scales for all constructs exhibited satisfactory reliability, and scales' composites can be calculated by averaging the respective scales items. Moreover, the kurtosis and skewness were also found within the acceptable range. Consequently, survey data is fairly normal as suggested by Xiong *et al.* (2015).

4.4. Construct validity

Construct validity of the study variables was tested by using the exploratory factor analysis (EFA) via principle components. Factor analysis of the grouping of constructs was determined by Varimax rotation. The factor loadings for most of the constructs could not load on construct dimensions rather items loaded on the study construct itself precisely. Only those variables were extracted which presented the factor loading values greater than 0.5 (Hair *et al.* 1995). Moreover, the factors with Eigen values more than one were extracted, which were only 2 to 3. The factor loadings for the project success items found within the range of 0.714 to 0.930 which depicts a prominent internal consistency between the items of project success. Likewise, factor analysis was performed to group 11 items of communication factors construct. Only one item was excluded due to low factors loading, however other 10 items were found within the range from 0.706 to 0.913. Factor analysis employed to group 8 items construct of team factors results in all the items acceptable range from 0.694 to 0.902. The factor loading for technical factors was found within the range of 0.684 to 0.896 for 7 items, however 2 times were dropped because of little factor loading values. Additionally, the factor loading values for organizational factors and environmental factors were also found within the acceptable ranges of 0.691 to 0.915 and 0.713 to 0.924 respectively. None of the item of organizational factors and environmental factors was found with less factors loading value.

4.5. Confirmatory factor analysis

Model measurement was confirmed by employing the Confirmatory Factor Analysis (CFA) (Andertson, Gerbing 1998). Prior to Confirmatory Factor Analysis (CFA), the model refinement was employed by using SPSS statistical package to enhance fit to suggested levels. Several trials were performed to exclude some items and to meet all the scales to recommended levels. Furthermore, all the constructs were determined with the composite reliability more than 0.7 levels, as recommended by Hair *et al.* (2006), depicting fair reliability of each construct variable.

Factor loadings for constructs' items were exceeded the 0.5 standard (Fornell, Larcker 1981) and determined at the 5% of statistically significant level. Adequate convergent validity was demonstrated by all the constructs. Discriminant validity determines the different measuring concepts of variable constructs (Hair *et al.* 2006; Hazen *et al.* 2015). The discriminant validity of all the variable constructs was assessed. First of all, each group of variable findings was paired with another group of findings. Then, every model analyzed twice by following suggestions of Li and Cavusgil (2000) once by running the correlations among the two variable constructs to unity and once through freeing this criterion. Discriminant validity of the variable constructs was determined from the given results. Likewise, the study adopted a multi-approach to model fit assessment as recommended by literature (Hair *et al.* 2014; Hazen *et al.* 2015; Schreiber *et al.* 2006). According to Hazen *et al.* (2015), it is important to check the goodness-of-fit (GOF) measures that demonstrate an adequate model fit to the data. Fitness indicators of CFA and final models are given in the Table 3.

Campbell and Fiske (1959) introduced the concept of discriminant and convergent validity. They highlighted the importance of testing discriminant and convergent validity for conducting new tests. Discriminant validity shows that concepts which are supposed to be discriminant; unrelated are unrelated. It signifies the degree to which the construct is empirically different from other constructs. In other words, the construct measures what it is intended to measure (Hair *et al.* 2014). There is no rule of thumb regarding considering any value to be standard to confirm the discriminant validity present in the data.

Convergent validity focuses on two measures of constructs that are supposed to be related with each other. Without confirming about validity and reliability of data, it is not appropriate to move further; as, final results can be affected, and results may be biased as well. Average Variance Extracted (AVE), Average Shared Squared Variance (ASV) and Maximum Shared Squared Variance (MSV) are the established measures for measuring validity. Hair

Table 3. Fitness indicators of CFA and the final model

GOF	CFA model	Final model	GOF range	Threshold
CMIN/DF	2.71	2.67	0 or above	1.00 to 3.00
P-Value	0.00	0.00	0 (no fit) to 1 (perfect fit)	0.9 or above
TLI	0.96	0.97	0 (no fit) to 1 (perfect fit)	0.9 or above
GFI	0.94	0.95	0 (no fit) to 1 (perfect fit)	0.9 or above
CFI	0.84	0.90	0 (no fit) to 1 (perfect fit)	0.9 or above
RMSEA	0.096	0.091	0 (perfect fit) to 1 (no fit)	0.1 or below

Table 4. Convergent and discriminant validity

Latent variable	CR	AVE	MSV	ASV	Project success	Communication factors	Team factors	Technical factors	Organizational factors	Environmental factors
Project success	0.893	0.710	0.602	0.457	**0.786**					
Communication factors	0.954	0.863	0.715	0.528	0.730	**0.736**				
Team factors	0.902	0.814	0.790	0.656	0.618	0.591	**0.673**			
Technical factors	0.825	0.792	0.626	0.514	0.586	0.457	0.538	**0.592**		
Organizational factors	0.862	0.801	0.739	0.626	0.615	0.592	0.597	0.478	**0.654**	
Environmental factors	0.968	0.905	0.798	0.692	0.723	0.651	0.603	0.569	0.536	**0.735**

Table 5. Correlation analysis

Variable	Correlation					
	1	2	3	4	5	6
1 Project success	1					
2 Communication Factors	0.547**	1				
3 Team factors	0.513**	0.324**	1			
4 Technical factors	0.217**	0.072	0.145*	1		
5 Organizational factors	0.234*	0.192*	0.279**	0.205**	1	
6 Environmental factors	0.532*	0.351**	0.406**	0.303**	0.408**	1

et al. (2006) gave the threshold points of the said validity measures, according to which there will be convergent validity if CR > AVE > 0.5, and discriminant validity will be observe if MSV < AVE > ASV.

