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Identification of major construction sector risks in Saudi Arabia

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ABSTRACT: Construction companies must differentiate between risks and opportunities, and aim to take advantage of the available opportunities to increase profits and avoid or mitigate risks to reduce any possible losses. The objective of this article is to report on comprehensive research undertaken to identify the critical risks associated with the construction industry in Saudi Arabia. The construction industry is one of the most important industries in Saudi Arabia with an annual growth of 4.5% and a total value of more than $30 billion. The study used quantitative methods based on a questionnaire survey to collect the required information on risks from construction industry experts working on several projects around the Kingdom. The outcome of the study indicated that economic and political risks have the highest impact on the implementation and success of construction projects in Saudi Arabia. Also, the risks of delayed payment to the contractors and unreasonably imposed tight deadlines are the two risks having the highest ranking among all the construction risks.

INTRODUCTION

Due to phenomenal growth in size and an increase in the level of complexity, the businesses all over the world are becoming riskier. The construction industry is no exception in terms of inherent risks. However, there are few factors due to which construction projects are considered risker than other businesses. First of all, there are a large number of parties involved in construction projects, which include the owners, contractors, sub-contractors, suppliers, workers, designers, etc. Interestingly, it may also involve a temporarily assembled team with a diverse business, cultural and country background. The identification and management of risk associated with such a diverse and large number of human factors are vital. Furthermore, most of the construction projects are a large dollar or mega investments which are done once in a while.

Such megaprojects may include infrastructure projects like transportation systems, bridges, dams, irrigation systems, ports, airports, oil pipelines, as well as buildings, such as residential and commercial, including skyscrapers. The identification and management of risk for such large megaprojects are critical since any risk related to design change and material quality may affect the cost, quality and completion timing of such projects [1]. Another distinctive aspect of the construction project is the completion time, which is normally extensive. So, there is always a likelihood of change in laws, regulation, political, social, economic and financial conditions, especially in the country where the project is to be undertaken. Hence, there is a good amount of probability that the construction project might face political, economic, regulatory or financial risks.

Overall, due to the multi-phenomenal nature of the construction projects, they are exposed to several types of risks, which may include financial, cost-related, operational, safety, contractual or human risks, etc. So, the success of construction projects may confront many challenges, hurdles and risks, and it depends on prudent management of these factors. The management of construction risks can be complicated, but it is not impossible. The probability of risks when turns into reality can delay or even derail a project. To avoid disaster, one needs to be able to properly assess, control and monitor risks, once these are identified [2], while considering that project success is defined as the degree to which the goals and objectives of the project are achieved after implementation. Since construction projects are one of the highest and largest projects worldwide, scholars are interested in discovering factors behind project failure. These factors generally are related to under-budgeting, cost and schedule overruns caused by improper scope definition and inability to meet the client's expectations and requirements. Many reasons are identified as the root causes of these failures, such as technological failures, project complexity, safety, health, inadequate management and lack of communication [3].

It is generally accepted that the construction industry of any country has a significant positive impact on the national economy of that country. As per the 2018 report of the United Nations Economic Commission for Europe (UNECE), the contribution of the construction sector in GDP terms was 10.4%. The construction sector in the Kingdom of Saudi Arabia (KSA) is growing, and it represents around 6% of total Saudi Arabia's gross domestic product (GDP). Besides, the Saudi government has also consistently helped and promoted the construction industry by adopting policies and procedures to increase the investment in the sector, and to ensure sustained diversification. Quick and vast improvements in the industry, especially in the housing market added value, and the construction industry in the country kept flourishing. The last decade has witnessed a special growth in the construction industry of the KSA, mainly due to several factors, such as the high demand caused by Saudi industry strategic directions to develop and enhance the country's basic infrastructures, which include roads, bridges, universities, sports facilities, residential housing and government office complexes. The majority of these projects are executed through a public-private partnership (PPP) contracts. Besides, due to the vision 2030, the Saudi government plans to realise a large number of huge capital projects introduced in the recent few years in co-operation between both the public and private sectors of the industry. These projects are attracting many national, regional and international construction companies and investors [4]. Furthermore, the construction industry of Saudi Arabia is also a large source of employment and it covers around 15% of the country's total workforce [5].

