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Research paper



Evaluation of Risk Factors Affecting on Oil and Gas Construction Projects in Yemen

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Abstract

Risk factors are unique in every of the construction projects are facing today. This research is conducted to identify and assess the relative importance of the significant risk factors contributing to cost and time overrun in oil and gas construction project in Yemen. Usually, construction projects affected by risk factors during the project lifecycle, without identifying and classify of this risks the project cannot be succeeded, in this paper, the project players, i.e. clients, contractor, consultant, project managers and engineers are taken for a survey to obtain the impact and probability of risk factors. The research aimed to identify the principal risks which effect on success of construction projects, to set the correct risk respond we should know the ranking of risks base on its impact and probability of occurs, in this paper we will use relative important index method (RII) and Spearman's rank correlation between the risks for analysis questionnaire responses. As a result of the research, external risk factors are the most influential in the oil sector construction projects in Yemen and project management risk factors are the most influential among the internal risk factors.

Keywords: *Construction projects; method; relative important index; risk factors; oil and gas; yemen.*

1. Introduction

Project risk management is one of the essential aspects of the project management, because of the uncertainty of construction risks, the losses due to risk directly impact all project participants' benefits [1]
The primary objective of this research is to increase the understanding of risk management in the different project phases: initial phase, feasibility study, design, bid, construction, and collaborative form of partnering, more in-depth understanding is expected to contribute to a more effective risk management, therefore, a better project output and better value for both clients and contractors. Risk management is a concept which becomes very popular in many businesses, many companies in the oil sectors often establish a risk management procedure in their projects for improving the performance and increase their profits. Projects undertaken in the construction sector are widely complex and often have significant budgets, and thus reducing risks associated should be a priority for each project manager, each one in project team provides their perception of what risk means and how to manage it, the description depends on the profession, project and type of business [2] .
Reference [3] provides a comprehensive description of the concept of risk management and how it can be used in practice. According to the authors, risk management cannot be perceived as a tool to predict the future, since that is impossible. Instead, they describe it as a tool to facilitate the project to make better decisions based on the information from the investment. In this way, decisions based on insufficient information can be avoided, and this will lead to better overall performance. In the literature, Risk Management described as a process with some predefined

Procedures, the scope of its definition differs among the authors; however, the core information is the same, from many definitions which can be found in the management literature. Reference [4] explanation brings the essence of this concept: The risk management process involves the systematic application of management policies, processes and procedures to the tasks of establishing the context, identifying, analysing, assessing, treating, monitoring and communicating risks.
The risk management aims to identify the undesired event to estimate risk, and it aims to the likelihood the unfavourable event to occur. The risk assessment helps in risk management by measuring, conducting quantitatively and qualitatively to estimate the significance level of the technical risk factors to the project and then to estimate of the risk of the potential factors to project success. The result of this step determines the input to make the optimum decision [5]. A systematic process of risk management has been divided into risk classification, risk identification, risk analysis and risk response. Risk response has been further divided into four actions, i.e. retention, reduction, transfer and avoidance [6]; [7]. However, Risk management may be described as "a systematic way of looking at areas of risk and consciously determining how each should be treated. It is a management tool that aims at identifying sources of risk and uncertainty, determining their impact, and developing appropriate management responses" [8].
The identification of risk factors is the first step in devising appropriate strategies to respond to risk factors. The importance of the risks according to their impact and frequency in the project.

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2. Risk factors classification in previous studies

