Journal of Contemporary Technology and Applied Engineering (JCTAE), **2**(1), 2023, 42-55

DOI: 10.21608/JCTAE.2023.222390.1015 Published by: *Faculty of Engineering, Kafrelsheikh University*

RISK AND CRISIS MANAGEMENT FOR ENGINEERING PROJECTS, SOLUTIONS AND PROPOSALS FOR ENVIRONMENT SECURITY

Received: 16-07-2023
Accepted: 10-09-2023

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ABSTRACT. The importance of the research lies in knowing the extent to which those in charge of engineering projects know the importance of studying the concept of risk and risk management in projects, identifying the risks most likely to occur and most affecting the implementation of projects and analyzing them, and then the possible response to potential risks within the stages of projects. For this regard, the descriptive analytical approach was followed to find out and evaluate the causes of risks that affect the implementation of engineering projects, through a set of data that was collected by designing a questionnaire and distributing it to a number of workers in the field of construction projects, including project owners, contractors and consultants. Statistical analysis was used to analyze the data as an introduction to the stage Interpretation and generalization of the results to reach proposals and recommendations for environmental security. The result concluded that the difference in architectural and construction plans is the first design, Misunderstanding of plans, conditions, and specifications is the least risk, Difficulty accessing the site is the first natural hazard, Wind and rain are the least natural hazards, Existence Non-permanent and technically unqualified employment, non-compliance of workers with the schedule are the most important human risks, Delayed disbursement of payments according to the contract is the least financial risk, Machinery breakdown and material shortage are the least administrative risks with an average impact size, Poor communication within the scope of work is the first administrative risk and Security instability is the least external risk with a medium impact size.

KEYWORDS: Risk Management; engineering projects; environment security; Statistical analysis; human risks; financial risk.

1. INTRODUCTION

Legislation, industry standards, and corporate policies all require project organisations to do risk management (RM), which is a crucial duty. According to ISO 31000, "RM creates and protects value" [1-6] is the first rule of RM. However, organizations frequently believe that their project risk management practices don't add value, and a common failure style is to just carry it out as a check-the-box activity [2-8]. Despite alleged difficulties in doing so, a high adoption rate for PRM practices suggests that stakeholders recognise some value in them. We look into how project risk management adds value to handle these contradicting observations. Recently, it notes the blurring of the global economy and the challenges facing global institutions, in how to respond quickly to environmental changes that lead to increased levels of risks and crises that arise, especially for engineering projects.In addition to the transformations and turmoil that the world is witnessing, which is changing rapidly. Hence, more researches have presented to study Risk and Crisis management for engineering projects [4-6].

In [9], In Pakistan's construction industry, a novel paradigm for risk management was presented. In order to look into the risk management procedures utilised in Pakistani construction projects, a survey-based study was carried out. This research study aimed to assess the impact of risk management in Pakistan's construction sector. The stakeholders in the project resulted more competitive as a result of comparing the risk elements of mega-construction projects, thus contractors must enhance their risk management procedures. This endeavour supported the emergence of a shift in thinking among all contractors towards spending money on risk management techniques for increased productivity.

Another study looked into the risks that Vietnam's many green building projects commonly face. No differences in risk preferences between various positions in green building projects were discovered by this study. These findings gave practitioners and future research some understanding of the risks associated with green building [10].

The current study proposed a multilayered TOE-based risk management framework to detect and manage the risks related to smart city governance. Through the smart city governing team and the integrated TOE layers, the framework connected intelligent residents with one another. It proved it accuracy in this field [11].

Engineering projects today are characterised by shifting, turbulent conditions and challenges accompanied by numerous risks, making it necessary to take the risk into account. As a result, the project owner or those responsible for carrying out the project must devote time and effort to managing these risks in order to reap the benefits of the positive aspects and avoid the negative ones. Because it has such a big impact on whether projects are continued or not, risk management has recently drawn a lot of attention from scholars. Risk is described as a complicated combination of the potential of an event and its repercussions [12, 13].

