International Transaction Journal of Engineering, Management, & Applied Sciences & Technologies

http://TuEngr.com

RISK ASSESSMENT OF FIRST OVERSEAS MASS RAPID TRANSIT PROJECT: PROMULGATING INTERPRETIVE QUALITATIVE PARADIGM FOR CHINA PAKISTAN CONSTRUCTION CONCESSION

Farman AFZAL [a*], Shao YUNFEI [a], Muhammad SAJID [b], and Fahim AFZAL [c]

[a] *School of Management and Economics, University of Electronic Science and Technology Chengdu, PR. CHINA.*
[b] *School of Management, Royal Holloway, University of London, UNITED KINGDOM.*
[c] *Business School of Hohai University, Hohai University Nanjing, PR. CHINA.*

ARTICLEINFO

Article history:
Received 10 September 2018
Received in revised form 22 October 2018
Accepted 26 October 2018
Available online 29 October 2018

Keywords:
Risk Factors; Success Criteria; Probability-Impact Matrix; Mega Construction Projects; Project Stakeholders; Risk Management.

JEL Classifications: G32, H43, M1, O22.

ABSTRACT

Integrated Project Risk (PR) planning is an urge to reduce growing risk and achieve better project goals. The study illustrates about the inherent individual PR for the success of Mass Rapid Transit project encountered by each project stakeholder. Risks are addressed across project level, market level, and country level in a highly uncertain environment. For holistic analysis, the interpretive paradigm case study approach is followed for this unique project case application. Semi-structured interviews were conducted to obtain feedback from construction experts, attached with the first Orange Line Metro Train (OLMT) project in Pakistan. Classification of complex Risk Factors (RFs) and Success Criteria (SC) for OLMT is quantified through thematic analysis and node process. Integrated Probability-Impact (PI) matrix is designed for the significance of factors at project evaluation stage. Subject to the findings of this study, it proposes a high-level Risk Assessment (RA) framework which signifies the classification and adaptation of key Success Factors (SF) at key stakeholder's levels. Adequate findings derived from this study will help to better evaluate the Project Risk Management (PRM) practices for risk maturity in a limited budget and high complexity.

1. INTRODUCTION

Mega-projects are connected with integrated activities rather than having numerous multiple single projects in the pipeline. Though, with single or multiple project management practices, there is a program management perspective in every Construction Management System (Zhi, 1995). The European Cooperation in Science and Technology classified mega-projects as, those projects which have high complexity (both in technical as well as human terms) and a long record of poor scope

*Corresponding author (Farman Afzal). Tel/Fax: +86-15528360293. E-mail: farmanafzal@gmail.com.

delivery are listed under mega-projects (Park, Park, Cha, & Hyun, 2016). Federal Highway Administration of the United States also defined mega-projects as, having a cost of more than $1billion or a project with high public interests (Flyvbjerg, Bruzelius, & Rothengatter, 2003). Cairns (2004) categorized mega-projects in a different way, i.e., projects that are having extreme physical structure, highly expensive, and with public attention. Song, Kim, Yu, Lee, and Lee (2012) evaluated 19 different projects to describe a mega-project as, having investments in infrastructure with a total cost of over $500 million.

Construction business confronts a great deal of evolving difficulties, namely complexity, progression, and growth. According to Standish report (2009) discussed by Eveleens and Verhoef (2010), the Project Success (PS) in consideration of time, cost and quality did not contribute more than 32% of the complete projects. Recent global economic changes have increased the business prospects of engineering management for construction firms all over the world. Increased worldwide competition and significant demand by stakeholders for good quality have instigated the companies to understand the importance of providing quality projects and services to compete in the global marketplace successfully (Park et al., 2016).

Transit Projects (TP) posted significant ridership expansion in recent times, which plays an important role in the development of a country's transit market. TPs are completed as a result of many activities, planned or unplanned over the project life cycle facility. As a result, it leads to the changes in project team members and processes in a continually changing environment (Carpintero & Siemiatycki, 2016).

Many high-tech infrastructure TPs confront a series of failure cases by schedule, cost overruns, and scope standards which result in the failure of the project's outcome. Therefore, it is pertinent to explore, evaluate, and manage numerous RFs prior to the beginning of project planning that may create a negative impact in project's progress (Taroun, 2014). Due to technological development, the demand for program type projects has increased recently which increased the importance of integrated *risk management* practices for complex high-tech infrastructure projects (Williams, 2016).

Public transit systems including Bus Rapid Transit, Light Rail Transit, and Mass Rail Transit are in operations since 1960 (Xu & Lin, 2016). The OLMT project is a 27.1km long rapid transit line project located in Lahore Pakistan, under construction with the support of Chinese contractors under China Pakistan Economic Corridor arrangements. Out of the total track, 25.4 km is above the ground while the rest of the track is underground. Total numbers of station sights are 36, and around 250,000 passengers are expected to travel daily. The train is having a nominal capacity of 1,300 passengers, seated in seven wagons. The average speed of the train is 45 km/h (28 mph/h), due to staying at each station along the route. Total estimated completion time was 27 months but running with schedule delays and with over cost due to poor risk assessment initially. This project has been started with an agreement made between Pakistan and China in 2014 and expected to be operational in 2019.

TPs are highly hostile in nature to risks. *Project Stakeholders* are more concerned about better risk management to avoid themselves from financial and legal consequences. It is most important to mitigate *risk* more effectively and efficiently, in a way to assure the *success* and satisfaction of the project to its stakeholders (Fang & Marle, 2012). Unique projects involve uncertainty and carry a high probability of risk. Uncertainty in the project's complexity, dynamism, and environment evolve an emerging issue that affects a project and its operational plan (Yang, Chen, Wu, Huang, & Cheng, 2015). Intensive work planning is required for evaluation of Risk and Success Criteria (RSC) for TPs where the combined effect of RSC is quite different from other traditional types of *construction projects*, like; buildings and roads construction (Liu, Zhao, & Yan, 2016). Though, under international construction partnership, project RFs are required to be classified for PS in the uncertain environment at different stakeholders' level (Müller, Martinsuo, & Blomquist, 2008).

Mass Rapid Transit projects are highly innovative with complexity and would have a huge impact on economic growth in future, but construction risk is considered high due to uncertain environmental conditions which lead toward variation in the schedule, cost, and quality in Under-Developing Countries, such as Pakistan. Involvement and preferences of stakeholders are different from project to project. In this situation, project RSC will be changed in terms of project specification, the external environment and within resource constraints (Pehlivan & Öztemir, 2018). To address the limitations of mega-projects and understating of risk, this study attempts to explore a research question; *how to evaluate better multiple risk dimensions and to measure uncertainty in the variability of time, cost and scope relationship for high-tech TPs which cause a delay in achieving project goals?* The objective of this research is to propose a RA framework which attempts to augment new insights for the further understanding of project potential RSC in future mega-projects in Pakistan. The framework will be useful for engineering managers in risk management decision-making during the early phase of project evaluation. Project RSC is different in developed and under-developed countries. Therefore, this research highlighted the impact of potential RFs for the TP. High-tech TPs are innovative or agile in Pakistan and have a complex structure (technology, resources, and skills), therefore projects need more understanding and diverse study for its success.

