



Identification and Assessment of Risk Factors in Construction Projects in Darfur States - Sudan

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Abstract: Construction projects are initiated in a complex and dynamic environments resulting in circumstances of highly uncertainty and risks. Risks always exist in construction projects and often cause schedule delay, cost overrun and poor quality. The main problem is that there is a gap of knowledge of risk management in construction projects. This gap has been represented in the lack of different strategies for managing risks and their techniques and application on the ground. The objectives of this study are to know the main gap in the knowledge of those risks, to identify and assess risk factors of construction projects in Darfur States and to know the most influential factors of risks. Copies of a questionnaire were distributed to relevant construction industry experts for data collecting purposes. Construction individual risks factors were identified and assessed by the researchers. Results show that not a single individual risk factor has been categorized as very high severity, almost 7 % of the researched risk factors have been categorized as high severity, 46 % of the researched risk factors have been categorized as medium severity, 44% of factors ranked as low severity and 3% as a very low severity. In fact, its recommended that 47 % of the researched risk factors would be taken to risk waiting list.

Keywords: Construction Industries, Individual Risks, Qualitative Risk Analysis, Risk Management, Risk Identification, Risk Assessment,

1. Introduction

Risks in construction, adversely affect project objectives of time, cost, scope and quality. Construction projects are considered as one of the most complex projects in general. This research deals with identification and assessment of risks facing these projects. Generally, construction projects in Sudan and particularly in Darfur states are exposed to many risks that reduce projects expected results. Construction risks can be related to specifications, materials, equipment's, project environment, project stages from initiation to operation, bidding documents, supply risk, financial risks, legal risks, dispute related risks, risks related to mismanagement, political risks, risks related

to the parties to the contract, risks related to the use of technology, ethical risks and risks related to Darfur states.

Risk: The possibility of danger occurring or suffering from harm or loss[1]. Also, its defined as variations in expected outcomes that exist in nature in a given situation[2]. Uncertain condition or event such that if it occurs it will have a negative or positive impact at one or more of the project objectives (scheduling, cost, quality) [3]-[4]. Table.1 shows several techniques employed to identify and analyze risks.

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Table.1 Risk Analysis techniques [5]

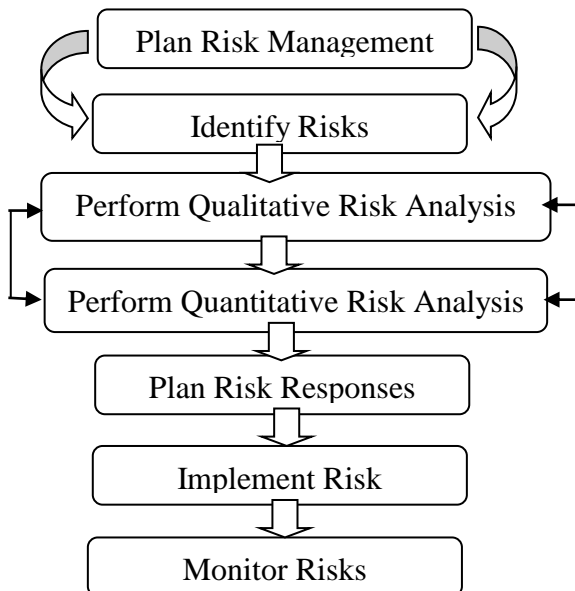
Qualitative Techniques	Quantitative Techniques
Direct judgment	Probability analysis
Ranking option	Sensitivity analysis
Comparing options	Scenario analysis
Descriptive analysis	Simulation analysis

2. Risk Management Processes

Project Risk Management includes: risk management planning, identification, analysis, response planning, response implementation, and monitoring risk.

The objectives of project risk management are to increase the probability and/or impact of positive risks and to decrease the probability and/or impact of negative risks in order to optimize the chances of project success [6]. Fig.1 shows risk management processes as per PMBOK.

Fig.1 risk management processes



3. Problem of The Study

The main problem of this research that there is a gap of knowledge of risk management processes in construction projects. This gap has been represented in the lack of different strategies for managing risks and their techniques and application on the ground.