Confirmatory factory analysis was used to check the discriminant and convergent validity of the scale. Validity of the dimensions was measured by construct validity (Cavana *et al.* 2001), however validity of constructs was determined by utilizing factor analysis. According to Malhotra (2008), once the KMO (Kasier Meyer Olkin) value stands between 0.5 and 1.0, then the factor analysis reflects to be suitable. The KMO value of the data found to be well within range; between 0.5 and 1.0, so the factor analysis is pertinent for present study. Furthermore, "statistical test for Bartlett test of sphericity was found significant (p = 0.000; d.f = 93) for all the correlations within a correlation matrix (at least for some of the constructs)" (Kwek *et al.* 2010). Results of Varimax rotation and principle components analysis demonstrated that the Eigen values for all the study constructs are higher than level 1. Factor loadings for all the study constructs were also found above the level of 0.50. Items of each particular measuring construct were loaded together and found to be with factor loading values above the 0.5 level. Hence, a higher degree of convergent validity is found in all the studied measurement scales. It was determined by outcome of the discriminant validity that items were not cross-loading and rather supported the respective variable constructs, as all the items were assigned rendering to the different study constructs. Results in Table 4 show that there are no issues of convergent and discriminant validity in the final model.

4.6. Correlation

The bivariate correlations between all the observed variables are shown in under mentioned Table 5. All correlations were found to be within the expected directions and statistically at significant level ($p < 0.05$), except the correlations between technical factors and communication factors ($\gamma = 0.072$, $p > 0.05$). Highest correlation was found between communication factors and project success ($\gamma = 0.547$, $p < 0.05$).

4.7. Hypotheses testing and discussion

During data analysis, none of the variables had multi co-linearity problem. Maximum co-relation was observed in between communication factors and project success which was 0.547. Apart from technical factors and communication factors, all the factors were positively co-related. This study was an effort to investigate the relations among communication factors, technical factors, environmental factors, team factors, and organizational factors (independent variables) over project success (dependent variables). Literature suggests that there is an affirmative relation of constructive communication with enhancement in technical abilities, smooth flow of organizational

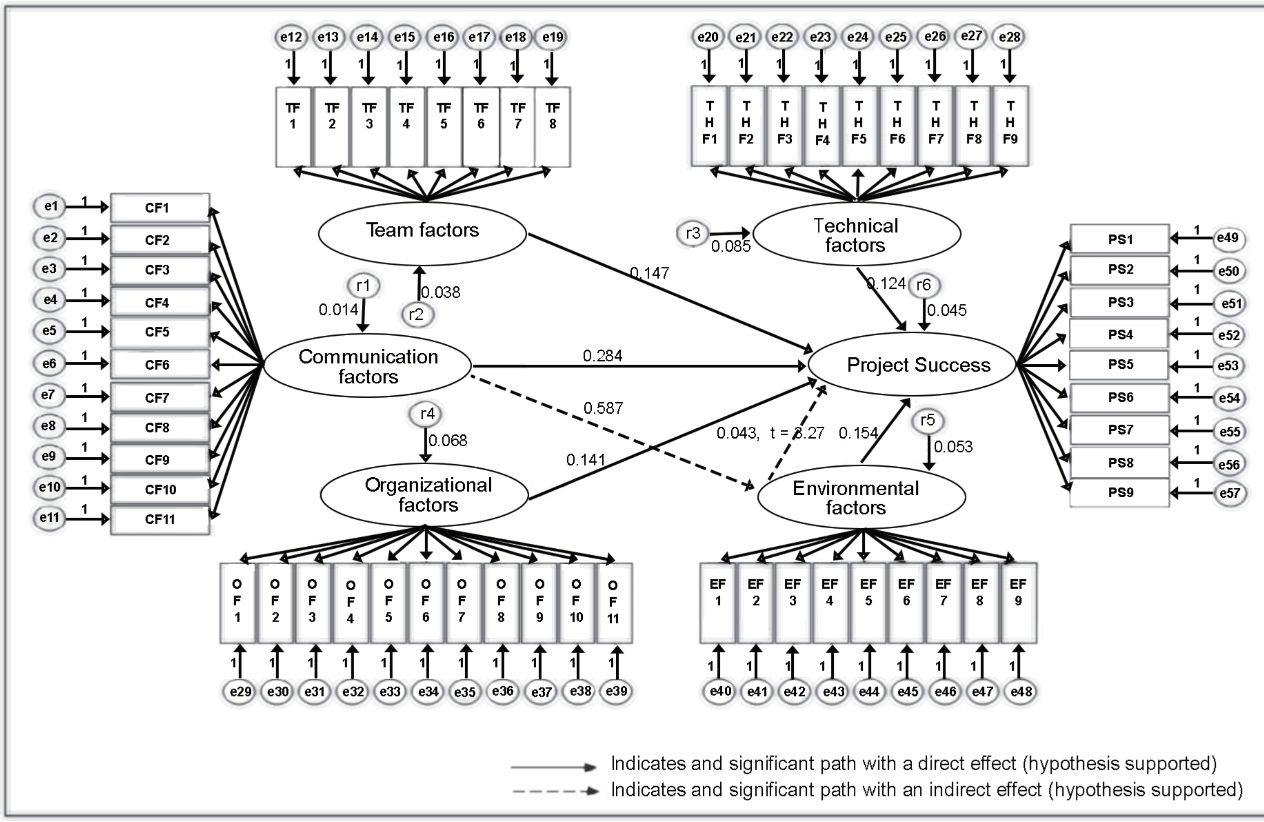

Figure 3. Final SEM of interrelationship framework between critical success factors and project success

factors, and firm's external environment (Allen 2000; Olasupo *et al.* 2012; Varona 1996). Figure 3 presents the path analysis between critical success factors (CSFs) and project success. According to Schreiber *et al.* (2006), a path model is usually developed to provide a pictorial representation of hypothesized relationships among the variables.