2. THEORY AND RISK EVALUATION MODELS

An Explicit Theory of project management rather scientific knowledge would serve several functions in addressing project risk and success. Explicit Theory of project is not only based on the observed behavior which leads towards the contribution of understanding but also provides a prediction of future behavior. This theory helps to design tools for investigating, designing and controlling the process. The theory provides a common understanding, through which project or firm is facilitated and empowers the direction to pinpoint sources of continuous progress. Explicit Theory addresses that the innovative practices can be transferred to other settings by first abstracting a theory from that practice and then applying it to target conditions (Koskela & Howell, 2008). PRM practices follow applied methods to minimize RFs and maximize opportunity by identifying and mitigating the effect of RFs (Fang & Marle, 2012). Subsequently, the ultimate goal of applying risk management practices is to complete a project successfully within all constraints (Williams, 2016).

Projects normally contain large, expensive or unique risks, which have to be completed within a schedule or within a specified budget, within some desirable performance level (Müller et al., 2008). This is called the threefold criterion of success, often called the Iron Triangle. It also comprises the fact that the client's objectives are also crucial in construction projects (Barnes, 1988; Williams,

*Corresponding author (Farman Afzal). Tel/Fax: +86-15528360293. E-mail: farmanafzal@gmail.com.

2016). Chapman and Cooper (1983) presented a set of five parameters of PS in a hierarchical way. Series of studies have been conducted to find out the SFs at different stakeholders' level over the project life cycle. Different stakeholders have quite different definitions of PS (Rodney, 2004).

To address RFs of overseas rapid TP, Zhi (1995) presented the Risk Identification Hierarchy for worldwide construction projects and classified projects' risks into four levels: nation, industry, company, and project levels. Hastak and Shaked (2000) identified 73 project related risks into three levels: country, market, and project. Dikmen, Birgonul, and Han (2007) analyzed a risk breakdown structure which included 45 RFs at country and project level. Deng, Low, Li, and Zhao (2014) conducted research on political RFs in the international projects commenced by Chinese contractors around the world. Park et al. (2016) worked on one overseas study and highlighted potential RFs into eight classes by causes and impact, which consist of total 122 enlisted RFs. A study on risk management revised risk groups and excluded the risks into 94 RFs for success based on potential impact. These categories were applied as potential RFs of overseas mega construction projects.

In integrated TPs, selection, and planning consider some basic guidelines for project selection and construction (Cui et al., 2010). Some key factors are measured and addressed during the decision process, according to the dynamics of the environment (Achillas, Vlachokostas, Moussiopoulos, & Banias, 2011). Limited studies are found in comparing the selection criteria of Mass Rapid Transit projects in Under Developing Countries (Cui et al., 2010; Mishra, Welch, & Jha, 2012). Iswalt, Wong, and Connolly (2011) suggested a multi-phased assessment process to identify the most feasible TP. A study conducted in the United States on the TP for development of operating plans and infrastructure strategies for risk management in the selection of preferred operating and infrastructure strategy within innovative projects (McNamara, Zimmerman, Orosz, Levinson, & Sampson, 2006).

Risk analysis techniques are grouped into two parts: quantitative (scientific) and qualitative (explicit) methods. The qualitative approach utilizes the data through immediate judgment, ranking options, comparing options, and descriptive analysis. In contrast, some of the quantitative risk analysis techniques, such as Monte Carlo Simulation, Analytic Hierarchy Process are also used in order to get numerical results of risks. While most of the tools and techniques used in evaluating the risks, provide quantitative explanations which constitute some subjectivity. Chapman and Cooper (1983) outlined one of the initial attempts to consider the need for structuring project risks and systematically identifying their sources. They presented the risk engineering approach, which integrates different tools and techniques, including the Program Evaluation and Review Technique, Decision Trees and Probability Distributions. Kangari and Riggs (1989) illustrated the use of Fuzzy Sets Theory as a RA tool for complex projects. Taroun (2014) explained the objective assessment of the merits and shortcomings of Fuzzy Sets Theory. Mustafa and Al-Bahar (1991) adopted the Analytic Hierarchy Process to evaluate the risk of the construction project. Similarly, Lin and Hsu (2008) proposed a decision model for selection of an agile project using the Analytic Hierarchy Process in a combination of qualitative and quantitative measures. Since 2000, RA instigated, Analytic Hierarchy Process and Fuzzy Sets Theory became the principal approaches for handling ill-defined project problems with subjectivity (Chang, 2014). Dikmen et al. (2007) used the Multi-Criteria Decision Making Framework for risk and opportunity assessment of international construction projects. Typically, to prioritize RSC, all methods are a result of two concepts, including probability and impact of key risk factors which are evaluated through qualitative or quantitative techniques (Abd El-Karim, Mosa El Nawawy, & Abdel-Alim, 2017). Many of these methods evaluate the characteristics of risks that are relativity consist on the expertise based techniques, namely expert's opinion or judgment using Delphi, peer interviews or risk analysis methodology (Williams, 2016).

2.1 PROPOSED RISK FRAMEWORK

Decision model of RA for the OLMT project is based on the correlation of interrelated RSC. This framework including the P-I matrix evaluates the RSC for the potential TS in three groups: country level, market level, and project level. The framework characterizes the potential SFs for all levels of stakeholders across the dynamics of the market (Fang & Marle, 2012; Park et al., 2016). International Construction Risk Assessment Model provides a structured approach for assessing the risk indicators, involved in international construction operations and can be used as a tool to quantify the risk involved as one of the primary steps in project evaluation. International Construction Risk Assessment Model provides three main results: first, the environmental impact of a country on a specific project; second, the impact of market environment on a specific project; and third, overall project risk (Hastak & Shaked, 2000). Fang and Marle (2012) analyzed the approach which manipulates values of risk interactions concerning nature and type of a project. Generally, risks are all evaluated in terms of the P-I matrix in the risk management of any project where risk related information is limited (Carbone & Tippett, 2004).

Potential project RSC is evaluated through qualitative research methods, and the result is typically a project risk list for success. Project risk interactions are identified on the basis of the risk list and categorized using a matrix based method (Floyd, Barker, Rocco, & Whitman, 2017). Further, in risk network assessment, the probabilities of known risks are estimated by the likelihood of occurrence, and strength of risk interactions is calculated with a magnitude of risk impact based method.