Another extraordinary change that the KSA construction industry has recently witnessed are the economic diversification efforts by the government. To reduce the oil dependence, the government is focusing on tourism, commercial and industrial activities. Furthermore, as part of the vision 2030, the Saudi government intends to invest more in social and economic infrastructures with capital projects on transportation, hotel, residential accommodation and energy infrastructures in the coming few years [6].

This new upsurge in the construction sector based on the number and complexity of projects may create an extra burden on the involved parties and it may increase the risk. Therefore, any effort to identify and access major risks prevailing in the KSA construction industry is not only important for local parties involved, but also important for international parties working or planning to work in the Saudi construction sector. Hence, the main objective of this article is to identify and assess the significant risks factor prevailing in the construction sector of the KSA. The authors of this article not only identify the risks in the light of previous literature, but also rank it according to the impact and severity. There was a need for a study highlighting the main risk in the Saudi construction sector. Such research is available for other countries; for example, Kangari for the USA [7], Ahmed et al for Hong Kong [8], Kartam and Kartam for Kuwait [9], Wang and Chou for Taiwan [10], Fang et al for China [11], Andi for Indonesia [12], and Ling and Hoi for India [13].

On the other hand, the studies on the Saudi construction sector were either limited in scope or were conducted before the announcement of the vision 2030. For example, Baghdadi and Kishk targeted aviation construction projects in the KSA [14], while Albogamy et al targeted only the delay factors in the KSA and Jordanian construction industries [15]. Alrashed et al provides the linear framework for risk decision making and its application in the Saudi context [16]. Keeping in view these previous studies, there was a need for a more recent study covering comprehensive aspects of the risks in the KSA construction sector. Hence, this study attempts to highlight the risks predominant in the overall KSA construction industry. Risk assessment and identification is extremely important for the management of high investment projects involving long time frame and number of parties.

The study is organised as follows, the next section covers the design and methodology of the research. The further section provides details on the analysis and findings of the conducted study and list the major risks with construction projects in Saudi Arabia. Whereas the last section provides a conclusion of the research.

METHODOLOGY

The research skims through a summarised analysis of all available relevant studies of the project execution in the construction industry of Saudi Arabia. This covers a variety of construction projects undertaken across multiple regions within the Kingdom. The study is based mainly on the quantitative research method (survey), which provided analyses and findings based on responses collected from industry experts. The study used a questionnaire-based research design and identifies all major risks in construction projects in the KSA. Using the existing literature, a comprehensive list of risks in the construction projects is prepared. The list is divided into two main parts, the internal and external risks. Each of these two types of risks further contains four subcategories. So in total, the authors targeted eight major risk types in the questionnaire. The internal risks include owners' risk factors, contractors and designers' factors, suppliers' risk factors and financial risk factors. Whereas the targeted external risks include political risk factors, cultural risk factors, economic risk factors and natural risk factors.

The questionnaire used is divided into three parts. The first part includes demographic variables that are important to analyse responses according to participants' position, experience, region and type of the project. Part two enquires about the internal risk factors and part three inquiries about external risk factors. Although the questionnaire was adapted from the already published research by El-Sayegh [17], still the authors sent it to academic and industry professionals for further validity checks in the KSA market. After their recommendation, the questionnaire was finalised by making some changes. The final version of the questionnaire was distributed to various major construction companies of Saudi Arabia targeting employees, consultants and contractors. The sample includes all relevant stakeholders in construction projects covering all regions within Saudi Arabia. It is used to measure the level of risks from the point of view, experience and location of several parties of the construction project. The questionnaire was sent to more than 300 potential respondents from various construction companies using QuestionPro. The authors received a total of 126 responses out of which 11 incomplete responses were excluded. The 115 responses were finalised for further analysis which makes the response rate of approximately 38%.