Construction in oil and gas projects facing challenges and risks as most construction projects, especially in one of the third world countries, such as Yemen, where risks surround these projects in many ways, and there is no professional management team to respond to these risks, the most of these projects is failure and loss due to exceeding the specific cost and time of the project.
According to [9] Risk is vital to contractors as well as clients and consultants within the construction industry; however, the problems of risk assessment are complex and poorly understood in practice. According to [10] in a related development, pointed out that construction activities are full of risk which include those that may relate to internal, external, commercial, design, construction and operation. However, they should be considered for active management to retain the primary objective of the project.
In construction projects, there are a lot of Stakeholders, partners and project contributors involves, the long duration time of the project and an open production system, entailing significant interaction between internal and external environments. It appears that risk assessment is a controversial subject [11]. However, it is the most useful part of the risk management process [3].
According to [12] in this kind of projects such as organisational and technological complexity generates enormous risks. As a result, project managers are obliged to rely on the elicitation of subjective probabilities base [13]. Thus, as a probabilistic approach cannot be utilised to quantify risks, individual knowledge, experience, axiomatic judgment and rules of thumb should be structured to facilitate and analysis for risk assessment [14].
Generally, in construction management are concentrated, and interest has been on quantitative risk as mention by [15] despite the obstacles to obtaining accurate and objective prospects in construction projects, where projects are often one-off and do not repeat the same risks in all corporate projects as per [16].
The researcher [15] use a hierarchical risk classification structure to classify risks in construction projects. The hierarchical risk allocation structure allows the risk to be divided into two main types of risk, namely, internal project-related and external, affecting the project. External risks are those that are relatively uncontrollable and unpredictable and include factors such as high rates of inflation, material price fluctuations, currency exchange, force majeure events or disasters. Because of their uncontrollable nature, there is an urgent need for continuous survey, study and forecasting of these risks and define the company's strategy for managing the effects of external forces on the project. Internal factors are relatively more controllable and vary between projects depending on the size and importance of the project. Examples of internal risk factors include the level of resources available, the amount of experience in the type of business, the location and size of the project, and the agreed terms of the contract. Some of these risk factors are localised for individuals, working groups or groups within the construction project, but others are global for an individual project and have nothing to do with any work package. There are not two projects that have the same level of risk and must be treated separately. The risk allocation structure should, therefore, reflect or classify these differences between projects. In the hierarchical structure, collapse is showing in the figure. 1, the total risk is divided into internal and external risks. Internal risks are divided into local and global risks. Local risks cover all uncertainties resulting from labour resources, project materials and subcontractors. Each work package or section of the global business and risk is considered individually and cannot be customised for individual work packages and evaluated on the construction project.
One of the essential researches by [17] from China considered the study of risks in Construction projects in developing countries the researcher found that twenty-eight critical risks directly related to the risks of States the sample of construction projects in developing countries has been identified and categorized into three main hierarchical levels (country risk, market risk and project-related risks).
The top 11 critical risks are: approval and authorization, constant change in the law, lack of promotion of justice, local partner's weak creditworthiness risk, lack the country's stability, the planned costs of the project, the spread of corruption and bribery, the rates of inflation and interest rates, have exceeded and policies of the government, the influence of the Government on inter-party disputes and termination of service, the researcher emphasized that risks at the country level are more important than at the level of market risk, while the market is more important than the project's risk level.
Reference [18], categorized risks into nine significant classes: (1) Financial; (2) Contractual and Legal; (3) Subcontractors; (4) Operational; (5) Safety; (6) Design; (7) Force Majeure; (8) Physical; and (9) Delay risks. However, reference [9], also, classified the construction risk factors into four significant partitions: (1) External and site conditions; (2) Economic and financial risks; (3) Technical and contractual risks; and (4) Managerial risks.
However, [19] conducted an in-depth study on the risks in the construction projects of the Vietnam oil and gas sector and interviewed and surveyed companies working in this area and concluded that: the research focused on two main objectives, namely, knowledge of the main risks affecting oil and gas construction projects draw up appropriate strategies to effectively mitigate critical risks using the questionnaire survey, and this study systematically examined the risks affecting Vietnam's oil and gas construction projects. The degree of risk index developed, with the support of in-depth interviews, has helped to identify and mitigate key risks and responses. The top ten significant risks were: (1) Bureaucratic government system and lengthy project approval procedure; (2) Poor design; (3) Incompetence of project team; (4) Inadequate tendering; (5) Late internal approval process from the owner; (6) Inadequate project organization structure; (7) Improper project feasibility study; (8) Inefficient and poor performance of constructors; (9) Improper project planning and budgeting; and (10) Design changes.
According to [20] further surveyed the risks in the United Arab Emirates (UAE) construction industry and distinguished the following factors as most important: (1) inflation and sudden changes in prices; (2) shortage in materials and labour supply; (3) unrealistic construction schedules; (4) improper intervention of clients; and (5) changes in design.
Summary of previous studies highlights the importance of identifying risks in construction projects so that project management can develop appropriate response strategies and thus successfully achieve the objectives of the project.