In [14], a novel risk management strategy was suggested. To order project activities according to the hazards they encountered when they crashed, The technique of Linear Assign was devised. In order to focus on high-risk activities, activities were divided into distinct classes according to their level of danger. The risk criterion is then taken into account by a new fuzzy TCT mathematical framework that is given. Horizon Risk study suggests a quantitative study of risks as the next stage. Finally, risk response options are discussed, and the outcomes are closely examined. For the purpose of evaluating the method's effectiveness, a real project from a gas sector company was used.

Another previous study used a Probabilistic Beliefs Networks model and a variety of data sources to examine the efficiency of both financial edging and operating risk management techniques of 31 top tramp shipping firms worldwide. Comparative trip distance, fleet positioning flexibility, and trading diversity are examples of short-to-medium-term operational risk management techniques. Long-term operational risk management tactics include fleet diversification and fleet age. Using data from the Automated Identifying System, short-to-medium-term operational risk management techniques was creatively. The findings demonstrated that financial hedging can successfully lower the risk associated with the price of bunker fuel, but not with the risk associated with freight rates. Companies can utilize operational risk management techniques to successfully minimize both risk exposures in the interim. Significant ramifications for shipping risk management were provided by this study [15].

There is little research that focused on one aspect, such as determining the level of understanding that those in charge of engineering projects have of the significance of studying the concept of risk and risk management in Egyptian projects, identifying and analysing the risks that are most likely to occur and have the greatest impact on the project's implementation, and then responding to potential risks internally.

In light of all of the above, our research was directed to answer the following questions:

1- What is the effect of studying the risk management in the Egyptian projects?

2- How can it positively identify and analyse the risks that are most likely to occur and have the greatest impact on the project's implementation?

3- How a statistical analysis results can help in responding to potential risks internally. For this regard, The research's significance lies in determining how well those in charge of engineering projects understand the value of studying the concept of risk and risk management in projects, of identifying and analyzing the risks that have the greatest likelihood of occurring and having the greatest impact on the implementation of projects, and of considering potential responses to potential risks throughout the stages of projects.

2. METHODOLOGY

The descriptive analytical approach was used, which relies on the study of reality or phenomenon as it really is, in order to reach the results of the study, by collecting data and analyzing it statistically to test the validity of the study hypotheses.

2.1. STUDY POPULATION AND SAMPLE

The study community in this section means the total group of elements that the researcher seeks to generalize the results on which are related to the studied problem .

It calculates a single (n) sample, as it exceeds the required minimum according to the statistical equation of the study specified for the sample size [16-19] according to figure (1).

$$n = \frac{Z^2 \ (P [1 - P])}{e^2} \quad (1)$$

At a confidence level of 95%, Z^2 = 1.96.

Where, n is the sample size; Z^2 is the standard score corresponding to the confidence level of 1.96; (P) is 50% success rate and e^2 is the standard error ± 0.05%.

2.2. The Questionnaire Design

In order to obtain the initial information and data for this study, the questionnaire was designed with the aim of knowing the impact of risks in the construction industry based on the approach used and the data method, and with the help of the research hypotheses. The questionnaire was divided two sections; Section One contains general information as shown in Fig. 1. Section two classifies into Physical and human hazards, Environmental and natural hazards, Design risks, Logistical risks, Financial risks, Legal risks, Risks directly related to implementation and Political risks. While the third section is presented as showing in Figure. 2.

1- before implementing the project.

2- during project implementation.

2.3. Study Community

The study community consisted of owners, consultants, and contractors of engineering construction projects, and it is a very large community that is difficult to reach in general, especially in the time specified for the study and the researcher's material capabilities but not less than 1500. Therefore, the researcher conducted the research using a random sample by designing an online questionnaire and publishing it in the engineering construction community.