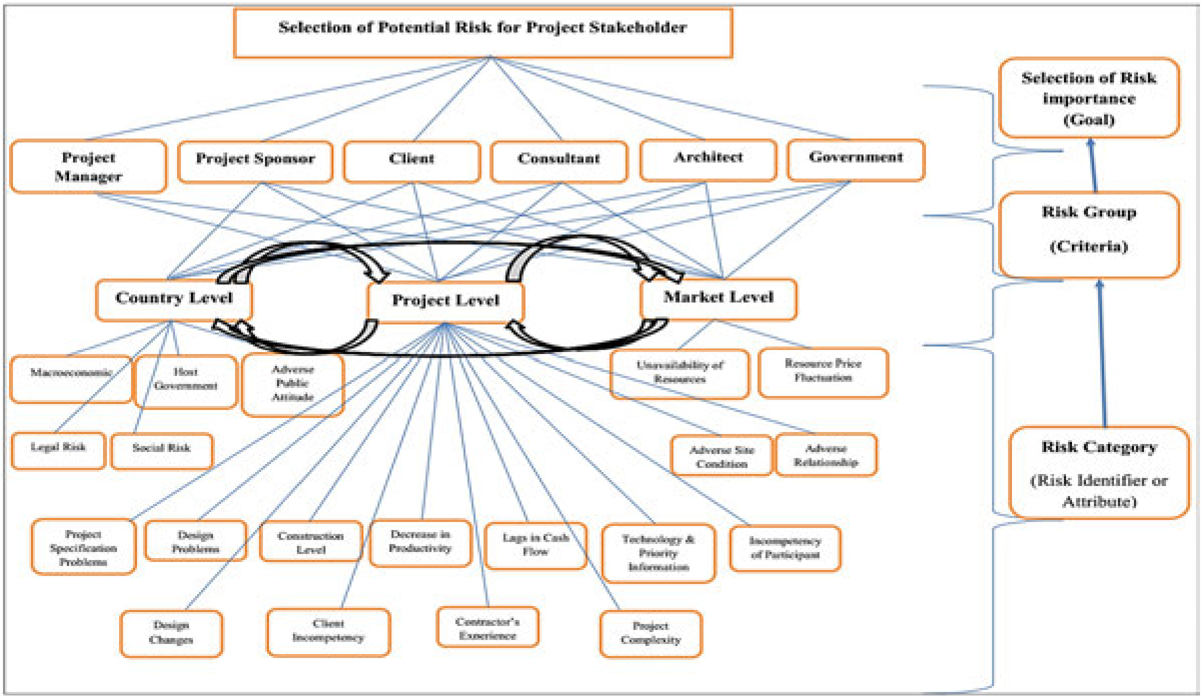

Figure 1: Hierarchy Process of Potential Risk for OLMT Project.

*Corresponding author (Farman Afzal). Tel/Fax: +86-15528360293. E-mail: farmanafzal@gmail.com.

Figure 1 shows the proposed ranking of potential RFs and SC according to the preferences of key stakeholders. Research framework characterizes sixty potential RFs in three main groups and SC in five main groups for OLMT project (Fang & Marle, 2012; Park et al., 2016).

3. RESEARCH DESIGN AND METHODOLOGY

Researchers must decide the type of case study they are going to conduct (Ponelis, 2015). The study objectives guide the selection of a specific type of case study design. When the aim is to understand how a phenomenon takes place, an exploratory case study is the best tool to use (De Massis & Kotlar, 2014). The present research is exploratory based on the interpretive paradigm of qualitative research method because research explores potential SFs of OLMT project in Pakistan (Lodhi & Malik, 2013). Qualitative research elucidates the holistic considerations of rich, contextual, unstructured and non-numeric data by engaging the researchers and participants in a natural setting of research regime (Ponelis, 2015). Research design provides the logic of how to collect data from respondents and the connection of data collection to the purpose of study and objectives. While using interpretive paradigm, case study protocol is important to ensure the accuracy of data collection for real-life scenario or project. The defining feature of case study research is to an emphasis on 'how' and 'why' questions for exploratory and descriptive studies. A case study focuses on describing the process, individual or group behavior in its total setting or the sequence of events in which the behavior occurs (Salling & Leleur, 2015). Case studies accommodate a rich variety of data sources, including interviews, archival data, survey data, ethnographies, and observation (Ponelis, 2015).

Communication sector of Pakistan is growing with potential investment in TPs under the China-Pakistan Economic Corridor. The government launches many innovative projects in support of foreign expertise and financing, so it is essential to understand the requirement of projects' stakeholders in project evaluation (Xu & Lin, 2016). As the momentum of these projects is high, failure chances can't be ignored in a highly uncertain environment of Pakistan (Hussain, 2017).

Table 1: OLMT Stakeholders

Sr. no.	Stakeholder	Authority	No. of Interviews
1	Consultants (technical experts)	Nespak	5
2	Project Manager	Habib Construction, ZKB Engineers and Constructors	5
3	Client	Lahore Development Authority	5
4	Architect/engineers	M/S China Railway Engineering Consulting Group Co. Ltd. (CEC), Nespak	1
5	Project Sponsor	Finance Division, Sponsoring Banks	5
6	Government (owner)	Metro Bus Authority (Punjab Mass Transit Authority)	5

The OLMT project is selected as a case to evaluate and design the emerging risk framework for PS. The data for this study is gathered through face-to-face interviews with representatives of the stakeholders, attached to the project (Davis, 2014). These stakeholders are the engineers as technical experts, government officials. The purposive, as well as the snowball sampling technique, is adapted to record interviews from 26 key respondents associated with OLMT project (see Table 1).

3.1 INTERVIEW PROTOCOL AND DATA COLLECTION

To integrate the objective nature of the issue and the perceptual data, case study method includes various techniques of data collection. Therefore, the interview protocol is adopted in the current research (Park, Lee, Choi, & Lee, 2017). Sjöberg (2000) claims that interviewers comparatively monitor the process and guide to correct any misunderstandings in data collection. Indeed, for data credibility, multiple people directly involved in the project are selected because they are the key respondents of the project. Few other respondents are also contacted with reference from the key respondents. Interviews are the primary source of data collection in the case studies approach (De Massis & Kotlar, 2014). The study holds 26 semi-structured interviews conducted on the sight of the project (Barzelay, Gaetani, Velarde, & Cejudo, 2003).

To avoid the biased responses, a careful consideration is made to design the interview questions (De Massis & Kotlar, 2014). Initially, RFs and SFs are selected from the literature, and the responses are recorded from all key stakeholders to confirm the potential factors of success (Davis, 2014). The interviews with key stakeholders were recorded in a face-to-face meeting lasting 30-45 minutes, subject to the time required for in-depth questions and answers (see Table 2).

Table 2: Interview Questions.