2.1 Development of risk factors framework for oil and gas construction projects

This paper provides a framework for categorising risk factors based on internal and external risk sources, which is particularly relevant to oil and gas construction projects in Yemen.
The first category of the risks facing most of the construction projects in Yemen are internal risks, which are often highly influential and may disrupt the construction project, if these risks are not reduced, and their relevance is due to their direct impact on the project, after a thorough examination of literature review and previous research in this area, it is appropriate to divide internal risks into two main types of sub-risks.
The first type is the technical risks related to the project, its implementation and management, and all the contracts, designs, human resources and supply of construction materials and all technical matters related to the project many risks are to be determined by the secondary divisions of each branch. The second type is non-technical and mainly involves all stakeholders in the project and the risks that

each of them may produce and affect them in the project and we mean stakeholders are the owner, the executing contractor and the consultants, and the resulting risks may affect the cost of the project and the time as well as the quality work during implementation.

The second category of the risk that faces construction projects is external risks which have direct or indirect impact on the project but it's poses a risk to the project because it causes delay in completion and may ultimately stop the project if the risk is high and is not addressed by risk management in project the impact of external risks because of their impact on the cost of the project and the agreed time of delivery on contracts and external risks in general may not we can control it or manage it because the actors in it are not part of the project team.

An example of this may represent the country's political and economic situation, the most critical risks that affect the project and cannot be managed by the project management, researchers have divided external risks into two types of sub risks, first is the country's risks, including the political and economic risks, the risks of dealing with the local community surrounding the oil sector, contributing to its development and meeting its different requirements, as will be clarified later.
The second type of external category is the physical risks including the environment surrounding the oil sector and includes environmental risks during project implementation, and the security risks surrounding the project and this is of great importance for the length of the oil sector and the difficulty of controlling it and protecting the roads leading to the sector and finally the force majeure risk factors, natural disasters and their consequences are a significant effect on the suspension of projects and their financial repercussions and losses.
Different risks were identified in the first stage, this was accomplished mainly through literature review, and Risk Breakdown Structure (RBS) is then developed to organise different categories of risks as Table 1, to improve the risk identification process, risks can be categorised according to the source of risks.

Table 1: Source of Risk Factors in construction projects

Client Risk -CL	**Contractor Risk - CO**
Government Delay in Decision Making.	Lack of Contractors Experience.
Unstable of Government.	Execution Errors.
Government interference in projects.	Inadequate coordination among contractors.
Oil company Interventions.	**Feasibility study & Design risk - FD**
Changes During Construction Process.	Improper Project Feasibility Study.
Delay Payment of Contractor's Dues.	Lack of Data Accuracy and Survey Information.
Consultant Risk -CN	Frequent Change of Designs.
Insufficient Consultant's Experience.	Wrong Project Cost Estimation.
Delays Review and Approval of Design.	Wrong Project Time Schedule Estimation.
Poor Contract Management.	**Resources and Material supply risk -RM**
Tendering & Contract risk- TC	Delay in Delivery of Materials to Site.
Inadequate Tendering.	Fluctuations in the Material's Cost.
Lack of Detailed Items.	Poor Quality of Construction Materials.
The Terms of the Contract are Unclear.	Shortage of Modern Equipment.
Corruption accompanying tenders.	**Economical Risk-EC**
Shortage and Low productivity of labours.	Economic and Financial Crisis.
Project Management risk -MR	Foreign Currency Fluctuation.
Inappropriate Organizational Structure.	Higher Insurance and Transport prices to Yemen.
Ineffective Management.	Lack of infrastructure projects.
Poor Planning and controlling for Scheduling, and Budgeting.	**Political Risk - PO**
Lack of Effective Communication and Coordination.	Political Instability.
lack of effective quality control management.	Change Regulations and Law.
Local People Risk - LP	Country Conditions During Construction.
Responsibility Towards Society.	Illegal support and nepotism.
Recruitment of Local Peoples.	**Environmental Risk - EN**
Different language and culture with the local community.	Environmental Protection Pressure of their Groups.
Security Risk - SE	Health and Safety.
Length of Oil Sector Border.	Waste Treatment.
The Threat of Armed Groups.	**Force Majeure Risk - FM**
Unsafe Transportation Routes.	Inclement Weather, Flood, Fire, Landslip.
	Unforeseen Circumstances.
	The war in Country.