Friedman's test has been widely used in literature for the ranking of various risks [18]. The Friedman correlation is the non-parametric test, which is an alternative of randomised block designs. The test is considered as very useful when data are ranked with each block [19]. Similarly, Kendall's W test is used as an explanation to the problem for agreement testing among *m* sets of rankings of *k* objects, which is intimately related to Friedman's two-way analysis of variance by ranks [20]. Kendell's W is proportional to the rank correlation average of all pairs of ranking in a group [21]. Both the tests have a null hypothesis that there is no difference among the ranks of all pairs of rankings.

Exploratory factor analysis (EFA) is also done on the data to explore the relationship among the variables, while confirmatory factor analysis (CFA) is a type of structural equation modelling that deals with measurement models [22]. CFA is used when one does not have a priori fixed number of actors, while EFA is used to verify the factor structure of a set of observed variables, and Harrington described CFA as a multipurpose analysis [23]. EFA is used for the development of new measures, evaluation of the psychometric properties of new measures, the examination of method effects, examining construct validation, measurement of invariant or unchanging across groups, populations or time. In EFA, the number of factors to extract is to find the number of factors that are responsible for the maximum variance in the data. Kaiser's criterion considers factors with an eigenvalue greater than one as common factors [24]. Cattell mentioned that in the scree plot of EFA each factor explains less variance than the preceding factors, with a straight line connecting the markers for the following factors [25].

ANALYSIS AND FINDINGS

After data screening of 126 responses, 115 responses were analysed for descriptive statistics and analysis. Eleven responses were incomplete and were not considered for data analysis. Table 1 shows the descriptive statistics for 115 respondents. Most of the respondents in this sample are males (97.39%), which demonstrates a relatively low number of female professionals in the construction sector of Saudi Arabia. As shown in Table 1, the sample contains a fair distribution of respondents from the contractors, clients and consultants. The majority of the respondents are having experience of 11-20 years (53%), while 16.5% are having experience of 21-30 years. 53.9% of the respondents represent companies that are involved in construction projects in the eastern region, while 37.4% of the respondents belong to construction projects all over the Kingdom. There is comparatively less representation of respondents from the western or central region construction projects. 65.2% of the respondents belong to construction companies, which are involved in government projects, while 72% of the respondents are graduates from a university.

Table 1: Demographic statistics.

Characteristics	Categories	Frequency	Percent
Gender	Male	112	97.39
	Female	03	2.61
	Total	115	100
Position in company	Owner	08	6.95
	Management	46	40
	Contractor	13	11.3
	Team member	43	37.4
	Other	05	4.34
	Total	115	100
Years of experience in construction business	Less than 10 years	31	2.7
	11-20 years	61	53
	21-30 years	19	16.5
	31-40 years	03	2.6
	More than 40 years	01	0.87
	Total	115	100
Region	Kingdom-wide	43	37.4
	Eastern region	62	53.9
	Western region	07	6.1
	Central region	03	2.6
	Total	115	100
Type of project	Government project	75	65.2
	Private project	40	34.7
	Total	115	100
Qualification	No formal education	01	0.86
	Primary	00	00
	Secondary	15	13.1
	Graduate	83	72.1
	Masters or more	16	13.9
	Total	115	100

The results of the Friedman test and its test statistics are shown in Table 2.

Table 2: Friedman test.

S. No.	Risk	Mean rank
1	Delayed payment to contractors	18.41
2	Unreasonably imposed tight deadlines	17.74
3	Frequent design changes	17.67
4	Delay in obtaining site access	15.49
5	Defective design	18.21
6	Construction accidents	13.71
7	Technical problems	16.82
8	Contractor incompetence	19.02
9	Lack of skilled staff	19.54
10	Breach of contract	14.13
11	Labour strikes	11.58
12	Material quality problems	15.75
13	Delay of material supply	17.33
14	Delay in payments due to cash flow	21.57
15	Delay in payments due to management approval	17.75
16	Unclear financial roles and responsibilities among stakeholders	16.66
17	Difficulty in insurance claims	14.01
18	Change in laws	17.02
19	Corruption and briberies	13.35
20	Delay in public sector approvals	19.09
21	War threats	13.01
22	Saudisation and local protectionism	20.84
23	Conflicts due to cultural issues	10.83
24	Criminal acts	8.01
25	Oil price fluctuations and government spending cuts	17.51
26	Inflation and price fluctuations	16.76
27	Material and equipment availability	16.31
28	Weather conditions	12.64
29	Natural disasters	9.71

Table 3: Test statistics.