Factors	Questions
Project Success Criteria	
Project Quality	1. How project success criteria should be measured for high-tech mass transit project?
	2. Why do you think that quality parameters are important for orange line project success?
Stakeholders' Satisfaction	3. Why stakeholders' satisfaction is important and how it should be achieved in OLMT project?
Project Delivery	4. Why project delivery elements: time and cost are important for orange line transit project and its reason for delay?
Project Management	5. Do you think success is also measured through the role of project management team and their satisfaction?
Project Risk Selection	
Country Level	6. Why country level risk factors are important for designing feasibility of mass transit train project?
Market Level	7. According to your point of view how market level risk may affect the OLMT in future and to control it?
Project Level	8. How would you describe the risk factors associated at project level for running mass transit project and which one you prefer?

The focus of interviews is on critical issues relating to the potential RFs of OLMT project in the planning stage. The respondents are supposed to answer according to their role in the project. The interviewees have assured anonymity as a condition of their participation in the research (Iswalt et al., 2011).

Data collected from stakeholders is quantified and evaluated through the P-I scale in the RA framework to measure the risk impact and importance of SC in groups. Further assessment is verified by the experts (Barnes, 1988). Case studies are normally presented in chronologically, thematically, or in both (Ponelis, 2015). This case study uses the Thematic Analysis for the narration of the potential RSC of OLMT. This method includes five main phases, which are familiarizing, identifying a thematic framework, indexing, charting, mapping and interpreting (Alrahlah, 2016). In the Thematic Analysis: Cluster Analysis and Word Frequency Techniques are used in support of code matching (Lodhi & Malik, 2013).

Construct validity is ensured to share the transcript of an interview protocol with respondents and their opinions are also critically reviewed. Internal validity is related to the data analysis and establishment of the causal relationship between the key variables. The sound explanation for the case

*Corresponding author (Farman Afzal). Tel/Fax: +86-15528360293. E-mail: farmanafzal@gmail.com.

OLMT is signified for the clear relationship between key RFs and SC. External validity is related to the generalization of the case study's finding. The present research is a starting point for theory development which gives a clear theoretical understanding of the problem and the objectives needed to be discussed. Reliability of the study is also important which refers to the extent to produce the same results if the study is conducted by the researcher in the same settings. Case study protocol is developed with detailed data collection techniques to attempt the reliability of the data from the sources. Even the concrete case study strategy is designed to avoid the validity and reliability issues (De Massis & Kotlar, 2014).

4. RESULTS AND INTERPRETATION

Different data analysis techniques are used to evaluate the themes of the study, like Coding Nodes, Word Tree, Word Tag Clouds, and Tree-Map. Data is compiled on different phases: (1) data from the interviews are recorded and transcribed into textual form; (2) different themes are extracted from the textual data, and (3) data is coded into connected themes. The research process used the Word Tree-Map and World Tag Clouds for collecting, evaluating and analyzing more evidence for the validity of themes.

Table 3 shows the attribute values of OLMT project's stakeholders in term of percentage coverage of interviews. Total, 26 interviews with respondents are conducted from each category of stakeholders on equal weighting of availability, including an interview about SC and RFs separately.

Table 3: Percentage Coverage of Each Attributes.

Participants	Attribute Value Combination	Percentage Coverage
Client	10	19.2
Consultants	10	19.2
Government	10	19.2
Project manager	10	19.2
Sponsor	10	19.2
Architect/engineers	2	3.8
Total	52	100

Figure 2: Word Cloud with Most Frequent Tags.

Figure 2 elaborates the Word Cloud Analysis; it visually presents the most frequent tags in the interview data. Different tags are highlighted according to the frequency of these tags repeated in data (Hearst & Rosner, 2008). World Cloud helps to identify the most significant RFs and SC highlighted by key stakeholders for OLMT project. After funneling approach, a minimum length of five alphabets is used in World Cloud Analysis to ignore the un-related words like years, indeed, etc. Major tags which we extracted from the analysis are a project, scope, design, complexity, schedule, success, risk, quality, budget, inflation, customer, contractor, incompetency, specialized, staff, stakeholders, and delivery.

According to the significance level in weighted percentage as a Word Frequency Count result, most critical RSFs are listed in hierarchical order. In Table 4, words that show up more frequently in combination with the pre-selected word are shown in a larger font size (Hutchison, Johnston, & Breckon, 2010).

Table 4: Impact of Risk and Success Factors in OLMT Project

Items	Nodes	Word tag	Count	Weighted %
Project Success Criteria				
	Project Quality			
		Defect	498	7.77%
	Project Delivery			
		On budget	391	6.10%
		On time	364	5.68%
	Stakeholders Satisfaction			
		Happy user	237	3.70%
		Happy team	221	3.45%
		Community satisfaction	208	3.25%
	Project Management			
		Control on resources	183	2.86%
		Health & safety	159	2.48%
Project Risk Selection				
	Country Level			
		Host government	156	2.43%
	Project Level			
		Cash flow	156	2.43%
		Complexity	156	2.43%
		Design scope	156	2.43%
	Market Level			
		Price fluctuation	153	2.39%

Figures 3 and 4 show Word Tree technique which provides evidence of keywords pattern of stakeholders' talk. In this study, two keywords are selected based on the research objectives, i.e., risk and success. Therefore, by using the text search query, Word Tree-Map of keyword RSFs is developed for deep analysis. Pattern matching gives a clear insight into potential RFs and how it affects the project execution. Similarly, the Word Tree pattern of success elements elaborates the latent SC for OLMT project. Pattern matching provides the justification of risk impact on project SC through detail reading of responses. This analysis excavates some additional word tags from the study which might be further evaluated in more details, like the strategic importance of OLMT project and long maturity of operation phase as a success. Some factors are eliminated which are not significant in pattern matching or are least responded.

Table 5 gives a detail analysis and ranking of potential RSFs for each stakeholder of the OLMT project. These word tags are selected from the interview protocol according to the priority and choices of respondents. Based on the frequency and weighted average of word tags in the pattern, these critical factors are ranked and highlighted according to the order of importance for the TS in Pakistan. Only those latent factors are ranked and are highlighted that have vital importance and impact in responses. Others factors are also found but eliminated due to low frequency and weighted average value.

*Corresponding author (Farman Afzal). Tel/Fax: +86-15528360293. E-mail: farmanafzal@gmail.com.

Figure 3: Word Search Query “Risk”.