The developed framework of risk factors in oil and gas construction projects as shown in Figure 1.

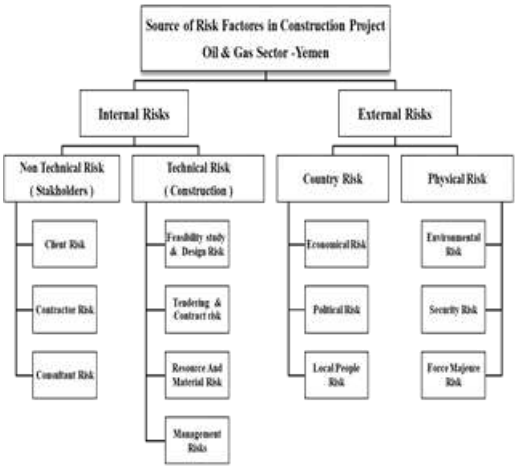


Fig 1: The risk factor framework in oil and gas construction projects -Yemen

3. Research methodology

The first step was to identify risks in construction projects; this was done primarily through literature review. A comprehensive list of 51 risks was developed based on previous studies gathering into two main groups internal and external risk factors which divided into 13 subgroups contains 51 risk factors as we explain above.

A questionnaire was then structured to get the perceptions of construction projects in the oil and gas sectors in Yemen. The questionnaire consisted of two main sections; the first section was intended to get information about the respondents' profile, the second section was intended to get the perception of the rating of each risk. Each risk had two questions, the first question relates to the probability of the risk event occurring on construction projects. Respondents were asked to choose between very low, low, moderate, high and very high. The second question refers to the impact on project objectives once the risk event occurs. The completed responses were collected either personally or received through regular e-mails, and faxes. Out of 360 distributed questionnaires, 202 were returned (or collected). 201 questionnaires were complete and used in the analysis only one response was an incomplete answer. Table 2 summarises the respondents' profile.

Table 2: Summary of demographic characteristics

Demographic Characteristic	Frequency	Percent
Age		
Less than 30	5	0.02
30-40	80	0.40
41-50	91	0.45
51 and above	25	0.12
Experience in Construction Industry		
Less than five years	23	0.11
5-10 years	49	0.24
10-20 years	69	0.34
20-30 years	44	0.22
More than 30 years	16	0.08
Job title		
Construction manager	25	0.12
Project manager	28	0.14
Project Coordinator	16	0.08
Site engineer (Civil -Electrical -Mechanical-Petroleum)	73	0.36
Site supervisor	37	0.18
Others	22	0.11
Oil Company work for		
Petro Masila Sector	38	0.19
Safer Sector	29	0.14
YLNG Sector	46	0.23
Total Sector	27	0.13
OMV Sector	32	0.16
Others	29	0.14

The Demographic Characteristic can explain the importance of this survey as we can see the most of participants age above than 40 years which reflect their experience in the oilfield projects. However, 34 per cent of responses have experience between 10 to 20 years, and 22 per cent have experience in this field for 20 to 30 years ,we can assume this group as experts plus the 8 per cent more than 30 years , The job title also gives us good idea how is the answer is related to the subject of survey, 26 per cent of the participants are managers 36 per cent of response are engineers who deal directly with risk management of the projects, this survey is covering all oil field companies in Yemen and concentrated on the significant five sectors as shown in the demographic table above.