For hypothesis 1 the sig value was 0.000 which determines a significant direct effect of communication factor over project success. The bivariate correlation between communication factors and project success is positively significant. Its beta value at 0.284 represents that one unit change in team factors has 28.4% impact on project success.

Hypothesis 2 was also significant and there existed a strong relation between team factors and the overall project success, their sig value was 0.000. The correlation between team factors and project success is also found positively significant, whereas the beta value between both variables found at 0.147.

Hypothesis 3 was also significant with sig value 0.000 that confirms a significant effect of technical factors on project success. The correlation between technical factors and project success was also found positively significant. The beta value is 0.124 between technical factors and project success, representing that one unit change in technical factors has 12.4% impact on project success.

Hypothesis 4 presented a statistically significant association between organizational factors and dependent variable of project success. The sig value was 0.000 and organizational factors were significantly affecting project success. Its beta value 0.141 represents that one unit change organizational factors has 14.1% impact on project success.

Hypothesis 5 was accepted there was a significant relation between environmental factors and project success. Sig value for their relationship was P = 0.000. The correlation between environmental factors and project success was also found positively significant. Its beta value was found at 0.298.

All the five factors, namely; communication factors, team factors, technical factors, organizational factors and environmental factors were found to be significantly contributing towards project success in their capacity. These findings are also in line with the outcomes of one recent research empirically conducted by Zhao and Chen (2018) on the renewable energy power generation of China. However, they have chosen 33 critical factors affecting the development of renewable energy power generation which are further condensed into 12 principal components (PCs) by using principal component analysis (PCA).

Jugdev and Mathur (2012) stated that communication was a significant factor in promising success for project success. Similar result was confirmed from Pakistani construction project industry. Similarly, project success was also delivered internationally by Technical (Buchanan, Badham 2008), Organizational (Kamal 2006), Environmental (Young, Poon 2013), and Team factors (Globerson,

Table 6. Regression weights

Hypothesis	Estimate	S.E.	C.R.	P
Hypothesis 1				
Project-Success <--- Communication-Factors	0.284	0.042	4.669	***
Hypothesis 2				
Project-Success <--- Team-Factors	0.147	0.142	7.528	***
Hypothesis 3				
Project-Success <--- Technical-Factors	0.124	0.045	2.742	***
Hypothesis 4				
Project-Success <--- Organizational-Factors	0.141	0.044	3.631	***
Hypothesis 5				
Project-Success <--- Environmental-Factors	0.298	0.085	5.882	***
Hypothesis 6				
Team-Factors <--- Communication-Factors	0.086	0.038	0.787	.231
Project-Success <--- Communication-Factors	0.103	0.029	3.506	.056
Project-Success <--- Team-Factors	0.089	0.056	8.521	.193
Hypothesis 7				
Technical-Factors <--- Communication-Factors	0.316	0.085	14.618	***
Project-Success <--- Communication-Factors	0.186	0.087	0.684	.064
Project-Success <--- Technical-Factors	0.109	0.050	0.910	.060
Hypothesis 8				
Organizational-Factors <--- Communication-Factors	0.615	0.068	13.380	***
Project-Success <--- Communication-Factors	0.131	0.072	1.490	.074
Project-Success <--- Organizational-Factors	0.083	0.047	0.474	.083
Hypothesis 9				
Environmental-Factors <--- Communication-Factors	0.587	0.053	12.225	***
Project-Success <--- Communication-Factors	0.043	0.014	0.672	***
Project-Success <--- Environmental-Factors	0.154	0.045	2.820	***

Zwikael 2002). The study expended the generalizability of these factors in the Pakistani renewable energy projects and it can be argued that to ensure construction of renewable energy projects these five factors must be taken into account as they were immensely related to stakeholder management. Regression weights of all the hypotheses are given in the Table 6.

Hypothesis 6 failed to show any mediating part of team factors in between communication and dependent variable of project success, as the indirect relationship between team factors and communication factors was found insignificant i.e. P = 0.231. Contrary to literature, team factors did not affect communication among project team for project success. H6 was rejected there was no relationship found in between communication factors and enhanced team cohesiveness and performance in renewable energy projects. There may be multiple reasons one may be nature of work, as construction engineers and experts tend to work alone they prefer loneliness and maximum attention is focused on their own decisions. While being talkative to other colleagues may be destructive for workability for them. Other reason may be the cultural impacts and should be exposed. Hence relation in between communication and team abilities cannot be generalized to renewable energy projects.

Hypothesis 7 was also rejected as the indirect relation between technical factors and project success possessed no significant relation with sig value as 0.060.

Hypothesis 8 was also rejected and there existed no mediating role of organizational factors between communication and project success. The indirect relation of organizational factors with project success was identified to be insignificant with sig value = 0.083.

Hypothesis 9 was accepted and there was a significant complete mediating effect of environmental factors between communication factors and project success with t statistic at 3.27. The direct relation after the addition of mediating factors was insignificant between communication factors and project success which was P = 0.003. Also, the indirect relations were significant for communication and environmental factors the sig value was 0.000 whereas for environmental factors and project success the sig value was 0.001.