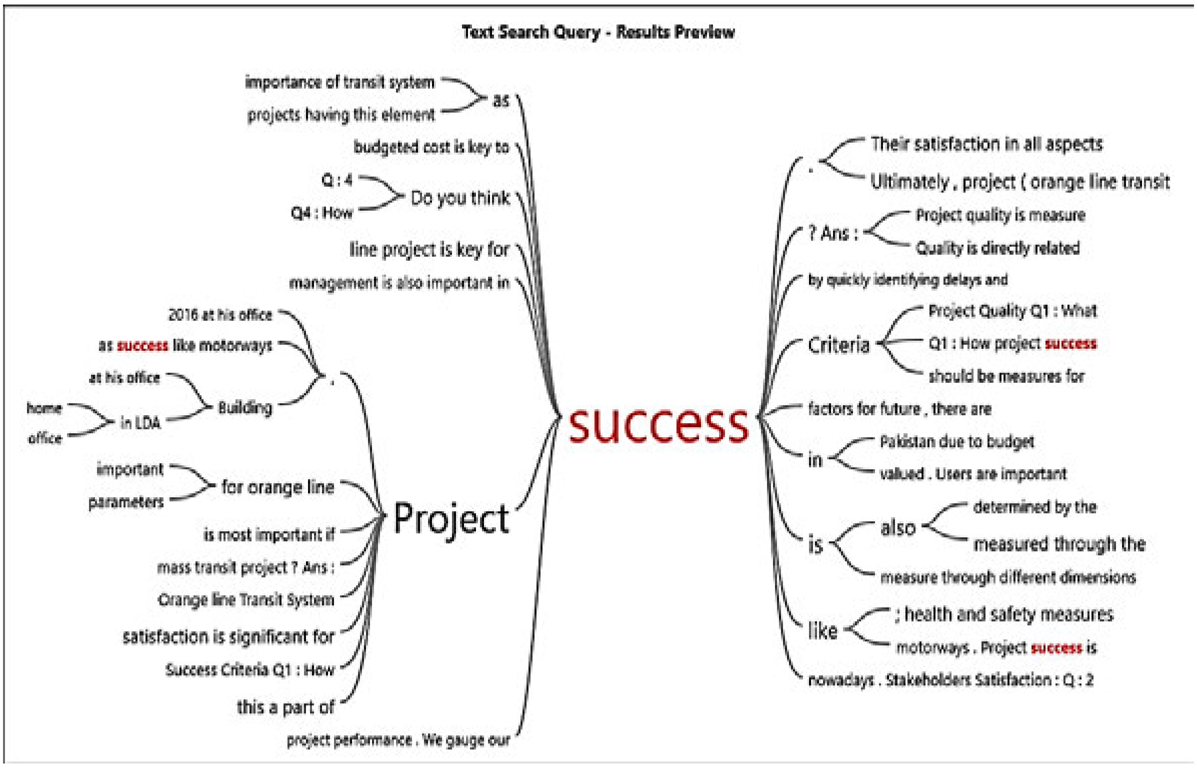

Figure 4: Word Tree "Success".

P-I matrix is important to measure the total value of risk associated with project conferring to the probability of occurrence of a particular risk and its impact on the project. As TS is unique in its category of the project, so designing a new matrix is important for further managerial implications in future (Dumbrava, 2013). Table 6 shows the probability of each extracted factors from pattern analysis and later rating of risk impact from respondents on five-point Likert scale rating (PMI, 2013).

Table 5: Ranking of Key Success and Risk Factors According to Stakeholders' Responses

Items	Nodes	Word tag	Count	Weighted %	Count	Weighted %	Count	Weighted %	Count	Weighted %	Count	Weighted %	Count	Weighted %
OLMT Project Risk and Success Factors			Project Manager		Consultant		Project Sponsor		Client		Government		Architect	
Project Success Criteria	Project Quality	Defect	65	9.13%	74	14.10%	140	24.52%	101	17.32%	67	18.98%	51	26.29%
	Project Delivery	On budget	125	17.56%	95	18.10%	61	10.68%	58	9.95%	36	10.20%	16	8.25%
		On time	91	12.78%	71	13.52%	32	5.60%	42	7.20%	14	3.97%	14	7.22%
	Stakeholders Satisfaction	Happy user	65	9.13%	41	7.81%	74	12.96%	34	5.83%	14	3.97%	9	4.64%
		Happy team	85	11.94%	26	4.95%	41	7.18%	38	6.52%	16	4.53%	15	7.73%
		Community satisfaction	60	8.43%	29	5.52%	53	9.28%	27	4.63%	19	5.38%	20	10.31%
	Project Management	Control on resources	28	3.93%	41	7.81%	32	5.60%	51	8.75%	26	7.37%	5	2.58%
		Health & safety	41	5.76%	36	6.86%	12	2.10%	26	4.46%	31	8.78%	13	6.70%
Project Risk	Country Level	Host government	20	2.81%	32	6.10%	23	4.03%	57	9.78%	15	4.25%	9	4.64%
	Project Level	Cash flow	33	4.63%	18	3.43%	22	3.85%	29	4.97%	43	12.18%	11	5.67%
		Complexity	35	4.92%	23	4.38%	29	5.08%	38	6.52%	19	5.38%	12	6.19%
		Design scope	41	5.76%	21	4.00%	18	3.15%	44	7.55%	26	7.37%	6	3.09%
	Market Level	Price fluctuation	23	3.23%	18	3.43%	34	5.95%	38	6.52%	27	7.65%	13	6.70%
			712	**100%**	**525**	**100.00%**	**571**	**100%**	**583**	**100.00%**	**353**	**100.00%**	**194**	**100.00%**

Table 6: Probability and Impact Score

Items	Nodes	Factors	Frequency	Probability	Impact	Risk score
Project Success Criteria	Project Quality	Defect	498	16%	4	66%
	Project Delivery	On budget	391	13%	5	64%
		On time	364	12%	3	36%
	Stakeholders Satisfaction	Happy user	237	8%	2	16%
		Happy team	221	7%	2	15%
		Community satisfaction	208	7%	2	14%
	Project Management	Control on resources	183	6%	3	18%
		Health & safety	159	5%	2	10%
Project Risk Selection	Country Level	Host government	156	5%	4	21%
	Project Level	Cash flow	156	5%	4	21%
		Complexity	156	5%	5	26%
		Design scope	156	5%	5	26%
	Market Level	Price fluctuation	153	5%	4	20%

SFs are also considered as a major contributor to finish the project within given time, cost, and quality. Table 7 shows the P-I matrix of the project which is expounded in term of rating of risk from high to low, according to the guidelines of the project management body of knowledge. The risk level for OLMT project is added to the matrix, conferring to the score calculation. The P-I matrix is important to allocate the right level of risk, and timely remedies can be taken indeed.

5. RESEARCH FINDINGS AND DISCUSSIONS

The present research has concluded findings based on the problem and proposition of the interview protocol, defined to address in this study. The intensive qualitative study is based on the case study approach, has extracted major potential RFs for OLMT project according to the weights given by the respondents.