4. Research Questions and Hypotheses

What is the level of understanding and knowledge of the construction industry risk management in the Darfur region?

What are the types of risks and risk factors associated with the construction projects in the region?

Are there any risk management techniques used to manage risk factors in construction projects?

5. Objective of The Study

The main objective of this research is to know the main gap in knowledge of the risk management processes in the Darfur states, determine and assess qualitatively individual risks factors that affect construction industry in a continuum range.

6. Literature Review

6.1 Plan Risk Management

This is how to define and conduct risk management activities for a project.

6.1.1 Identify Risks:

Risk management always starts with risk identification, which may be considered the most important phase of the risk management process [6].

Risk identification greatly depends on the manager's knowledge. Managers' use various tools for risk identification are:

- Brainstorming
- Interviews
- Questionnaires
- Delphi technique
- Expert systems, etc.

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6.1.2 Risk Analysis

Risk analysis deals with the causes and effects of events which cause harm.

6.1.3 Perform Qualitative Risk Analysis

The process of prioritizing individual project risks for further action by assessing their probability of occurrence and impact as well as other characteristics.

6.2 Assessment of Risks Factors

Risk analysis involves assessing the identified risks. It's the process of assessing the possibility of risks occurrence and the degree of impact of those risks on the project objectives, if those risks occur. Researchers combine risk probability of occurrence with its degree of impact as follows [7]-[8].

$$R = P * I$$

R: The risk indicator, and its value is in the range [1,0].

P: The probability of a risk and its value is in the range [1,0].

The I: Impact of risk and its value is in the range [1,0].

Table.2 shows measures of probability of occurrence while table.3 shows the effect or impact of the event occurrence [6]-[9].

Table.2 Scale of probability

Probability	Scale
Frequent	5
Probable	4
Occasionally	3
Rarely	2
Improbable	1

Table .3 Scale of impact

Impact	Scale
More severe	5
Severe	4
Moderate	3
Little	2
Small	1

Researchers use several measures of probability and impact measures to replace the qualitative scale with numbers in the statistical analysis. The following scale was adopted by the authors in table.4 [10].

Table.4 Risk Indicator Level Scale

P	I	P*I	% rang
Improbable	Very Low	0.00 - 0.040	0.05
Rarely	Low	0.041 - 0.160	0.10
Occasionally	Moderate	0.161 - 0.360	0.25
Probably	Severe	0.361 - 0.640	0.50
Frequently	Catastrophic	0.641 - 1.00	>0.50

The level of severity was determined based on indicator of risks and according to the principle of calculating the difference between the largest value of the risk indicator and its smallest value and symbolized by the symbol (D). This principle can be relied upon to determine the limits of the risk indicator for the purpose of treating it according to the available resources as follows:

D = Largest value – smallest value.

Table.5 shows severity indicator ranges to each risk level.

Table.5 The risk severity indicator range

Level	LL	Upper limit
Very Low	LL	LL + 10%D
Low	LL	LL+ 30%D
Medium	LL	LL+ 30%D
High	LL	LL + 30%D
Very High	LL	LL + 30%D

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A number of studies have been carried out to determine individual risk factors of construction project:

P.J. Edwards, conducted a research on risk and risk management in construction. Primarily, risks have been classified into two main categories: natural risks and human related risks. Natural risks occur outside human system, while human risks arise within humanly organized system. The sub categories of human risks related to construction and project risks that include social, political, economical, financial, legal, health, managerial, technical and cultural risks[11].

Pejman Rezakhani has classified project risks into external, operational, project management, technical and financial [12]. Bhandari M.G., conducted study on risk management in construction. He classified risks into technical risks, logistical risks, management risks, Environmental risks, Financial risks and socio-political risks[13].

Mamdouh.J.H, Fateh.R.M and Muhammad.Y conducted a research that resulted in a consensus among the participants that the most severe obstacles are economical such as inflation, administrative weakness of incentives, wages, failure in the occupational health and safety system. The negative factors were illustrated in percentages[14].