N	106
Chi-square	668.097
Df	28
Asymp. sig.	0.000

a. Friedman test

Table 3 shows the mean rank of all 29 risks present in the construction sector of Saudi Arabia. The *p*-value of the test shows that there are significant differences among the ranks of the risks, and the null hypothesis is rejected. The alternate hypothesis is accepted, and there is a significant difference among the ranks of all risks. Table 4 shows the ten most important risks ranked as per Friedman test. The delay in payments due to cash flows and Saudisation and local protection are considered as the two most important risks having the highest ranks among all the risks in the construction sector.

Table 4: Ten most import risks as per Friedman test criteria.

S. No.	Risk	Mean rank
1	Delayed payment to contractors	21.57
2	Unreasonably imposed tight deadlines	20.84
3	Frequent design changes	19.54
4	Delay in obtaining site access	19.09
5	Defective design	19.02
6	Construction accidents	18.41
7	Technical problems	18.21
8	Contractor incompetence	17.75
9	Lack of skilled staff	17.74
10	Breach of Contract	17.67

The results of Kendall's W test are shown in Table 5. It shows the mean rank of all the 29 risks present in the construction sector of Saudi Arabia. The *p*-value of the test shows that there are differences among the ranks of the risks, and hence, the null hypothesis is rejected. The alternate hypothesis is accepted, and there is a significant difference among the ranks of all risks.

Table 5: Kendall’s W test.

S. No.	Risk	Mean rank
1	Delayed payment to contractors	18.41
2	Unreasonably imposed tight deadlines	17.74
3	Frequent design changes	17.67
4	Delay in obtaining site access	15.49
5	Defective design	18.21
6	Construction accidents	13.71
7	Technical problems	16.82
8	Contractor incompetence	19.02
9	Lack of skilled staff	19.54
10	Breach of contract	14.13
11	Labour strikes	11.58
12	Material quality problems	15.75
13	Delay of material supply	17.33
14	Delay in payments due to cash flow	21.57
15	Delay in payments due to management approval	17.75
16	Unclear financial roles and responsibilities among stakeholders	16.66
17	Difficulty in insurance claims	14.01
18	Change in laws	17.02
19	Corruption and Briberies	13.35
20	Delay in public sector approvals	19.09
21	War threats	13.01
22	Saudisation and local protectionism	20.84
23	Conflicts due to cultural issues	10.83
24	Criminal acts	8.01
25	Oil price fluctuations and government spending cuts	17.51
26	Inflation and price fluctuations	16.76
27	Material and equipment availability	16.31
28	Weather conditions	12.64
29	Natural disasters	9.71

Table 6: Test statistics.

N	106
Kendall’s W[a]	0.217
Chi-square	668.097
Df	29
Asymp. sig.	0.000

a. Kendall’s coefficient of concordance

Table 7 shows the ten most important risks ranked as per Kendall’s W test. The delay in payments due to cash flows, and Saudisation and local protection are considered as two most important risks having the highest ranks among all the risks in the construction sector.

Table 7: Ten most important risks as per Kendall’s W rank test.

S. No.	Risk	Mean rank
1	Delay in payments due to cash flow	21.57
2	Saudisation and local protectionism	20.84
3	Lack of skilled staff	19.54
4	Delay in public sector approvals	19.09
5	Contractor incompetence	19.02
6	Delayed payment to contractors	18.41
7	Defective design	18.21
8	Delay in payments due to management approval	17.75
9	Unreasonably imposed tight deadlines	17.74
10	Frequent design changes	17.67

Table 8: Comparison of two tests.