5.1 RISK AND SUCCESS FACTORS

The analysis shows that project quality (7.77% weight) is important in the context of the Mass

Transit System. Such high-tech systems ensure the users' satisfaction and safety. Different other studies also addressed the significance of project quality as a success parameter (Davis, 2014; Park et al., 2016). However, Respondents have multiple points in quality like, "quality is also important if projects are for a strategic point of view" (Rg3). Respondents commented that about the quality is compromised in a certain situation: "In Pakistan, sometimes quality is compromised due to budget constraint but not to go beyond the minimum benchmark decided earlier in a feasibility report; if resources are limited, then according to the situation, quality is compromised with some changes in quality standard" (Rs3).

Table 7: P-I Matrix for OLMT Project

		Impact				
Probability		Negligible	Minor	Moderate	Significant	Severe
Very likely	0.9	0.045, Low	0.09, Medium	0.18, High Control on Resources	0.36, High On Time	0.72, High Defect & On Budget
Likely	0.7	0.035, Low	0.07, Medium	0.14, Medium Happy User Happy Team Community Satisfaction	0.28, High Complexity Design Scope	0.56, High
Possible	0.5	0.025, Low	0.05, Low	0.1, Medium Health & Safety	0.2, High Government Cash Flow Price	0.4, High
Unlikely	0.3	0.015, Low	0.03, Low	0.06, Medium	0.12, Medium	0.24, High
Very unlikely	0.1	0.005, Low	0.01, Low	0.02, Low	0.04, Low	0.08, Medium
		0.05	0.1	0.2	0.4	0.8

Note: Rg: Respondent from Government.
Rs: Respondent from Sponsor.
Rp: Respondent from project manager.
Rc: Respondent from consultant.

Project quality means the project is defect free or having low defects. "Project is also successful if the defined project's scope is achieved within acceptable variations in design or facilities" (Rp2). Different comments are recorded from stakeholders, as important elements in success. The project sponsor, client, government, and architect have given the response weights of 24.52%, 17.32%, 18.98%, and 26.2% respectively, to the quality (low defects). Rests of the potential factors are also ranked by key stakeholders and least preferred are eliminated accordingly (see Table 5). Respondents claim that "market and project level risk are controllable, but the country-level risk is hard to mitigate in certain situations" (Rp1). In the country level factors, adverse public attitude is very significant in the context of OLMT project, due to mass expansion of structure. Later, the risk is characterized by different levels of impact scale. Rating of risks defines the required level of expertise is needed to overcome the risk in a specific situation.

Project SFs are divided into four major categories, and project quality is one of the major success elements for high-tech projects in Pakistan. Though, a majority of the stakeholders prefer it as a key element for success, like government, client, architect, and project sponsor. Moreover, the project delivery is important in view of stakeholders. Project managers and consultants urge to complete the project within the estimated project budget and in time (18% weights). By focusing on the causes of project delay and cost overrun, respondents have a belief that country economic situation, expertise for the said project, and changes in scope might create pressure on project delivery for the high-tech project (Olaniran, Love, Edwards, Olatunji, & Matthews, 2015).

Some key points regarding project delivery criteria are evaluated through analysis of data collected from the interviews. “Project delivery concerning time and cost is an important element in Developing and Under Developing Countries. Sometimes, project delay in Pakistan is acceptable but cost overrun due to delay is a major element of failure in project progress” (Rc3). “Project delivery is important in the context of OLMT. As it is a unique and first project of its nature in Pakistan, so on-time completion within the budget is an important element to complete the project successfully. Due to some political and legal decisions, it might get delayed with over budget” (Rs1). SC is ranked according to different types of project stakeholders based on the interview responses. PS is also evaluated in the P-I matrix to measure the required level of impact of each element.

6. CONCLUSIONS

Conceptualizing and designing a RA framework is a challenge in a unique and complex environment, where mega-projects are launched at the first time. Achieving project goals in such dynamics and uncertain market is hard, and failure case rate is high due to poor planning of risk. OLMT project in Pakistan is a concession agreement between Pakistan and China under the China Pakistan Economic Corridor initiative. This project is currently facing different problems in the accomplishment of its goals. The project was launched in 2014, but it encountered many hurdles in the beginning. Still, different issues are encircled which increased the risk level of a project, like quality, legal, social and contractor related issues. Project bid was revised three times in the first two years. RA framework analyzed the key RSC for the potential OLMT project. This framework is developed for PRM practices for the high-tech MRT project. The study is based on the explicit theory of risk management models for mega construction (Liu et al., 2016). Complex risk and SFs are further characterized according to the preferences of key project stakeholders. The OLMT project is unique and innovative, facing different types of unique risks; e.g., social and organizational. As risk is unique to each project so, different mega-projects require different PRM practices for the successful launching and completion of such projects. Traditional PRM models may not be suitable for such types of projects due to limited shared information and high uncertainty.

7. IMPLICATIONS FOR ENGINEERING MANAGERS

Existing model factors are reviewed and characterized over the choices of different key players of the project including engineers and government officials. Although more and more stakeholders are attached with this TP, so, the consideration of each stakeholder for project managers is important in the framework, and it may also vary conferring to the level of interest and share in the project (Fang & Marle, 2012). Expert opinion of key stakeholders is recorded to propagate the holistic view of current risk mitigation practices in the industry. The project delay and cost overrun are major problems in Under Developing Countries, though the project managers are facing huge pressure from

*Corresponding author (Farman Afzal). Tel/Fax: +86-15528360293. E-mail: farmanafzal@gmail.com.

stakeholders to complete projects within time and baseline cost with minimum variation. The proposed framework will help engineers to plan better project activities while considering significant risk factors which affect the project progress.

Integrated PRM Framework based on the P-I matrix is developed which comprises the magnitude of each factor. Contemplation of these factors is significant in designing a framework for future successful projects. This study extracted the following five points for the success of mega transit projects:

1. High-tech infrastructure demands a high quality of project; poor quality may create troubler for project success.
2. Stakeholders' interest is high in such type of projects. Hence in PRM practices, their role can't be avoided, and significant importance should be considered for each stakeholder.
3. Due to a high level of investment, time may be compromised, but additional financing can disturb the project SC.
4. The modified integrated P-I matrix is designed for OLMT project which can be customized or revised separately for each project under planning.
5. Projects like OLMT also have strategic importance in the scope parameter. The project can be used for the economic corridor and strategic actions rather than only for public transit projects.

The study is limited for OLMT project and to its key stakeholders but can be generalized for future projects of the same definition. Normally the risk is different for each project but can be better managed through similar PRM practices. Integrated RA framework can provide a basic evaluation to develop or plan Mass Transit Systems in future.   The research will also help the planning team to consider the role of stakeholders in PS.

The study can be extended for empirical findings of this framework. Future research can consider more projects for cross-comparison and evaluation of risk management practices. Interdependencies of project RFs can be tested for TPs in the future (e.g., Karachi Circular Railway Project). Analytical Hierarchy Process can also be computed for ranking of risk according to stakeholders. For empirical findings, research can be extended for further investigation of cost overrun and schedule delay factors based on the project's activity data through Fuzzy Sets Theory, Program Evaluation Review Technique and Simulation.