The relation of communication factors and project success was constructed by Holland and Light (1999) and Shenhar *et al.* (1997). This relation was tested in the construction industry of Pakistan and was found correct hence its generalizability can be promoted to the construction industry as well. Other part was the testing of mediations if they cause any alteration in the effects. It was noted that only environmental factors were significant in mediating the effect of communication factors over project success. Internal as well as the external environment of the construction organizations arose to be an imperative factor for the accomplishment of the final product and the project management processes. Wüste and Schmuck (2012) and Rajkumar (2010) also discussed that environmental factors influence communication factors for attaining project success. Other than environmental factors rest of all, which are team, technical, and organizational factors, were not mediating the communication effect on project success. The results are unique to Pakistani context and may also be discovered in other parts as well if are tried to dig out. The failure rate of renewable projects worldwide is alarming, and these results of no mediation might also be a continuation to that. As these projects mainly fail due to their poor quality of the final product which is not as was promised or due to the failure of project management which mainly go beyond the boundary of cost, time, and scope.

All the five CSFs categories were concluded to be imminent for successful construction of renewable energy projects. However, this study does not offer support to the hypotheses that three CSFs categories, namely; team factors, technical factors, and organizational factors contribute to mediate the relationship between communication factors project success. As the communication factors were vital for project management of the construction of renewable energy project so as the environmental factors were important gear to enhance the relationship between communication factors and project success. Furthermore, environmental factors were found to be predominant critical success factors category which can mediate between communication factors and project success. The environmental factors which influence the project while mediating the communication factors are; political situation, legal environment, credit management system, peace situation and local community influence. The role of the Pakistani government and legislation bodies is most important to formulate such policies which could help the project investors, moreover ensure about its safe capital and assets in the country. Government should formulate such kind of incentive policies for the industry which can help to lower the project construction and power generation cost. According to Zhao *et al.* (2017), incentive policies such as preferential loans, tax support and zero land cost for power stations play significant role for constructing renewable energy projects. Firms should also consider the internal as well as the external environment, which can play an important role in the success or failure of the renewable project. Similarly, the project success depends upon the cohesiveness and support for each other among the project organizations and the level of support and cooperation between government and legislation departments. Resultantly; this paves its way towards friendly atmosphere among project stakeholders; which can further contribute towards added efficiency to the success of renewable energy projects in the country

Conclusion and recommendations

This paper has presented the relationship and impact of critical success factors vis-à-vis project success in construction of renewable energy projects. The present study is the very first attempt in research to present a causal model for determining CSFs in renewable energy projects. Clustering the critical success factors (CSFs) for renewable energy projects and determining significant sub-factors in all the relevant categories is the significant contribution of the present study. Several success factors have been identified via literature review and earlier case studies, and correspondence and survey interviews with professionals and experts of renewable energy projects. Further, these success factors are evaluated, refined, coded, and lastly classified into five major CSFs categories: 1) communication factors, 2) team factors, 3) technical factors, 4) organizational factors, and 5) environmental factors.

A significantly positive association was verified through correlation values and SEM among project CSFs and project success of renewable energy projects. Additionally, the mediating relation of four CSFs (team factors, technical factors, organizational factors, and environmental factors) was also observed between communication factors (independent variable) and project success (dependent variable). The proposed model conceptualized the theory that project success in renewable energy projects are due to five major types of critical success factors (CSFs) namely; communication factors, team factors, technical factors, organizational factors, and environmental factors; however, it is also observed that only environmental factors significantly mediates the connections between project success and project communication factors. The presented model claims a contribution to further extend the concept of project development with the help of CSFs in renewable energy projects, which have hardly been studied in the existing academic works of literature. Moreover, the analysis and comparison with earlier researches purport worthy contribution in the present study.

The present study will not only contribute to fill up the literary gap as discussed above, nevertheless will also assist project firms in weighing the CSFs from a different perspective that has not been touched up till now. The present study will help towards widening up the current knowledge base for the critical success factors (CSFs) by adorning the research findings vis-à-vis their impact on the success of the renewable energy projects. Since the renewable project is at a developing stage of germinate in Pakistan, a study of the CSFs should lead a better perspective of the factors persuading the success or otherwise of renewable projects. This can pave the way for effective decision making in opting the suitable projects (for which the CSFs can be guaranteed or managed in some way) and in the enhanced administration of those already embarked upon. Conforming effective approaches based on those identified CSFs can also be made for successfully resulting future renewable energy projects for accelerated excellence. It is believed that this study has helped to describe the perspectives of Pakistani renewable energy experts in their estimation of CSFs for renewable energy projects in Pakistan.

Nevertheless, readers must take into account that there will be the consistent development of CSFs for renewable energy projects from the time of data gathering till the time of paper publication. The present study will also lay the first stone for new direction to upcoming scholars in executing the research at the international level with an intent to find out concrete recommendations for warranting performance in sustainable as well as renewable projects. Though the CSFs are determined for renewable energy projects and their relationship is analyzed with project success, still the study is not without limitations. Future researches are expected to be carried out across the industries and countries in order to identify differences in between different industrial settings and in different cultural implications upon these success factors. So that results may be generalized in multiple countries.

Authors contributions

All of the authors have contributed equally to the design of theoretical model, to analyzing and discussing the data and to writing the paper. All of the authors read and approved this manuscript.

Disclosure statement

The authors declare no conflict of interest.