S. No.	Friedman test	Kendall's W test
1	Delayed payment to contractors	Delay in payments due to cash flow
2	Unreasonably imposed tight deadlines	Saudisation and local protectionism
3	Frequent design changes	Lack of skilled staff
4	Delay in obtaining site access	Delay in public sector approvals
5	Defective design	Contractor incompetence
6	Construction accidents	Delayed payment to contractors
7	Technical problems	Defective design
8	Contractor incompetence	Delay in payments due to management approval
9	Lack of skilled staff	Unreasonably imposed tight deadlines
10	Breach of contract	Frequent design changes

Table 8 shows the comparison of the ten most important risks as per the Friedman test and Kendall's W test. While comparing 10 most important risks as per both tests, the authors found that five construction risks are common in both tests and they are the following:

1. Delayed payment to contractors.
2. Unreasonably imposed tight deadlines.
3. Frequent design changes.
4. Defective design
5. Lack of skilled staff.

All these five risks are owners' factors, contractors' and design factors, which have the highest ranking among all the risks present in the construction industry of Saudi Arabia.

Table 9: KMO and Bartlett's test.

Kaiser-Meyer-Olkin measure of sampling adequacy		0.811
Bartlett's test of sphericity	Approx. chi-square	1778.191
	Df	406
	Sig.	0.000

Kaiser-Meyer-Olkin (KMO) and Bartlett's tests for exploratory factor analysis (EFA) results are given in Table 9. The KMO measure of sampling adequacy has a value of 0.811, which is well above the minimum value. Bartlett's test of sphericity has a *p*-value significant at a 99% confidence level.

Table 10 shows the total variance explained by five components or factors. The table shows that the five components explain around 59.94% of the variance in the model, which is quite satisfactory for the results as some more components have eigenvalue more than 1, but heir explanation of variation is low. All these five components have an eigenvalue of more than 1.

Table 10: Total variance explained.

Component	Initial eigenvalues			Extraction sums of squared loadings			Rotation sums of squared loadings		
	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %	Total	Variance %	Cumulative %
1	9.531	32.866	32.866	9.531	32.866	32.866	5.352	18.457	18.457
2	2.836	9.779	42.645	2.836	9.779	42.645	4.886	16.850	35.306
3	1.891	6.521	49.166	1.891	6.521	49.166	3.486	12.020	47.326
4	1.585	5.467	54.633	1.585	5.467	54.633	2.041	7.037	54.363
5	1.540	5.309	59.943	1.540	5.309	59.943	1.618	5.580	59.943
6	1.432	4.937	64.880						
7	1.075	3.707	68.587						
8	0.979	3.376	71.963						
9	0.793	2.736	74.698						
10	0.758	2.613	77.312						
11	0.720	2.484	79.796						
12	0.650	2.241	82.037						
13	0.632	2.181	84.218						
14	0.539	1.858	86.076						
15	0.497	1.713	87.789						

16	0.470	1.622	89.411						
17	0.431	1.487	90.897						
18	0.404	1.395	92.292						
19	0.351	1.211	93.503						
20	0.317	1.093	94.595						
21	0.262	0.905	95.500						
22	.250	0.862	96.362						
23	0.222	0.767	97.129						
24	0.199	0.688	97.817						
25	0.179	0.617	98.434						
26	0.141	0.487	98.921						
27	0.115	0.397	99.319						
28	0.106	0.366	99.685						
29	0.091	0.315	100.000						

Note: Extraction method: principal component analysis

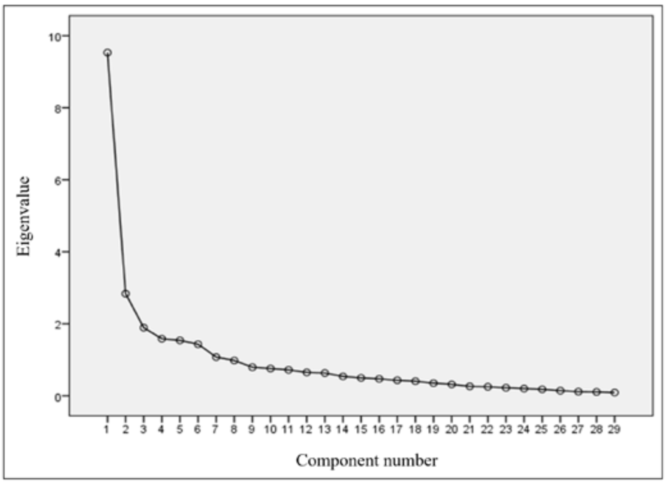

Figure 1: Scree plot.