3. Sample Properties

The researcher coded the data included in Google Forms and included them in the SPSS statistical analysis program (Ver. 26). The characteristics of the sample were as in the table **1.**

According to the the results of the distribution of the sample members personal data, it was found that the distribution of the sample according to gender was the percentage of male participants greater than females, as the number of males reached 2 7 0 with a ratio of 8 3 . 33 % of the number of females 54 by 16 . 67 %, and the distribution of the sample according to the academic qualification. Those with a bachelor's degree were the highest of the participating groups, with a number of 255, or 78.7%, and the least of the participating groups were holders of a doctoral degree, with a number of eight participants, or a rate of 2.47%. As for the distribution of the sample members according to the number of years of practical experience in the contracting field, it was the highest category . Those with experience for between five and ten years, with a number of 257, or 79.32%, and the least of the participants was the category with experience of less than five years, with a rate of less than 1%. Approximately 51%, respectively. As for the distribution of the sample according to projects, government projects were slightly less than private projects, at a rate of approximately 48%, approximately 52%, respectively. As for the size of the project, medium-sized projects constituted the largest percentage, and it was approximately 74%, compared to 12%. Approximately 10% for large-scale projects and approximately 14% for small-scale projects.

3.1. Validity of the Study Tool

The validity of the content of the tool , we conducted a pilot study on a sample outside the study community in preparation for collecting important and necessary data. In order to measure the apparent validity of the study, the validity of the arbitrators was used, which is defined as "the researcher examining the content of the test a careful and regular examination to determine whether it includes a representative sample of the field of behavior that it measures." And after completing the design of the questionnaire in its initial form, it was presented to a group of arbitrators with specialization, in order to express their opinions and observations on the following points:

- Comprehensiveness of the questionnaire for the research axes
- The integrity of the scientific formulation of the paragraphs of the questionnaire .
- The integrity of linguistic formulation of the paragraphs of the questionnaire.
- The questionnaire is free from stuffing and repetition.

As the arbitrators expressed their opinions in the questionnaire, while recording some important observations, including :

- Return The integrity of linguistic formulation back for some of the questions.
- Delete some questions and modify others