References

AEDB. 2010. *Alternate Energy Development Board report*. Ministry of Power Division, Government of Pakistan [online], [cited 8 January 2010]. Available from Internet: http://www.aedb.org/2010

Ahimbisibwe, A.; Cavana, R. Y.; Daellenbach, U. 2015. A contingency fit model of critical success factors for software development projects: A comparison of agile and traditional plan-based methodologies, *Journal of Enterprise Information Management* 28(1): 7–33. https://doi.org/10.1108/JEIM-08-2013-0060

Ahmed, S.; Mahmood, A.; Hasan, A.; Sidhu, G. A. S.; Butt, M. F. U. 2016. A comparative review of China, India and Pakistan renewable energy sectors and sharing opportunities, *Renewable and Sustainable Energy Reviews* 57: 216–225. https://doi.org/10.1016/j.rser.2015.12.191

Ali, S. H.; Zuberi, M. J. S.; Tariq, M. A.; Baker, D.; Mohiuddin, A. 2015. A study to incorporate renewable energy technologies into the power portfolio of Karachi, Pakistan, *Renewable and Sustainable Energy Reviews* 47: 14–22. https://doi.org/10.1016/j.rser.2015.03.009

Allen, T. J. 2000. Architecture and communication among product development engineers, in *Proceedings of the 2000 IEEE Conference "Engineering Management Society"*, 15 August 2000, Albuquerque, NM, USA, 155–158. https://doi.org/10.1109/EMS.2000.872493

Amer, M.; Daim, T. U. 2011. Selection of renewable energy technologies for a developing county: a case of Pakistan, *Energy for Sustainable Development* 15(4): 420–435. https://doi.org/10.1016/j.esd.2011.09.001

Andertson, J.; Gerbing, D. 1998. Structural equation modeling in practice: A review and recommended two–step approach, *Psychological Bulletin* 103(2): 411–423. https://doi.org/10.1037/0033-2909.103.3.411

Arshad, M.; Ahmed, S. 2016. Cogeneration through bagasse: a renewable strategy to meet the future energy needs, *Renewable and Sustainable Energy Reviews* 54: 732–737. https://doi.org/10.1016/j.rser.2015.10.145

Asif, M. 2009. Sustainable energy options for Pakistan, *Renewable and Sustainable Energy Reviews* 13(4): 903–909. https://doi.org/10.1016/j.rser.2008.04.001

Awan, A. B.; Khan, Z. A. 2014. Recent progress in renewable energy – Remedy of energy crisis in Pakistan, *Renewable and Sustainable Energy Reviews* 33: 236–253. https://doi.org/10.1016/j.rser.2014.01.089

Babakus, E.; Mangold, W. G. 1992. Adapting the SERVQUAL scale to hospital services: an empirical investigation, *Health Services Research* 26(2): 767–86.

Baccarini, D.; Collins, A. 2003. Critical success factors for projects, surfing the waves: Management challenges; Management solutions, in *Proceedings of the 17th ANZAM Conference,* 2–5 December 2003, Perth, Australia, 2–5.

Bairi, J.; Manohar, B. M. 2011. Critical success factors in gaining user customer satisfaction in outsourced IT services, *Journal of Enterprise Information Management* 24(6): 475–493. https://doi.org/10.1108/17410391111166530

Bayiley, Y. T.; Teklu, G. K. 2016. Success factors and criteria in the management of international development projects: Evidence from projects funded by the European Union in Ethiopia, *International Journal of Managing Projects in Business* 9(3): 562–582. https://doi.org/10.1108/IJMPB-06-2015-0046

Bergmann, A.; Hanley, N.; Wright, R. 2006. Valuing the attributes of renewable energy investments, *Energy Policy* 34: 1004–1014. https://doi.org/10.1016/j.enpol.2004.08.035

Biedenbach, T.; Müller, R. 2011. Paradigms in project management research: examples from 15 years of IRNOP conferences, *International Journal of Managing Projects in Business* 4(1): 82–104. https://doi.org/10.1108/17538371111096908

Buchanan, D. A.; Badham, R. J. 2008. *Power, politics, and organizational change: Winning the turf game.* 1st ed. London, UK: SAGE Publications. https://doi.org/10.4135/9781446280300.n6

Campbell, D. T.; Fiske, D. W. 1959. Convergent and discriminant validation by the multitrait-multimethod matrix, *Psychological Bulletin* 56(2): 81–105. https://doi.org/10.1037/h0046016

Cavana, R. Y.; Delahaye, B. L.; Sekaran, U. 2001. *Applied business research: Qualitative and quantitative methods.* 1st ed. Milton, Queensland, Australia: John Wiley & Sons.

Chaudhry, M. A.; Raza, R.; Hayat, S. A. 2009. Renewable energy technologies in Pakistan: prospects and challenges, *Renewable and Sustainable Energy Reviews* 13(6): 1657–1662. https://doi.org/10.1016/j.rser.2008.09.025

Chou, J. S.; Pramudawardhani, D. 2015. Cross-country comparisons of key drivers, critical success factors and risk allocation for public–private partnership projects, *International Journal of Project Management* 33(5): 1136–1150. https://doi.org/10.1016/j.ijproman.2014.12.003

Cooper, R. 1998. Benchmarking new product performance: Results of the best practices study, *European Management Journal* 16(1): 1–17. https://doi.org/10.1016/S0263-2373(97)00069-8

Cserhati, G.; Szabo, L. 2014. The relationship between success criteria and success factors in organisational event projects, *International Journal of Project Management* 32(4): 613–624. https://doi.org/10.1016/j.ijproman.2013.08.008

Davcik, N. S. 2014. The use and misuse of structural equation modelling in management research: A review and critique, *Journal of Advances in Management Research* 11(1): 47–81. https://doi.org/10.1108/JAMR-07-2013-0043

Devlin, S. J.; Dong, H. K.; Brown, M. 1993. Selecting a scale for measuring quality, *Marketing Research* 5: 12–17.