Figure 1 shows the scree plot of the components and their eigenvalues. The figure shows that all 5 components are having an eigenvalue of more than 1, which satisfies the criteria given by Cattell [25].

Table 11 shows the rotated component matrix for EFA analysis. It shows that the first component has a loading of more than 0.60 on the following five risks: war threats, inflation and price fluctuations, oil price fluctuations and government spending cuts, criminal acts and change in laws. One can call this component political and economic risks.

The second component of the rotated matrix shows the loading of more than 0.60 on the following five risks: contractor incompetence, defective design, material quality problems, construction accidents, and a lack of skilled staff. One can call this component contractor and design risks. The third component of the rotated matrix shows the loading of more than 0.60 on the following three risks: delay in payments due to cash flow, delay in payments due to management approval, unclear financial roles and responsibilities among stakeholders. One can call them financial risks. The fourth component of the rotated matrix shows the loading of more than 0.60 on the following two risks: weather conditions and natural disasters. One can call them natural risks. The last and fifth component of the rotated matrix is having a loading of more than 0.60 on only one risk and that is a delay of material supply, and one can call this component the supply chain risks.

Table 11: Rotated component matrix.

Risks	Component				
	1	2	3	4	5
War threats	0.818				
Inflation and price fluctuations	0.806				
Oil price fluctuations and government spending cuts	0.761				
Criminal acts	0.732				
Change in laws	0.629				
Conflicts due to cultural issues					
Delay in public sector approvals					
Saudisation and local protectionism					
Corruption and briberies					
Material and equipment availability					

Contractor incompetence		0.803			
Defective design		0.740			
Material quality problems		0.630			
Construction accidents		0.623			
Lack of skilled staff		0.618			
Frequent design changes					
Technical problems					
Labour strikes					
Unreasonably imposed tight deadlines					
Delayed payment to contractors					
Delay in payments due to cash flow			0.783		
Delay in payments due to management approval			0.783		
Unclear financial roles and responsibilities among stakeholders			0.657		
Delay in obtaining site access					
Difficulty in insurance claims					
Weather conditions				0.657	
Natural disasters				0.652	
Breach of contract					
Delay of material supply					0.762

Note: Extraction method: principal component analysis
Rotation method: Varimax with Kaiser normalisation

IMPLICATIONS FOR ENGINEERING EDUCATION

In this research, the authors discuss the risk management in construction projects, which is an important managerial process for the achievement of the project’s objectives. Construction engineers who are one of the leading stakeholders in the projects also require the active assessment and management of risk. Hazards need to be identified, and the consequences and probabilities analysed beforehand in the construction projects. If the risk falls in the acceptable limit, then the activity must continue with essential risk monitoring and control measures. If the risk falls beyond the acceptable level, the project activity may not be undertaken.

In nutshell, the engineering profession also requires a good understanding and management of risk practices. Prudent risk management practices are particularly important in civil/construction engineering education since capital intensive and long duration projects undertaken by future engineers involve a variety of risks in terms of time, costs, quality, safety and environmental sustainability. That is why the domain of risk management has been included in the curriculum by many engineering institutions across the world. This study has perceptible implications for engineering education since it highlights the key risks in the growing construction sector of an emerging economy, with the largest oil revenue in the world.

CONCLUSIONS

The objective of this research was to identify the critical risks in the construction industry of Saudi Arabia covering both private and public sector projects. The undertaken risk analysis covered both specific and general risks faced in the industry, which includes a long list of interested and relevant entities, such as owners, contractors, vendors, managers and employees in the Saudi construction sector. Furthermore, the identification of risks is a very critical step and considered as the first phase of the standard risk management process, which aims to define the critical risks that can impact the project success and the organisation’s performance, and hinder its ability to achieve its objectives and goals.