7. REFERENCES

Abd El-Karim, M. S. B. A., Mosa El Nawawy, O. A., & Abdel-Alim, A. M. (2017). Identification and assessment of risk factors affecting construction projects. *HBRC Journal*, *13*(2), 202–216. https://doi.org/10.1016/j.hbrcj.2015.05.001

Achillas, C., Vlachokostas, C., Moussiopoulos, N., & Banias, G. (2011). Prioritize strategies to confront environmental deterioration in urban areas: Multicriteria assessment of public opinion and experts' views. *Cities*, *28*(5), 414–423. https://doi.org/10.1016/j.cities.2011.04.003

Alrahlah, A. A. (2016). The impact of motivational factors on research productivity of dental faculty members: A qualitative study. *Journal of Taibah University Medical Sciences*, *11*(5), 448–455. https://doi.org/10.1016/j.jtumed.2016.06.006

Barnes, M. (1988). Construction project management. *International Journal of Project Management*, *6*(2), 69–79. https://doi.org/10.1016/0263-7863(88)90028-2

Barzelay, M., Gaetani, F., Velarde, J. C. C., & Cejudo, G. (2003). A CONCEPTUAL FRAMEWORK AND METHODOLOGICAL GUIDE FOR RESEARCH ON PUBLIC MANAGEMENT POLICY CHANGE IN THE LATIN AMERICAN REGION. In *International Public Management Review* (Vol. 4, pp. 349–370). https://doi.org/10.1016/S0723-1318(04)13014-4

Cairns, G. (2004). Megaprojects and Risk: An Anatomy of Ambition20042B. Flyvbjerg, N. Bruzelius and W. Rothengatter. Megaprojects and Risk: An Anatomy of Ambition . Cambridge: Cambridge University Press 2003. 207 pp. *International Journal of Public Sector Management*, *17*(3), 275–277. https://doi.org/10.1108/09513550410530199

Carpintero, S., & Siemiatycki, M. (2016). The politics of delivering light rail transit projects through public-private partnerships in Spain: A case study approach. *Transport Policy*, *49*, 159–167. https://doi.org/10.1016/j.tranpol.2016.05.001

Chang, C.-W. (2014). Develop a ranking algorithm for the green building project. *Quality & Quantity*, *48*(2), 911–921. https://doi.org/10.1007/s11135-012-9812-2

Chapman, C. B., & Cooper, D. F. (1983). Risk Engineering: Basic Controlled Interval and Memory Models. *Journal of the Operational Research Society*, *34*(1), 51–60. https://doi.org/10.1057/jors.1983.7

Cui, S., Niu, H., Wang, W., Zhang, G., Gao, L., & Lin, J. (2010). Carbon footprint analysis of the Bus Rapid Transit (BRT) system: a case study of Xiamen City. *International Journal of Sustainable Development & World Ecology*, *17*(4), 329–337. https://doi.org/10.1080/13504509.2010.490657

Davis, K. (2014). Different stakeholder groups and their perceptions of project success. *International Journal of Project Management*, *32*(2), 189–201. https://doi.org/10.1016/j.ijproman.2013.02.006

De Massis, A., & Kotlar, J. (2014). The case study method in family business research: Guidelines for qualitative scholarship. *Journal of Family Business Strategy*, *5*(1), 15–29. https://doi.org/10.1016/j.jfbs.2014.01.007

Deng, X., Low, S. P., Li, Q., & Zhao, X. (2014). Developing Competitive Advantages in Political Risk Management for International Construction Enterprises. *Journal of Construction Engineering and Management*, *140*(9), 04014040. https://doi.org/10.1061/(ASCE)CO.1943-7862.0000836

Dikmen, I., Birgonul, M. T., & Han, S. (2007). Using fuzzy risk assessment to rate cost overrun risk in international construction projects. *International Journal of Project Management*, *25*(5), 494–505. https://doi.org/10.1016/j.ijproman.2006.12.002

Dumbrava, V. (2013). Using Probability – Impact Matrix in Analysis and Risk Assessment Projects. *Journal of Knowledge Management, Economics and Information Technology*, (Special Issue), 76–96. Retrieved from http://www.scientificpapers.org/wp-content/files/07_Dumbrava_Iacob-USING_PROBABILITY__IMPACT_MATRIX_IN__ANALYSIS_AND_RISK_ASSESSMENT_PROJECTS.pdf

Eveleens, J. L., & Verhoef, C. (2010). The rise and fall of the Chaos report figures. *IEEE Software*, *27*(1), 30–36. https://doi.org/10.1109/MS.2009.154

Fang, C., & Marle, F. (2012). A simulation-based risk network model for decision support in project risk management. *Decision Support Systems*, *52*(3), 635–644. https://doi.org/10.1016/j.dss.2011.10.021

Floyd, M. K., Barker, K., Rocco, C. M., & Whitman, M. G. (2017). A Multi-Criteria Decision Analysis Technique for Stochastic Task Criticality in Project Management. *Engineering Management Journal*, *29*(3), 165–178. https://doi.org/10.1080/10429247.2017.1340038

Flyvbjerg, B., Bruzelius, N., & Rothengatter, W. (2003). *Megaprojects and Risk*. *Megaprojects and Risk: An Anatomy of Ambition*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9781107050891

Hastak, M., & Shaked, A. (2000). ICRAM-1: Model for International Construction Risk Assessment. *Journal of Management in Engineering*, *16*(1), 59–69. https://doi.org/10.1061/(ASCE)0742-597X(2000)16:1(59)

Hearst, M. A., & Rosner, D. (2008). Tag Clouds: Data Analysis Tool or Social Signaller? In *Proceedings of the 41st Annual Hawaii International Conference on System Sciences (HICSS 2008)* (pp. 160–160). IEEE.

https://doi.org/10.1109/HICSS.2008.422

Hussain, F. (2017). *Annual Report Economic Review*. *State Bank of Pakistan*. karachi. Retrieved from http://www.sbp.org.pk/reports/annual/arFY17/Anul-index-eng-17.htm

Hutchison, A. J., Johnston, L. H., & Breckon, J. D. (2010). Using QSR‐ NVivo to facilitate the development of a grounded theory project: an account of a worked example. *International Journal of Social Research Methodology*, *13*(4), 283–302. https://doi.org/10.1080/13645570902996301

Iswalt, M., Wong, C., & Connolly, K. (2011). Innovative Operating Solutions for Bus Rapid Transit through a Congested Segment of San Jose, California. *Transportation Research Record: Journal of the Transportation Research Board*, *2218*(1), 27–38. https://doi.org/10.3141/2218-04