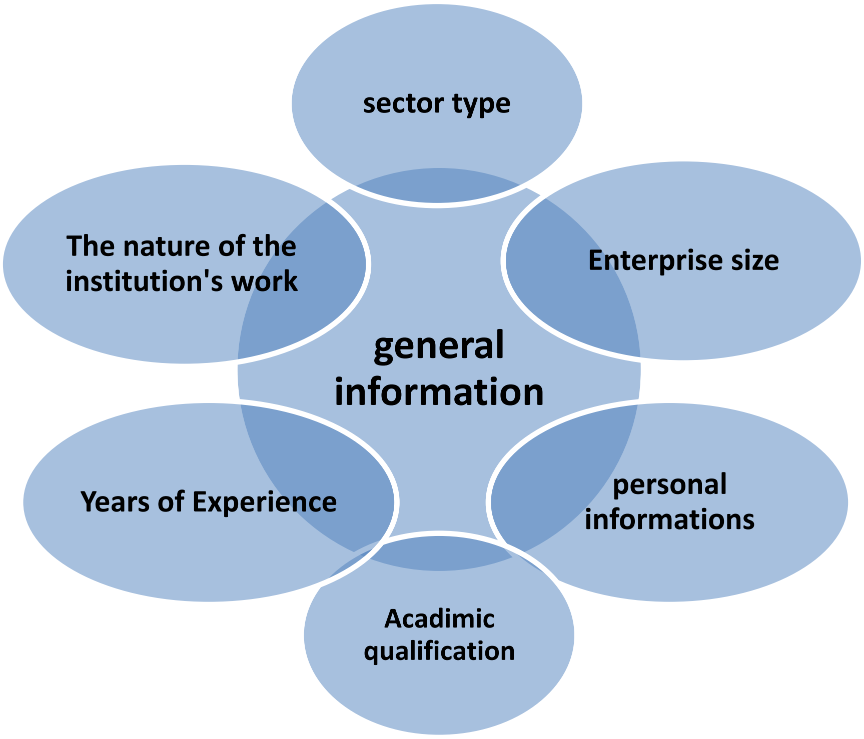

Fig. 1. General questions

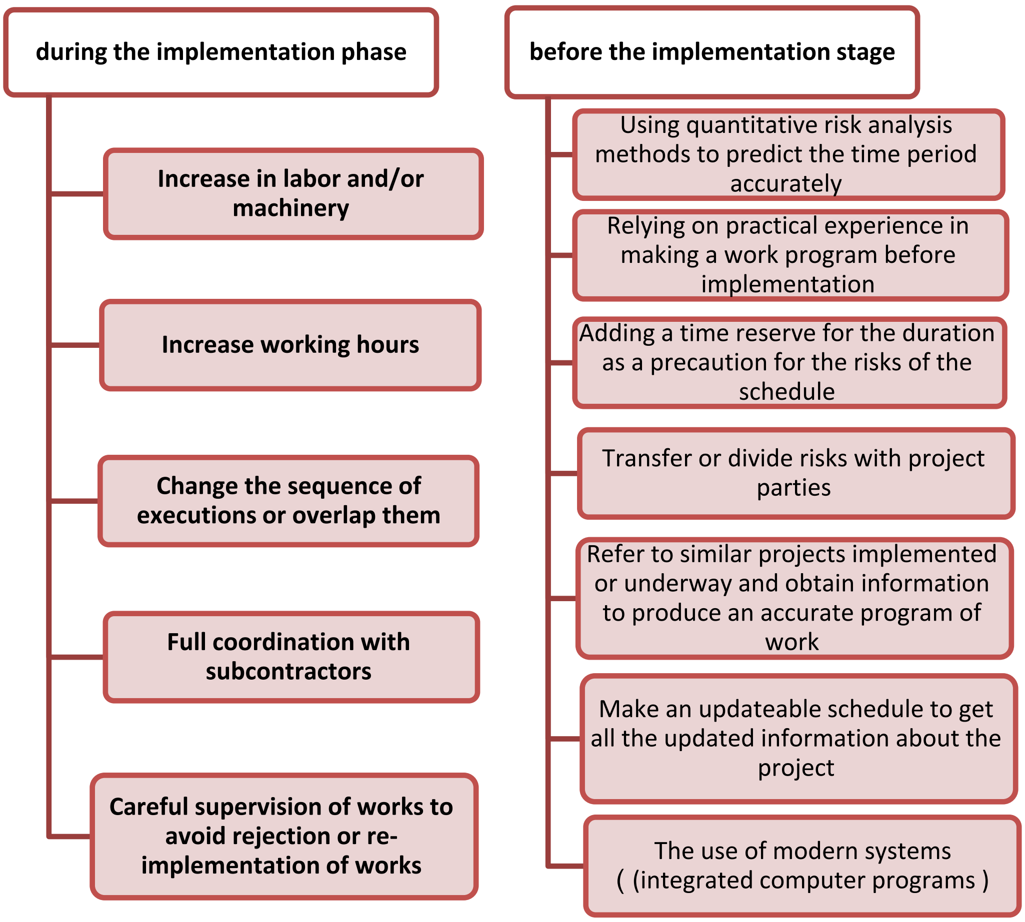

Fig. 2. Ways to handle the effects of risks

Table 1. The sample characteristics.

variable	Adjective	Frequancies	The ratio
Type	male	270	83.33%
	feminine	54	16.67%
Educational Qualification	Tehnical Diplome	28	8.64%
	Bachelor's	255	78.70%
	Master's	33	10.19%
	Ph.D	8	2.47%
lber of years of practicaum N experience in the contracting field	less than five years	3	0.93%
	From 5: 10 years	257	79.32%
	From 10: 15 years	49	15.12%
	years and over 16	15	4.63%
Nature of work on site	Advisor	121	37.35%
	Owner	38	11.73%
	contractor	165	50.93%
Project Type	governmental	155	47.84%
	private sector	169	52.16%
Project size	small	45	13.89%
	middle	239	73.77%
	big	40	12.35%
Total		324	100%

3.2. Test Reliability

The stability of the study tool means that the questionnaire gives the same result if the questionnaire is redistributed more than once under the same circumstances and conditions, as each axis measures what it is intended to measure, so the researcher calculated Cronbach`s Alpha coefficient using the statistical program SPSS (V.28) to measure the validity and reliability of the questionnaire, the test results were as shown in the following table. 2

3.3. Statistical Treatment

The previous table shows that the number of questions on the scale is 45, and the Cronbach's alpha coefficient is 0.944. Since the coefficient value is higher than (0.9) while the standard of Cronbach's alpha coefficient is 0.7, the degree of stability of the scale is excellent, meaning that if this scale is repeated several times, it will give the same results for the same sample and the same conditions during a certain period of time. The degree of validity of the scale was calculated and it was 0.972 , which is a high degree of validity, that is, it measures what was designated for its measurement. In the same way, the same test was conducted on all axes and scales, and the results were as in the table 4.