Abeer.M.M Conducted a research supported by a questionnaire explained through the target group set of risks:

The weakness of the financial position of the kingdoms, and their effect was 76%. Changing the terms of the contract and adding new clauses by the owner, an incidence rate of 61.9%. Weather hazards, with an incidence rate of 61.9%. Workmanship defects, the impact rate is 57%. Existence of connections between old

and new buildings, with an impact rate of 47.6%. Invisible businesses, with an impact ratio of 47.6%. Weakness of the contractor program with an impact rate of 47.6%. Difficulty accessing materials to the site, impact rate 42%. Delaying payments on subcontractors and suppliers, the effect of which was 42%. [15].

Tasneem.G. S showed that the most severe impact on construction industry is the fluctuation of foreign currency exchange rate followed by prices increase of construction materials [16].

Patel Kinnareesh, conducted studies on risk assessment in India. He found that the majority of construction projects have no systematic procedures to deal with. Indian construction projects general practice is informal approach of risk management. In fact there is a thriving need to have a well-documented procedure which should be a one stop solution to all the risks that are likely to be faced during project life cycle[17].

7. Work Methodology

The research methodology selected for this study was comprised of a comprehensive review of relevant literature which will assist in providing an insight to the company. Questionnaire survey self-administered on 36 randomly selected construction practitioners involved in East, South, North, Central and West Darfur states. Information was related to their academic qualification, years of experience and number of projects they have handled. Specific data that depicts their degree of risk factors, awareness, Probability of occurrence and their impact on the performance of the projects were collected. Random sampling method was chosen for each state. A well-structured close- ended

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questionnaire was designed for the research and directed to the selected targets. The questionnaire was divided into three sections. The first section (A) deals with the general information and issues relating to the characteristics of respondents, while section (B) deals with information about the respondent's organization.

Section Two focused on impact and importance of risk management in the various stages of the project.

Third Section is designed to determine the probability of occurrence and degree of their impact on project.

(50) Copies were distributed at a rate of 1:5 copies for each state. The copies were distributed to contractors in public and private sector institutions.

(36) Copies were retrieved and (14) were loses. Finally, Statistical Package for Social Sciences (SPSS) and Excel programs were used to analysis data.

8. Results and Discussions

8.1. Section One: (A)

This section deals with general information about the respondent: profession, the nature of his work, institutional job, educational qualifications, years of experience in the construction industry and level of knowledge of construction industry risk management.

Table.6 shows that 64% of the respondents are civil engineers.

Table.6: Respondent's Job

Occupation	Frequency	Percent
civil engineer	23	64
Architect	8	22
other	5	14
Total	36	100

Table.7 shows that 64% of the respondents are contractors.

Table.7: Respondent's function

function	Frequency	Percent
Owner	8	22
Consultant	5	14
contractor	23	64
Total	36	100

8.2. Section One: (B)

This section contains information about the institution in which the respondent works, its establishment, the number of projects that have been implemented during the past ten years, the number of its permanent employees and the areas or stages in which it operates.

Table.8 shows number of projects executed by respondents during the past ten years. 39 % of the organizations implemented 6 -25 projects.

Table.8: projects executed during the past ten years.

numbers of projects	Frequency	Percent
One to five projects	6	17
Six to twenty five	14	39
Twenty-six to fifty	8	22
fifty one to one hundred	5	14
more than a hundred	3	8
Total	36	100

Table.9 shows number of permanent employees within researched organizations.

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Table.9: Number of Permanent Employees

Number of employees	Frequency	Percent
One to Three	13	36
Four to Six	6	17
Seven to Ten	8	22
More than ten	3	08
There is no fixed employee	6	17
Total	36	100

36 % of institutions employ about one to three permanent staff, 22% about seven to ten and 17% of the institutions have no fixed employees.

8.3. Section Tow:

This section focuses on impact of risk factors in the various stages of the project. 64 % of the companies participate in more than one stage of projects.

Table.10: company contribution on project phases.

project phase	Frequency	Percent
Project execution	13	36
In more than one	23	64
Total	36	100

Table.11 shows that 61% of respondents were not engaged in risks identification process.