Dvir, D.; Lipovetsky, S.; Shenhar, A.; Tishler, A. 1998. In search of project classification: a non–universal approach to project success factors, *Research Policy* 27(9): 915–935. https://doi.org/10.1016/S0048-7333(98)00085-7

Ellabban, O.; Abu-Rub, H.; Blaabjerg, F. 2014. Renewable energy resources: Current status, future prospects and their enabling technology, *Renewable and Sustainable Energy Reviews* 39: 748–764. https://doi.org/10.1016/j.rser.2014.07.113

Fang, Y.; Zeng, Y. 2007. Balancing energy and environment: the effect and perspective of management instruments in China, *Energy* 32(12): 2247–2261. https://doi.org/10.1016/j.energy.2007.07.016

Fornell, C.; Larcker, D. F. 1981. Evaluating structural equation models with unobservable variables and measurement error, *Journal of Marketing Research* 18(1): 39–50. https://doi.org/10.2307/3151312

Ghafoor, A.; ur Rehman, T.; Munir, A.; Ahmad, M.; Iqbal, M. 2016. Current status and overview of renewable energy potential in Pakistan for continuous energy sustainability, *Renewable and Sustainable Energy Reviews* 60: 1332–1342. https://doi.org/10.1016/j.rser.2016.03.020

Globerson, S.; Zwikael, O. 2002. The impact of the project manager on project management planning processes, *Project Management Journal* 33(3): 58–64.

Gondal, I. A.; Masood, S. A.; Amjad, M. 2017. Review of geothermal energy development efforts in Pakistan and way forward, *Renewable and Sustainable Energy Reviews* 71: 687–696. https://doi.org/10.1016/j.rser.2016.12.097

Gondal, I. A.; Sahir, M. 2010. The potential of renewable hydrogen production in Pakistan, *ISESCO Science and Technology Vision* 10(6): 68–81.

GoP. 2006. *Policy for development of renewable energy for power generation report*. Government of Pakistan [online], [cited 4 December 2017]. Available from Internet: http://aedb.org/Documents/Policy/REpolicy.pdf

Gopalasamy, P.; Mansor, Z. 2013. An investigation on project management standard practices in IT organization, *International Journal of Computer Engineering Science (IJCES)* 3(1): 1–12.

Hair, J. F.; Anderson, R. E.; Black, W. C. 1995. *Multivariate data analysis with reading.* 4th ed. New Jersey, USA: Prentice-Hall.

Hair, J. F.; Black, W. C.; Babin, B. J.; Anderson, R. E.; Tatham, R. L. 2006. *Multivariate data analysis.* Vol. 6. New Jersey, USA: Pearson Prentice Hall.

Hair, J. F.; Sarstedt, M.; Hopkins, L.; Kuppelwiser, V. G. 2014. Partial least squares structural equation modeling (PLS–SEM): An emerging tool in business research, *European Business Review* 26(2): 196–121.

Hayes, B. E. 1992. *Measurement customer satisfaction: Development and use of questionnaire*. Milwaukee, WI: ASQC Quality Press.

Hayfield, F. 1979. Basic factors for a successful project, in *Proceedings of the 6th Internet Congress*, 1979, Garmisch-Partenkirchen FRG, Germany, 7–37.

Hazen, B. T.; Overstreet, R. E.; Boone, C. A. 2015. Suggested reporting guidelines for structural equation modelling in supply chain management research, *The International Journal of Logistics Management* 26(3): 627–641. https://doi.org/10.1108/IJLM-08-2014-0133

Holland, C. R.; Light, B. 1999. A critical success factors model for ERP implementation, *IEEE Software* 16(3): 30–36. https://doi.org/10.1109/52.765784

Hulio, Z. H.; Jiang, W; Rehman, S. 2017. Technical and economic assessment of wind power potential of Nooriabad, Pakistan, *Energy, Sustainability and Society* 7(1): 35. https://doi.org/10.1186/s13705-017-0137-9

Ika, L. A., Diallo, A.; Thuillier, D. 2012. Critical success factors for World Bank projects: An empirical investigation, *International Journal of Project Management* 30(1): 105–116. https://doi.org/10.1016/j.ijproman.2011.03.005

Ika, L. A.; Donnelly, J. 2017. Success conditions for international development capacity building projects, *International Journal of Project Management* 35(1): 44–63. https://doi.org/10.1016/j.ijproman.2016.10.005

Jugdev, K.; Mathur, G. 2012. Classifying project management resources by complexity and leverage, *International Journal of Managing Projects in Business* 5(1): 105–124. https://doi.org/10.1108/17538371211192928

Kamal, M. 2006. IT innovation adoption in the government sector: identifying the critical success factors, *Journal of Enterprise Information Management* 19(2): 192–222. https://doi.org/10.1108/17410390610645085

Kwek, C. L.; Lau, T. C.; Tan, H. P. 2010. Education quality process model and its influence on students' perceived service quality, *International Journal of Business and Management* 5(8): 154–165.

Larson, E. 1995. Project partnering: results of study of 280 construction projects, *Journal of Management in Engineering* 11(2): 30–35. https://doi.org/10.1061/(ASCE)0742-597X(1995)11:2(30)

Lewin, M. D. 2001. *Better software project management.* 1st ed. New York, USA: John Wiley & Sons, Inc.

Li, E. Y. 1997. Perceived importance of information system success factors: a meta analysis of group differences, *Information and Management* 32(1): 15–28. https://doi.org/10.1016/S0378-7206(97)00005-0

Li, T.; Cavusgil, T. 2000. Decomposing the effects of market knowledge competence in new product export, *European Journal of Marketing* 34(1): 57–80. https://doi.org/10.1108/03090560010306205

Liu, J.; Love, P. E.; Smith, J.; Regan, M.; Davis, P. R. 2014. Life cycle critical success factors for public-private partnership infrastructure projects, *Journal of Management in Engineering* 31(5): 1–7.