This table also shows that Cronbach's alpha coefficient for all axes of the scale ranges from (0.718, 0.967), which are high coefficients , and the degree of validity for all axes and scales ranged between (0.848, 0.983), which are high coefficients, and this indicates that the study tool has Great stability and a high degree of credibility , which makes us fully confident in the validity and validity of the scale , and its results can be relied upon . The tool, in its final form, is ready to analyze and interpret the results of the study and test its hypotheses.

In the light of the sample social survey method, descriptive and inferential statistics were used in the statistical treatment of the data, and the data was dumped on the spss statistical package program, with the aim of processing it according to the tests that achieve the purposes of the study, specifically the following methods:

Table 2. Cronbach`s Alpha Test Results

Section	number of variables	Cronbach's alpha coefficient (stability coefficient)	honesty coefficient
everyone	45	0.944	0.972
effect size	31	0.967	0.983
eenFirst: Contractual risks (betw parties to the contract the)	4	0.842	0.917
Second: Design Risks:	5	0.866	0.931
Third: environmental and natural hazards	3	0.718	0.848
Fourth: human risks	4	0.919	0.959
Fifth: Financial risks	5	0.900	0.948
Sixth: External risks	4	0.884	0.940
th: Administrative risksSeven	5	0.878	0.937
Means of coping with the effects of risks	14	0.795	0.892
Means of remedying the effects of risks before implementing the project	8	0.792	0.890
Means of remedying the effects of risks during he implementatio project	6	0.862	0.928

4. RESULTS AND DISCUSSION

4.1. THE FIRST REQUIREMENT: THE PARTIAL RESULTS OF THE STUDY

This study aims to know the extent to which those in charge of engineering management in projects, to know the importance of studying the concept of risk and risk identifying the risks most likely to occur and most affecting the implementation of projects and analyzing them , and then the possible response to potential risks within the stages of projects. This is done by answering the questions raised by this study as follows:

1. What are the risks to which engineering construction projects are exposed?

In order to answer this question, the researcher put a set of questions within the questionnaire identifying these risks and classifying them into seven categories using the standard triple Likert scale, which has three degrees 1 for weak ,2 for middle, and 3 for big effect with the average cutoff points 1.67 for weak effect, 2.34 for middle effect, and more than 2.34 for big effect. The results of this section were as follows in table 3.

It is clear from the table that the size of the impact of contractual risks is medium, as shown in Table 4.

- Ambiguity in some contract clauses is the first contractual risk and its size is average at 71.5%.

4.2. DESIGN RISKS

The absence of specific procedures to reduce contract risks is the least contractual risk with a medium impact size and a relative importance of 70.5%

- It is clear from the previous table that the size of the impact of design risks is medium, as shown:
- The difference in architectural and construction plans is the first design

Misunderstanding of Plans, conditions, And specifications risk, and its size is an average of 67.4% is the least

-Design risk with an average impact size and a relative importance of 63.4%.

natural (environmental) hazard.

It is clear from theTable 5 that the size of the mpact of natural(,environmental(risks is medium as shown in table 4.7

Difficulty accessing the site is the first natural hazard and its size is average at 65.3%

Wind and rain are the least natural hazards with an average impact size and a relative importance of 63.6%.

human risks

Table 6 shows the size of the impact of the human risk. As showing in this table:-

- Existence Non-permanent and technically unqualified employment , non-compliance of workers with the schedule are the most important human risks and in the first place with an average of 1.883 and a relative importance of 62.8%.