The article consists of a comprehensive analysis conducted on the Saudi construction companies working on both international and national projects that can be either public or private funded. The results of the study provided clarity on the major and critical risks that have the highest impact on construction projects in Saudi Arabia. These risks are categorised as either internal or external risks. Internal risks are related to the company’s capabilities and cover different aspects, such as financial liquidity, people, technology, operational and supply-chain related factors. On the other hand, external risks are related to factors that are not under the control of the company, such as government regulations, economic conditions, natural disasters and political factors.

The ranking of risk results confirmed that three major construction risks include delayed payment to contractors, unreasonably imposed tight deadlines and frequent design changes. The results are in line with the study by Rostami and Oduoza for the Italian market [26]. As mentioned earlier, their study identifies delay in payments, cost overrun, funding problems, tight deadline and client variations as the main risks existing in the construction sector of Italy.

The outcome of this research indicated that political and economic risks have the highest impact on the implementation and success of construction projects in Saudi Arabia. These risks include inflation, oil price fluctuation, delay in payments and financial risks that will lead to over-schedule and over-budget situations affecting the project. Similar types of seven risks are identified by Khodeir and Mohamed for Egyptian construction projects including changes in tax, change of energy cost, official changes and workers strikes [27]. These results are also in line with the work of Omran and Abdulrahim, who confirmed that the three most ranked significant factors in Libyan building firms are variation by the client, tight schedules and lack of enough trained professional managers [28]. On the other hand, Deng et al discussed that political risk is the biggest risk in Chinese international construction projects [29]. These results are also consistent with the findings of Fernando et al, who found that variation in material prices is the most significant risk for the contractors of Sri Lanka [30].

Furthermore, this study is an attempt to highlight the main risks prevailing in the growing construction industry of the KSA. The identification and assessment of risk factors are critical for the overall risk management of the projects, and useful for the involved parties. It is anticipated that this study will provide good insight into the involved risks in the sector for international companies. Whereas, the local companies may get assistance in proper risk allocation in contract negotiation. Finally, it is hoped that this study will also help in decision making regarding risk response planning and control; and may have a strong impact on the education process.