Relative importance index (RII) for each risk was calculated using Equation 1. RII calculated for the probability, impact and rating for risk. The risk rating calculated by multiplying the probability and impact of risk. The risk rating can be used to prioritise risks for further quantitative assessment or response planning. ‘‘The specific combinations of probability and impact lead to a risk being rated as ‘‘high’’, ‘‘moderate’’, or ‘‘low’’ importance.’’
Relative importance index

$$RII = \Sigma W / (A*N) \quad (1)$$

Where:
RII – is Relative Importance Index
W –is the weight given to each factor by the respondents from 1, 2, 3, 4 and 5 for very low, low, moderate, high and very high, respectively;
A – is the highest weight (i.e. 5 in this case), and;
N – is the total number of respondents.
To get the strength of the relationship between two sets of risk groups can be calculated by the Spearman rank correlation coefficient which determined by using Equation 2. Spearman rank correlation coefficient has been widely used by many researchers for the statistical analysis, particularly when the rank used for the data analysis. Spearman’s rank correlation coefficient is a non-parametric measure of correlation between two series using the ranks rather than the actual values.

$$r_s = 1 - \frac{6\sum d^2}{n\left(n^2 - 1\right)} \quad (2)$$

where:
rs Spearman rank correlation coefficient
d difference in ranking
N number of variables (risks) = 51 while the higher the value of rs (approaching 1) indicates a strong association between the two sets of ranking.

3. Analysis and result

4.1 Descriptive statistics analysis

The researchers use SPSS V23 for statistical analysis to calculate the descriptive statistics and the correlation among the risks factors groups, as shown in Appendix I.

Statistical analysis of risk factors gives a preliminary idea of the completeness of the data and the responses of the participants and the lack of missing values as it is an indication of the order of these factors by calculating the arithmetic mean of the factors.
The usefulness of descriptive statistics in determining the standard deviation of the responses of participants to find the appropriateness, convergence and divergence of the questions of the questionnaire through descriptive analysis.

4.2 Correlation analysis

The aim of correlation Analysis is to examine the relationship between variables or risk factors in our case, in this research that includes several variables 51 factors, beyond knowing the means and standard deviations of the dependent and independent variables, the researcher would often like to know how one variable is related to another and correlations analysis indicates the nature, direction and significance of the bivariate relationship of the variables used in the study.
The correlation could be a perfect positive between two variables, which is represented by 1.0 (plus 1), or a perfect negative correlation which would -1.0 (minus 1), which mean the correlation could range between -1.0 and +1.0, the researcher need to know if any correlation found between the two variables is statistically significant or not (i.e. if it has occurred solely by chance or if there is a high probability of its real existence), we use Spearman’s rank correlation analysis by SPSS V23 to calculate correlation between risk factor groups as shown in the table 3:

Table 3: Spearman’s Correlation Analysis

Correlations-Spearman's rho													
	CL	CO	CN	FD	TC	RM	MR	EC	PO	LP	EN	SE	FM
CL	1												
CO	.710**	1											
CN	.600**	.727**	1										
FD	.661**	.744**	.806**	1									
TC	.638**	.719**	.675**	.777**	1								
RM	.665**	.724**	.677**	.734**	.741**	1							
MR	.570**	.743**	.702**	.737**	.718**	.803**	1						
EC	.642**	.654**	.560**	.636**	.597**	.732**	.742**	1					
PO	.572**	.617**	.501**	.598**	.665**	.722**	.706**	.829**	1				
LP	.522**	.609**	.710**	.718**	.645**	.689**	.726**	.687**	.706**	1			
EN	.558**	.643**	.693**	.757**	.614**	.695**	.700**	.717**	.689**	.721**	1		
SE	.545**	.584**	.582**	.694**	.617**	.711**	.721**	.795**	.749**	.732**	.740**	1	
FM	.447**	.544**	.493**	.520**	.591**	.624**	.665**	.692**	.733**	.634**	.662**	.725**	1

** Correlation is significant at the 0.01 level (2-tailed).

The correlation between factors gives a pointer over they affect to each other and is useful in developing a risk response strategy. The previous table shows that the correlation between different factors and significant statistical connotations must be considered.
Through the correlation Table 4, we can notice the relationship between each set of risk factors to the other for example, the correlation coefficient between consultant risk and feasibility study; project design risk value is 0.806 this indicates the significant correlation of these two sets of factors.