Table.11 Risks identification

Answered	Frequency	Percent
Yes	7	20
No	22	60
Sub total	29	80
Not answered	7	20
Total	36	100

66% of respondents and their institutions do not engage in risks management plan.

Table.12 Risk management plan

Answered	Frequency	Percent
Yes	6	17
No	24	66
Sub total	30	83
Not answered	6	17
Total	36	100

8.4. Section Three:

This section focuses on determining the probability of occurrence of risks and the rate of impact of risks on the project, and categorizing them according to severity levels.

$D = \text{Largest value} - \text{smallest value}$

$$D = 0.554 - 0.195 = 0.359$$

Table.14 shows severity limits. Numbers have been rounded to three decimal places for ease.

Table.13 risk severity ranges

severity level	lower limit	upper limit
very Low	0.195	0.231
low	0.232	0.340
medium	0.341	0.449
high	0.450	0.558
very high	0.559	0.667

In table.14 there is no a single individual risk factor that appeared at very high severity level, maybe we need to do other qualitative analysis techniques to compare the results. There are 8 factors ranked as high severity: financial risks, ethical risks, risks related to Darfur States and political risks. These factors affect the contractor in the execution phase and must be given priority in response planning. 54 factors ranked as Medium severity most of them are in design and execution phase, the priority of responding to them comes

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second when managing risks. 51 factors are low severity in deferent stages of the project and they can be taken to the waiting list. Finally, there are 3 factors are very low severity, those comes in the last priority in response planning.

Table.14 ranked researched risks

Risk ID	severity Level	Percent
there is no a single individual risk factor appeared in this level	Very High severity	0%
R99, R115, R103, R30, R114, R35, R89, R37	High severity	7%
R92, R84, R87, R20, R68, R51, R32, R34 R91, R83, R113, R62 R1, R52, R88, R90 R58, R22, R63, R108 R57, R95, R116 R21 R107, R78, R27, R86 R111, R4, R18, R60 R101, R19, R3, R26 R109, R13, R14, R79 R81, R85, R17, R28 R50, R77, R45, R29 R54, R66, R72, R10 R70, R36	Medium severity	46%
R31, R56, R80, R96 R15, R110, R6, R9 R64, R12, R67, R98 R104, R5, R40, R75 R59, R112, R39, R2 R46, R82, R43, R102 R76, R16, R53, R24 R105, R48, R55, R71 R106, R33, R69, R8 R38, R25, R97, R41 R73, R7, R100, R23 R65, R74, R61, R94 R49, R44, R11	Low severity	44%
R47, R42, R93	Very Low severity	3%

Table.14 key

- R = risks related to specifications and work of materials and equipment
- R = environmental risks
- R = risks related to designs and bidding documents
- R = supply (logistic) risks
- R = financial risks
- R = legal risks
- R = dispute related risks
- R = execution risks
- R = risks related to mismanagement
- R = political risk
- R = risks related to the parties to the contract
- R = risks related to the Darfur States Sector
- R = risks related to the use of technology
- R = ethical risks

9. CONCLUSION

- 64% of respondents are civil engineers.
- 64% of respondents are contractors.
- 64% of the respondents' organizations contribute in more than one of the project phases.
- 66% of the respondents' organizations have no risks management plan.
- Not a single individual risk factor has been categorized as very high severity.
- Almost 7 % of the researched risk factors have been categorized as high severity.
- 46 % of the researched risk factors have been categorized as medium severity.
- 44% of factors ranked as low severity and 3% as very Low severity.

9.1. RECOMMENDATIONS

- It's recommended that 47 % of the researched risk factors would be taken to risk waiting list.
- It's recommended that 53 % of the researched risk factors would be taken to the responding planning process then to control process.
- 28% of The questionnaire participants must be qualified and developed in the

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areas of identifying, analyzing and managing risks through training courses.

- It's recommended to take into account the identification, analysis and management of risks in the contractual forms between the owner and the contractor to ensure the rights of all parties.

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