REFERENCES

1. Thompson, P.A. and Perry, J.G., *Engineering Construction Risks: a Guide to Project Risk Analysis and Assessment Implications for Project Clients and Project Managers*. Thomas Telford (1992).
2. Wang, S.Q., Dulaimi, M.F. and Aguria, M.Y., Risk management framework for construction projects in developing countries. *J. of Construc. Manage. and Economics*, 22, **3**, 237-252 (2004).
3. Ikediashi, D.I., Ogunlana, S.O. and Alotaibi, A., Analysis of project failure factors for infrastructure projects in Saudi Arabia: a multivariate approach. *J. of Construc. in Developing Countries*, 19, **1**, 35 (2014).
4. Al-Otaibi, M. and Price, A.D., Analysis and evaluation of criteria for pre-selecting contractors in the Saudi Arabian construction sector. In: Egbu, C. (Ed), *Proc. 26th Annual ARCOM Conf.,* 6-8 September 2010, Leeds, UK, Association of Researchers in Construction Management, 1141-1148 (2010).
5. Al Haadir, S. and Panuwatwanich, K., Critical success factors for safety program implementation among construction companies in Saudi Arabia. *Procedia Engng.*, 14, 148-155 (2011).
6. Elawi, G.S.A., Algahtany, M. and Kashiwagi, D., Owners' perspective of factors contributing to project delay: case studies of road and bridge projects in Saudi Arabia. *Procedia Engng*., 145, 1402-1409 (2016).
7. Kangari, R., Risk management perceptions and trends of US construction. *J. of Construc. Engeg. and Manage.*, 121, **4**, 422-429 (1995).
8. Ahmed, S.M., Ahmad, R. and De Saram, D.D., Risk management trends in the Hong Kong construction industry: a comparison of contractors and owners perceptions. *Engng., Construc. and Architectural Manage.,* 6, **3**, 225-234 (1999).
9. Kartam, N.A. and Kartam, S.A., Risk and its management in the Kuwaiti construction industry: a contractors' perspective. *Inter. J. of Project Manage.*, 19, **6**, 325-335 (2001).
10. Wang, M.T. and Chou, H.-Y., Risk allocation and risk handling of highway projects in Taiwan. *J. of Manage. Engng.*, 19, **2**, 60-68 (2003).
11. Fang, D., Li, M., Fong, P.S.-W. and Shen, L., Risks in Chinese construction market - contractors' perspective. *J. of Construc. Engng. and Manage.*, 130, **6**, 853-861 (2004).
12. Andi, The importance and allocation of risks in Indonesian construction projects. *Construc. Manage. Economics,* 24, **1**, 69-80 (2006).
13. Ling, F.Y.Y. and Hoi, L., Risks faced by Singapore firms when undertaking construction projects in India. *Inter. J. of Project Manage.*, 24, **3**, 261-270 (2006).
14. Baghdadi, A. and Kishk, M., Saudi Arabian aviation construction projects: identification of risks and their consequences. *Procedia Engng*., 123, 32-40 (2015).
15. Albogamy, A., Scott, D., Dawood, N. and Bekr, G., Addressing crucial risk factors in the Middle East construction industries: a comparative study of Saudi Arabia and Jordan. *Sustainable Building Conf.*, Coventry University, West Midlands, UK (2013)
16. Alrashed, I., Alrashed, A., Taj, S.A. and Kantamaneni, M.P.A.K., Risk assessments for construction projects in Saudi Arabia. *Research J. of Manage. Sciences*, 3, **7**, 1171 (2014).
17. El-Sayegh, S.M., Risk assessment and allocation in the UAE construction industry. *Inter. J. of Project Manage.*, 26, **4**, 431-438 (2008).
18. Zimmerman, D.W. and Zumbo, B.D., Relative power of the Wilcoxon test, the Friedman Test, and repeated-measures ANOVA on ranks. *The J. of Experimental Educ*., 62, **1**, 75-86 (1993).
19. Bajpai, N., *Business Research Methods*. Pearson Education India (2011)
20. Schucany, W.R. and Frawley, W.H.J.P., A rank test for two group concordance. *Psychometrika*, 38, **2**, 249-258 (1973).
21. Li, L. and Schucany, W.R., Some properties of a test for concordance of two groups of rankings. *Biometrika*, 62, **2**, 417-423 (1975).
22. Brown, T.A., *Confirmatory Factor Analysis for Applied Research*. Guilford Publications (2015).
23. Harrington, D., *Confirmatory Factor Analysis*. Oxford University Press (2009).
24. Nunnally, J.C., *Psychometric Theory*. New York: McGraw-Hill (1978).
25. Cattell, R.B., The scree test for the number of factors. *Multivariate Behavioral Research*, 1, **2**, 245-276 (1966).
26. Rostami, A. and Oduoza, C.F., Key risks in construction projects in Italy: contractors' perspective. *Engng., Construc. and Architectural Manage.*, 24, **3**, 451-462 (2017).

27. Khodeir, L.M. and Mohamed, A.H.M., Identifying the latest risk probabilities affecting construction projects in Egypt according to political and economic variables. From January 2011 to January 2013. *HBRC J.*, 11, **1**, 129-135 (2015).
28. Omran, A. and Abdulrahim, A., Barriers to prioritizing lean construction in the Libyan construction industry. *Acta Technica Corviniensis-Bulletin of Engng.*, 8, **1**, 53 (2015).
29. Deng, X., Pheng, L.S. and Zhao, X., Project system vulnerability to political risks in international construction projects: the case of Chinese contractors. *Project Manage. J.*, 45, **2**, 20-33 (2014).
30. Fernando, C.K., Hosseini, M.R., Zavadskas, E.K., Perera, B.A.K.S. and Rameezdeen, R., Managing the financial risks affecting construction contractors: implementing hedging in Sri Lanka. *Inter. J. Strategic Property Manage.*, 21, **2**, 212-224 (2017).