Malhotra, N. K. 2008. *Marketing research: An applied orientation.* 5th ed. New Jersey, USA: Pearson Education. https://doi.org/10.1108/S1548-6435(2008)4

Maqbool, R.; Sudong, Y.; Manzoor, N.; Rashid, Y. 2017. The impact of emotional intelligence, project managers' competencies, and transformational leadership on project success, *Project Management Journal* 48(3): 58–75.

Marzagão, D. S. L.; Carvalho, M. M. 2016. Critical success factors for Six Sigma projects, *International Journal of Project Management* 34(8): 1505–1518. https://doi.org/10.1016/j.ijproman.2016.08.005

Mirza, U. K.; Ahmad, N.; Harijan, K.; Majeed, T. 2009. Identifying and addressing barriers to renewable energy development in Pakistan, *Renewable and Sustainable Energy Reviews* 13(4): 927–931. https://doi.org/10.1016/j.rser.2007.11.006

Mirza, U. K.; Maroto-Valer, M. M.; Ahmad, N. 2003. Status and outlook of solar energy use in Pakistan, *Renewable and Sustainable Energy Reviews* 7(6): 501–514. https://doi.org/10.1016/j.rser.2003.06.002

Mukhtar, M. M.; Amirudin, R. B.; Sofield, T.; Mohamad, I. B. 2017. Critical success factors for public housing projects in developing countries: a case study of Nigeria, *Environment, Development and Sustainability* 19(5): 2039–2067. https://doi.org/10.1007/s10668-016-9843-2

Muller, R.; Turner, R. 2010. Leadership competency profile of successful project managers, *International Journal of Project Management* 28(5): 437–448. https://doi.org/10.1016/j.ijproman.2009.09.003

Nastase, M. 2009. Leadership development within SMEs: Solving the organizational conflict, *International Review of International Comparative Management* 10(5): 1035–1042.

Nunnally, J. C.; Bernstein, I. H. 1994. *Psychometric theory.* 3rd ed. New York, USA: McGraw-Hill Education.

Olasupo, A. R.; Ibrahim, O. O.; Gazal, H. O. 2012. Effect of project management on project success, *Australian Journal of Business and Management Research* 2(3): 1–11.

Osei-Kyei, R.; Chan, A. P. 2015. Review of studies on the critical success factors for Public-Private Partnership (PPP) projects from 1990 to 2013, *International Journal of Project Management* 33(6): 1335–1346. https://doi.org/10.1016/j.ijproman.2015.02.008

Pal, R.; Wang, P.; Liang, X. 2017. The critical factors in managing relationships in international engineering, procurement, and construction (IEPC) projects of Chinese organizations, *International Journal of Project Management* 35(7): 1225–1237. https://doi.org/10.1016/j.ijproman.2017.05.010

Pfeffer, J. 1994. *Competitive advantage through people: Unleashing the power of the work force.* 1st ed. Boston, USA: Harvard Business Press.

PMD. 2004. *Feasibility report – the establishment of commercial wind power plant of 18 MW at Gharo–Sindh.* Technical Report no. PMD–11/2004, Pakistan Meteorological Department [online], [cited 4 December 2017]. Available from Internet: http://www.pmd.gov.pk/wind/Wind_Project_files/Feasibility%20Report-Gharo.pdf

Prabhakar, G. P. 2008. Projects and their management: A literature review, *International Journal of Business and Management* 3(9): 3–10. https://doi.org/10.5539/ijbm.v3n8p3

Raja, I. A.; Dougar, M. G.; Abro, R. S. 1996. Solar energy applications in Pakistan, *Renewable Energy* 9(1–4): 1128–1131. https://doi.org/10.1016/0960-1481(96)88477-1

Rajkumar, S. 2010. Art of communication in project management, in *PMI® Research Conference: Defining the Future of Project Management*, 11–14 July 2010, Washington, DC. Newtown Square, PA: Project Management Institute.

REN21. 2010. *Renewables 2010 global status report*.

Ribeiro, M. B.; Duarte, V. D.; Salgado, E. G.; Castro, C. V. 2017. Prioritization of critical success factors in the process of software development, *IEEE Latin America Transactions* 15(1): 137–144. https://doi.org/10.1109/TLA.2017.7827917

Rogers, E. M. 1976. New product adoption and diffusion, *Journal of Consumer Research* 2(4): 290–301. https://doi.org/10.1086/208642

Sahir, M. H.; Qureshi, A. H. 2008. Assessment of new and renewable energy resources potential and identification of barriers to their significant utilization in Pakistan, *Renewable and Sustainable Energy Reviews* 12(1): 290–298. https://doi.org/10.1016/j.rser.2006.07.002

Saunders, M. N.; Saunders, M.; Lewis, P.; Thornhill, A. 2015. *Research methods for business students.* 5th ed. India: Pearson Education.

Schreiber, J. B.; Stage, F. K.; King, J.; Nora, A.; Barlow, E. A. 2006. Reporting structural equation modelling and confirmatory factor analysis results: A review, *The Journal of Educational Research* 99(6): 323–338. https://doi.org/10.3200/JOER.99.6.323-338

Shahbaz, M.; Loganathan, N.; Zeshan, M.; Zaman, K. 2015. Does renewable energy consumption add in economic growth? An application of auto-regressive distributed lag model in Pakistan, *Renewable and Sustainable Energy Reviews* 44: 576–585. https://doi.org/10.1016/j.rser.2015.01.017

Shakeel, S. R.; Takala, J.; Shakeel, W. 2016. Renewable energy sources in power generation in Pakistan, *Renewable and Sustainable Energy Reviews* 64: 421–434. https://doi.org/10.1016/j.rser.2016.06.016

Sheikh, M. A. 2009. Renewable energy resource potential in Pakistan, *Renewable and Sustainable Energy Reviews* 13(9): 2696–2702. https://doi.org/10.1016/j.rser.2009.06.029

Shen, W.; Tang, W.; Siripanan, A.; Lei, Z.; Duffield, C. F.; Wilson, D.; Wei, Y. 2017. Critical success factors in Thailand's green building industry, *Journal of Asian Architecture and Building Engineering* 16(2): 317–324. https://doi.org/10.3130/jaabe.16.317

Shenhar, A.; Levy, O.; Dvir, B. 1997. Mapping the dimensions of project success, *Project Management Journal* 28(2): 5–13.