4.3 Relative important index (RII)

Based on the results of the survey, the Relative Important Index (RII) calculated each risk regarding the frequency of occurrence of risks as well as the amount of impact on the construction project in oil companies in Yemen; the result summarised as shown in Appendix II.
Evident through previous table impact of economic, political and security factors on the oil industry, especially in an unstable country like Yemen and that make political instability in front of risks that affect construction projects in the oil and gas sector (RII=0.753), following that war and cause a deadlock for projects And is a real threat to complete implementation as is happening now since 2014 till now (RII=0.752) follows that economic factors and crises of world oil prices (RII=0.666) and the effects of the armed groups (RII=0.624) and the lack of infrastructure for the country(RII=0.624) which is high risk value rating.
Table 4 illustrated the top 15 risks which have a significant impact in construction projects in Yemen oil sector:

Table 4: Top 15 risk factors effect on oil and gas construction projects in Yemen

Risk Factor	Rank
Political Instability	1
War in Country	2
Economic and Financial Crisis	3
The Threat of Armed Groups	4
Lack of infrastructure projects	5
Unsafe Transportation Routes	6
Unstable of Government	7
Country Conditions During Construction	8
Foreign Currency Fluctuation	9
Corruption accompanying tenders	10
Higher Insurance and Transport prices to Yemen	11
Health and Safety	12
Illegal support and nepotism	13
Length of Oil Sector Border	14
Poor Planning and controlling for Scheduling, and Budgeting	15

In the first risk group the client risk factors we can see the importance of a stable government as a client of all oil fields in Yemen, and this is the risk no 7 in ranking which indicates to the importance of this factor, this finding matching with the result of [19] research about the Risk management in oil and gas construction projects in Vietnam; he found the bureaucratic government system and lengthy project approval procedure is the first risk factor affecting a construction project for oilfield companies.
The second set of risks includes contractor risks and we can clearly see that the most critical factors in this group are the contractor's lack of experience, which poses a real threat to complete project implementation and leads to cost losses resulting from repeated errors resulting from the contractor's lack of experience, which is consistent with what the researcher [20] findings in a study titled (Risk assessment and allocation in the UAE construction industry) that poor contractor performance is one of the leading causes of risk in construction projects in the UAE.
The importance of the project consultant is the follow-up and control of implementation by contract terms, so poor contract management is one of the causes of the risks in construction projects.
Feasibility study & Design stage is one of the critical phases of the project and can be source of project risk as found in research the wrong in project cost and time estimate will affect and cause cost overrun and delay in project implementation, [7] confirm in his research subjected (Assessment of risk management practices in Nigerian construction industry: Toward establishing risk management index) that the Improper planning & budgeting Poor and Improper project feasibility studies are the significant risks in Nigerian construction industry.
Corruption accompanying tenders are the most effective risk factor in the tendering and contract risk group and this also confirmed by [21] in research under titled (Requirements for Economic Sustainability in the Yemen Construction Industry) which explain the impact of corruption in the construction industry in Yemen.
In the next group of risk factors resource and material risks we found the impact of delay in delivery of materials to site and fluctuations in the material's Cost are significant in oil and gas construction project and cause delay in project schedule time and cost overrun, this result confirmed also by [11], [22], [23], [24], [25] and [26].
Management risk factors are affecting and controlling for other factors and can be the main reason to fail or stop the project. Poor Planning and controlling for Scheduling, and budgeting is one of the top 15 risks in ranking which effect in the construction project, and this supported by [27], [28], [29] and [30].
Economical risk group contain 3 risk factors include in the top 15 risk factors ranking this is indicate to the impact of country economy to success the projects and gave idea how this effect on construction project, this issue was confirmed by many researchers before like [24], [25], [31] and [32], However, the impact of political instability is the first risk in the RII ranking and has the top significant impact in oil and gas construction projects in Yemen, the political risk was considered as high impact risk by [11], [24], [25], [33] and [34].
Social Responsibility and recruitment of local people are one of the risks to avoid problems with the society around the oil sector.
The physical risks include the environmental, security and force majeure risks effects in all oilfield operation including the construction project in Yemen like other developing countries, the company should consider physical risk response strategy to avoid or reduce the effect of this risk according to [25], [33], [35], [36] and [37].