Kangari, R., & Riggs, L. S. (1989). Construction risk assessment by linguistics. *IEEE Transactions on Engineering Management*, *36*(2), 126–131. https://doi.org/10.1109/17.18829

Koskela, L., & Howell, G. (2008). The Underlying Theory of Project Management Is Obsolete. *IEEE Engineering Management Review*, *36*(2), 22–34. https://doi.org/10.1109/EMR.2008.4534317

Lin, L.-Z., & Hsu, T.-H. (2008). The Qualitative and Quantitative Models for Performance Measurement Systems: The Agile Service Development. *Quality and Quantity*, *42*(4), 445–476. https://doi.org/10.1007/s11135-006-9053-3

Liu, J., Zhao, X., & Yan, P. (2016). Risk Paths in International Construction Projects: Case Study from Chinese Contractors. *Journal of Construction Engineering and Management*, *142*(6), 05016002. https://doi.org/10.1061/(ASCE)CO.1943-7862.0001116

Lodhi, R. N., & Malik, R. K. (2013). Impact of Electricity Shortage on Daily Routines: A Case Study of Pakistan. *Energy & Environment*, *24*(5), 701–709. https://doi.org/10.1260/0958-305X.24.5.701

McNamara, I., Zimmerman, S., Orosz, T., Levinson, H., & Sampson, D. (2006). Bus Rapid Transit in New York City: Corridor Evaluation and Screening. *Transportation Research Record: Journal of the Transportation Research Board*, *1971*(1), 3–13. https://doi.org/10.3141/1971-03

Mishra, S., Welch, T. F., & Jha, M. K. (2012). Performance indicators for public transit connectivity in multi-modal transportation networks. *Transportation Research Part A: Policy and Practice*, *46*(7), 1066–1085. https://doi.org/10.1016/j.tra.2012.04.006

Müller, R., Martinsuo, M., & Blomquist, T. (2008). Project Portfolio Control and Portfolio Management Performance in Different Contexts. *Project Management Journal*, *39*(3), 28–42. https://doi.org/10.1002/pmj.20053

Mustafa, M. A., & Al-Bahar, J. F. (1991). Project risk assessment using the analytic hierarchy process. *IEEE Transactions on Engineering Management*, *38*(1), 46–52. https://doi.org/10.1109/17.65759

Olaniran, O. J., Love, P. E. D., Edwards, D., Olatunji, O. A., & Matthews, J. (2015). Cost Overruns in Hydrocarbon Megaprojects: A Critical Review and Implications for Research. *Project Management Journal*, *46*(6), 126–138. https://doi.org/10.1002/pmj.21556

Park, J., Park, B., Cha, Y., & Hyun, C. (2016). Risk Factors Assessment Considering Change Degree for Mega-projects. *Procedia - Social and Behavioral Sciences*, *218*, 50–55. https://doi.org/10.1016/j.sbspro.2016.04.009

Park, K., Lee, H. W., Choi, K., & Lee, S.-H. (2017). Project Risk Factors Facing Construction Management Firms. *International Journal of Civil Engineering*, *0*(0), 0. https://doi.org/10.1007/s40999-017-0262-z

Pehlivan, S., & Öztemir, A. E. (2018). Integrated Risk of Progress-Based Costs and Schedule Delays in Construction Projects. *Engineering Management Journal*, *30*(2), 108–116. https://doi.org/10.1080/10429247.2018.1439636

PMI. (2013). *A guide to the project management body of knowledge (PMBOK ® guide)*. *Project Management Institute*. https://doi.org/10.1002/pmj.20125

Ponelis, S. R. (2015). Using Interpretive Qualitative Case Studies for Exploratory Research in Doctoral Studies: A Case of Information Systems Research in Small and Medium Enterprises. *International Journal of Doctoral Studies*, *10*, 535–550. https://doi.org/10.28945/2339

Rodney, T. J. (2004). Five necessary conditions for project success. *International Journal of Project Management*, *22*(5), 349–350. https://doi.org/10.1016/j.ijproman.2004.02.001

Salling, K. B., & Leleur, S. (2015). TRANSPORT PROJECT EVALUATION: FEASIBILITY RISK ASSESSMENT AND SCENARIO FORECASTING. *Transport*, *32*(2), 180–191. https://doi.org/10.3846/16484142.2015.1063003

Sjöberg, L. (2000). The methodology of risk perception research. *Quality & Quantity*, *34*(4), 407–418. https://doi.org/10.1023/A:1004838806793

Song, Y. W., Kim, J. D., Yu, L., Lee, H. K., & Lee, H. S. (2012). A comparative study of the telematics industry in Korea and China. *Journal of Internet Banking and Commerce*, *17*(1), 97–112. https://doi.org/10.1002/pmj.21558

Taroun, A. (2014). Towards a better modelling and assessment of construction risk: Insights from a literature review. *International Journal of Project Management*, *32*(1), 101–115. https://doi.org/10.1016/j.ijproman.2013.03.004

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

Xu, W., & Lin, W. (2016). Selecting the public transit projects with PCA-DP technique: The example of Xiamen City. *Transport Policy*, *46*, 56–71. https://doi.org/10.1016/j.tranpol.2015.11.002

Yang, L.-R., Chen, J.-H., Wu, K.-S., Huang, D.-M., & Cheng, C.-H. (2015). A framework for evaluating relationship among HRM practices, project success and organizational benefit. *Quality & Quantity*, *49*(3), 1039–1061. https://doi.org/10.1007/s11135-014-0033-8

Zhi, H. (1995). Risk management for overseas construction projects. *International Journal of Project Management*, *13*(4), 231–237. https://doi.org/10.1016/0263-7863(95)00015-I.

Mr. Farman Afzal is a Ph.D. scholar in School of Management and Economics, University Electronic Science and Technology of China. Mr. Farman is serving as a lecturer in Institute of Business & Management, University of Engineering and Technology Lahore, Pakistan. He received his Master Degree in Management Sciences from SZABIST, Pakistan. His research interests are Operations Management, and Project Complexity & Risk.

Professor Dr. Shao Yunfei received her Ph.D. and MS. degree from the University Electronic Science and Technology of China (UESTC). She is a Professor in School of Management and Economics of (UESTC). Her research interests are Strategic Management and Innovation Management.

Mr. Muhammad Sajid is a Doctoral Candidate at the School of Management, Royal Holloway, University of London, United Kingdom. Besides, Mr. Sajid is serving as a Lecturer in Finance at the Lyallpur Business School, Government College University Faisalabad, Pakistan. He received his M.S. from the Air University (Pakistan). Mr. Sajid's research interests are: Behavioural Finance, Corporate Finance, Financial Markets, and Operations Research.

Mr. Fahim Afzal is a Ph.D. scholar in Business School of Hahai University Nanjing. He received his Master Degree in Management Science and Engineering from Business School of Hahai University. His research area is Project Risk Management.