Standish, G. 1994. *The CHAOS report*. The Standish Group International, Inc, Boston.

Sudhakar, G. P. 2012. A model of critical success factors for software projects, *Journal of Enterprise Information Management* 25(6): 537–558. https://doi.org/10.1108/17410391211272829

Tabachnick, B. G.; Fidell, L. 2012. *Using multivariate statistics.* 6th ed. New Jersey, USA: Pearson.

Thite, M. 1999. Leadership: a critical success factor in IT project management, in *Proceedings of Portland International Conference on Management of Engineering and Technology (PICMET'99)*, 29–29 July 1999, Portland, USA, 298–303. https://doi.org/10.1109/PICMET.1999.787819

Varona, F. 1996. Relationship between communication satisfaction and organizational commitment in three Gautemalan organizations, *International Journal of Business Communication* 33(2): 111–140. https://doi.org/10.1177/002194369603300203

Verma, V. K. 1995. *Organizing projects for success – The human aspects of project management.* Vol. 1. Pennsylvania, USA: Project Management Institute.

Westerveld, E. 2003. The Project Excellence Model®: linking success criteria and critical success factors, *International Journal of Project Management* 21(6): 411–418. https://doi.org/10.1016/S0263-7863(02)00112-6

White, D.; Fortune, J. 2002. Current practice in project management – An empirical study, *International Journal of Project Management* 20(1): 1–11. https://doi.org/10.1016/S0263-7863(00)00029-6

Williams, T. 2016. Identifying success factors in construction projects: A case study, *Project Management Journal* 47(1): 97–112. https://doi.org/10.1002/pmj.21558

Wixom, B. H.; Watson, H. J. 2001. An empirical investigation of the factors affecting data warehousing success, *MIS Quarterly* 25(1): 17–41. https://doi.org/10.2307/3250957

Wüste, A.; Schmuck, P. 2012. Bioenergy villages and regions in Germany: an interview study with initiators of communal bioenergy projects on the success factors for restructuring the energy supply of the community, *Sustainability* 4(2): 244–256. https://doi.org/10.3390/su4020244

Xavier, R.; Komendantova, N.; Jarbandhan, V.; Nel, D. 2017. Participatory governance in the transformation of the South African energy sector: Critical success factors for environmental leadership, *Journal of Cleaner Production* 154: 621–632. https://doi.org/10.1016/j.jclepro.2017.03.146

Xiong, B.; Skitmore, M.; Xia, B. 2015. A critical review of structural equation modeling applications in construction research, *Automation in Construction* 49: 59–70. https://doi.org/10.1016/j.autcon.2014.09.006

Xu, P.; Chan, E. H. W.; Qian, Q. K. 2011. Success factors of energy performance contracting (EPC) for sustainable building energy efficiency retrofit (BEER) of hotel buildings in China, *Energy Policy* 39(11): 7389–7398. https://doi.org/10.1016/j.enpol.2011.09.001

Yalegama, S.; Chileshe, N.; Ma, T. 2016. Critical success factors for community–driven development projects: A Sri Lankan community perspective, *International Journal of Project Management* 34(4): 643–659. https://doi.org/10.1016/j.ijproman.2016.02.006

Yamin, M.; Sim, A. K. 2016. Critical success factors for international development projects in Maldives: Project teams' perspective, *International Journal of Managing Projects in Business* 9(3): 481–504. https://doi.org/10.1108/IJMPB-08-2015-0082

Young, R.; Poon, S. 2013. Top management support – almost always necessary and sometimes sufficient for success: Findings from a fuzzy set analysis, *International Journal of Project Management* 31(7): 943–957. https://doi.org/10.1016/j.ijproman.2012.11.013

Zhao, Z. Y.; Chen, Y. L. 2018. Critical factors affecting the development of renewable energy power generation: Evidence from China, *Journal of Cleaner Production* 184: 466–480. https://doi.org/10.1016/j.jclepro.2018.02.254

Zhao, Z. Y.; Chen, Y. L.; Chang, R. D. 2016. How to stimulate renewable energy power generation effectively? – China's incentive approaches and lessons, *Renewable Energy* 92: 147–156. https://doi.org/10.1016/j.renene.2016.02.001

Zhao, Z. Y.; Chen, Y. L.; Thomson, J. D. 2017. Levelized cost of energy modeling for concentrated solar power projects: A China study, *Energy* 120: 117–127. https://doi.org/10.1016/j.energy.2016.12.122

Zhao, Z. Y.; Zuo, J.; Zillante, G.; Wang, X. W. 2010. Critical success factors for BOT electric power projects in China: Thermal power versus wind power, *Renewable Energy* 35(6): 1283–1291. https://doi.org/10.1016/j.renene.2009.09.016

Zou, W.; Kumaraswamy, M.; Chung, J.; Wong, J. 2014. Identifying the critical success factors for relationship management in PPP projects, *International Journal of Project Management* 32(2): 265–274. https://doi.org/10.1016/j.ijproman.2013.05.004