4. Conclusion

In developing countries like Yemen, the oil and gas industry and its projects closely related to the country's economy as one of the country's public budget income resources.
Overall construction projects affected by the many risks that affect directly or indirectly the project cost and time schedule these risks may lead to cost overruns or delay the implementation of the project on time, hence the importance of this study is to identify the risks that may face a project which helps the project managers to develop appropriate plans to respond to such risks.
Development in developing countries need political and economic stability which is lacking in Yemen and revealed this study involving a lot of project managers and engineers working in oil companies in Yemen which confirms the recommendations contained in previous studies that the Yemeni Government should provide an appropriate environment and political and economic stability for incentive for construction projects in the oil sector which considered infrastructure projects for the development of Yemeni economy, as to provide more infrastructure projects like roads and electricity in petroleum exploration areas would be one of factors for attracting foreign investment in this vital field, which supports the national economy, the impact of the war in Yemen and the proliferation of armed groups is one of the primary risks in oil projects in Yemen and will usually stop projects and production of oil fields.
The lack of modern strategies in project planning and management and lack of control of cost and schedule time of the project during construction implementation task that leads to delayed implementation and might stop the project altogether.
Study of risk factor sources and develop appropriate strategies to respond to them is one of the outcomes of this study and will assist the Yemeni Government and companies working in the oil sector and researchers in this area to understand the nature of the relationship between sources of risks in construction projects and recommend that researchers in this field. Continually research and develop appropriate studies due to lack of references on this topic especially in Yemen.

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Appendix I

Descriptive Statistics Analysis

	N	Mean		Std. Deviation
	Statistic	Statistic	Std. Error	Statistic
CL1	201	3.7118	.05873	.83270
CL2	201	3.7847	.06024	.85404
CL3	201	3.2303	.05722	.81120
CL4	201	3.3629	.05131	.72745
CL5	201	3.7886	.05920	.83927
CL6	201	3.0974	.06162	.87359
CO1	201	3.6533	.05404	.76616
CO2	201	3.3525	.05750	.81519
CO3	201	3.3149	.05907	.83749
CN1	201	3.4118	.05928	.84048
CN2	201	2.9709	.05729	.81226
CN3	201	3.3660	.06610	.93713
FD1	201	3.5376	.07133	1.01128
FD2	201	3.2114	.06349	.90015
FD3	201	3.4520	.07014	.99445
FD4	201	3.7412	.07188	1.01908
FD5	201	3.7087	.06935	.98319
TC1	201	2.9783	.05797	.82182
TC2	201	3.1458	.05900	.83644
TC3	201	3.6607	.05952	.84380
TC4	201	3.4100	.05854	.82989
RM1	201	3.5557	.06816	.96631
RM2	201	3.3271	.05508	.78091
RM3	201	3.2211	.05099	.72290
RM4	201	3.3675	.05997	.85027
RM5	201	3.2034	.06452	.91480
MR1	201	3.3260	.06240	.88472
MR2	201	3.3401	.06038	.85603
MR3	201	3.3901	.06228	.88294
MR4	201	3.1954	.05678	.80504
MR5	201	3.2593	.05811	.82379
EC1	201	3.5352	.06025	.85419
EC2	201	3.3517	.06067	.86020
EC3	201	3.2881	.05836	.82740
EC4	201	3.4910	.06375	.90380
PO1	201	3.6772	.06428	.91134
PO2	201	3.1720	.05828	.82632
PO3	201	3.3885	.05691	.80680
PO4	201	3.2466	.05496	.77918
LP1	201	3.1726	.05437	.77084
LP2	201	3.4601	.06180	.87618
LP3	201	3.0005	.06258	.88722
EN1	201	3.2831	.05407	.76651
EN2	201	3.4032	.06068	.86028
EN3	201	3.0212	.05910	.83785
SE1	201	3.3014	.06073	.86096
SE2	201	3.3836	.05917	.83890
SE3	201	3.5022	.05524	.78321
FM1	201	3.0166	.05794	.82140
FM2	201	3.1181	.05503	.78014
FM3	201	3.6738	.05819	.82501
Valid N (listwise)	201			

Appendix II

Relative Important Index RII – Overall risk significance

No	Risk Factors	Probability		Impact		Rating	
		RII	Rank	RII	Rank	Value	Rank
1	Government Delay in Decision Making	0.641	28	0.683	32	0.437	32
2	Unstable of Government as client	0.764	7	0.791	6	0.604	7
3	Government interference in projects	0.621	38	0.588	48	0.365	49
4	Oil company Interventions	0.633	35	0.588	48	0.372	47
5	Changes During Construction Process	0.672	19	0.661	39	0.444	28
6	Delay Payment of Contractor's Dues	0.640	31	0.636	43	0.407	41
7	Lack of Contractors Experience	0.672	19	0.726	15	0.488	20
8	Execution Errors	0.621	38	0.659	40	0.409	40
9	Inadequate coordination among contractors	0.635	34	0.655	41	0.416	37
10	Insufficient Consultant's Experience	0.603	47	0.679	33	0.409	39
11	Delays Review and Approval of Design	0.617	42	0.647	42	0.399	44
12	Poor Contract Management	0.641	28	0.704	23	0.451	24
13	Improper Project Feasibility Study	0.621	38	0.713	19	0.443	31
14	Lack of Data Accuracy and Survey Information	0.617	42	0.687	30	0.424	34
15	Frequent Change of Designs	0.639	33	0.694	27	0.443	30
16	Wrong Project Cost Estimation	0.658	24	0.725	17	0.477	21
17	Wrong Project Time Schedule Estimation	0.681	17	0.723	18	0.492	18
18	Inadequate Tendering	0.640	31	0.693	29	0.443	29
19	Lack of Detailed Items	0.601	48	0.665	38	0.399	43
20	The Terms of the Contract are Unclear	0.588	49	0.628	45	0.369	48
21	Corruption accompanying tenders	0.713	14	0.753	9	0.537	10
22	Shortage and Low productivity of labours	0.649	25	0.687	30	0.445	26
23	Delay in Delivery of Materials to Site	0.676	18	0.735	14	0.497	16
24	Fluctuations in the Material's Cost	0.661	23	0.673	35	0.444	27
25	Poor Quality of Construction Materials	0.606	45	0.695	26	0.421	35
26	Shortage of Modern Equipment's	0.630	37	0.666	37	0.419	36
27	Inappropriate Organizational Structure	0.606	45	0.679	33	0.411	38
28	Ineffective Management	0.641	28	0.743	12	0.476	22
29	Poor Planning and controlling for Scheduling, and Budgeting	0.666	22	0.749	10	0.499	15
30	Lack of effective Communication and Coordination	0.620	41	0.697	25	0.432	33
31	lack of effective quality control management	0.648	26	0.707	22	0.458	23
32	Economic and Financial Crisis	0.803	3	0.830	3	0.666	3
33	Foreign Currency Fluctuation	0.753	8	0.747	11	0.563	9
34	Higher Insurance and Transport prices to Yemen	0.728	10	0.736	13	0.536	11
35	Lack of infrastructure projects	0.786	5	0.794	5	0.624	5
36	Political Instability	0.847	2	0.889	1	0.753	1
37	Change Regulations and Law	0.615	44	0.630	44	0.387	46
38	Country Conditions During Construction	0.741	9	0.761	8	0.564	8
39	Illegal support and nepotism	0.718	12	0.712	21	0.512	13
40	Responsibility Towards Society	0.707	15	0.694	27	0.490	19
41	Recruitment of Local Peoples	0.699	16	0.704	23	0.493	17
42	Different language and culture with the local community	0.586	50	0.570	50	0.334	50
43	Environmental Protection Pressure of their Groups	0.670	21	0.670	36	0.448	25
44	Health and Safety	0.723	11	0.726	15	0.525	12
45	Waste Treatment	0.632	36	0.627	46	0.396	45
46	Length of Oil Sector Border	0.717	13	0.713	19	0.511	14
47	The Threat of Armed Groups	0.785	6	0.795	4	0.624	4
48	Unsafe Transportation Routes	0.788	4	0.781	7	0.616	6
49	Inclement Weather, Flood, Fire, Landslip	0.568	51	0.544	51	0.309	51
50	Unforeseen Circumstances	0.646	27	0.624	47	0.403	42
51	War in Country	0.856	1	0.879	2	0.752	2