-The low quality of the materials used is the least human risk in the ranking, with an average of 1.843 and a relative importance of 61.4%.

Table 3. Contractual risks (between the parties to the contract)

danger	weak	middle	big	average	effect size	Relative importance	arrangement
The size of the impact of ignoring the involvement of the contractor when designing the project	(%29.01) 94	(%13.27) 43	(%57.71) 187	2,117	middle	%70.6	3
The size of the effect of ambiguity in some terms of the contract	(%23.45) 76	(%21.29) 69	(%55.24) 179	2,146	middle	%71.5	1
The size of the impact of not including risk management, including the risk management structure in contracting	(%21.6) 70	(%27.16) 88	(%51.23) 166	2,126	middle	%70.9	2
The size of the effect of not including specific procedures to reduce contracting risks	(%16.97) 55	(%37.65) 122	(%45.37) 147	2,115	middle	%70.5	4
Total	(%22.76) 295	(%24.845) 322	(%52.39) 679	2,126	middle		

Table 4. Contractual risks

danger	weak	middle	big	average	effect size	Relative importance	arrangement
The magnitude of the impact of misunderstanding the schemes, terms and specifications	(%30.55) 99	(%33.33) 108	(%36.11) 117	1,903	middle	%63.4	5
The size of the effect of low level design quality	(%29.62) 96	(%30.86) 100	(%39.5) 128	1,943	middle	%64.8	3

Continued Table 4

danger	weak	middle	big	average	effect size	Relative importance	arrangement
The magnitude of the impact of the difference in architectural and construction plans	(%24.69) 80	(%32.09) 104	(%43.2) 140	2,023	middle	%67.4	1
The size of the effect of mismatch between quantities, plans and specifications	(%28.7) 93	(%27.46) 89	(%43.82) 142	1,991	middle	%66.4	2
The magnitude of the impact of a design change	(%33.64) 109	(%25.92) 84	(%40.43) 131	1,915	middle	%63.8	4
Total	(%29.444) 477	(%29.938) 485	(%40.616) 658	1,955	middle		

Table 5. The impact of natural (environmental).

danger	weak	middle	big	average	effect size	Relative importance	arrangement
The size of the impact of natural disasters (winds and (rains	(%31.48) 102	(%30.86) 100	(%37.65) 122	1,909	middle	%63.6	3
The size of the impact of unfavorable weather conditions	(%36.41) 118	(%18.2) 59	(%45.37) 147	1,934	middle	%64.5	2
The size of the impact of the difficulty of accessing the site	(%33.95) 110	(%20.37) 66	(%45.67) 148	1,960	middle	%65.3	1
Total	(%33.95) 330	(%23.14) 225	(%42.9) 417	1,935	middle		

Table 6. The impact of Human Risks

danger	weak	middle	big	average	effect size	Relative importance	arrangement
The magnitude of the impact of the presence of non-permanent and technically unqualified workers	(%27.77) 90	(%41.04) 133	(%31.17) 101	1,883	middle	%62.8	1
The magnitude of the impact of the low quality of the materials used	(%33.64) 109	(%33.64) 109	(%32.71) 106	1,843	middle	%61.4	4
The magnitude of the impact of accidents due to the lack of safety precautions	(%26.54) 86	(%45.67) 148	(%27.77) 90	1,863	middle	%62.1	3
The magnitude of the impact of employees' non-compliance with the schedule	(%30.86) 100	(%34.87) 113	(%34.25) 111	1,883	middle	%62.8	1
Total	(%29.7) 385	(%38.81) 503	(%31.48) 408	1,868	middle		

Table 7. The impact of financial risks

danger	weak	middle	big	average	effect size	Relative importance	arrangement
The magnitude of the effect of inflation	(%25.3) 82	(%34.87) 113	(%39.81) 129	1,986	middle	%66.2	3
exchange rate instability	(%27.77) 90	(%33.64) 109	(%38.58) 125	1,952	middle	%65.1	4
The size of the impact of delayed payments in accordance with the contract	(%28.08) 91	(%36.41) 118	(%35.49) 115	1,920	middle	%64.0	5
The magnitude of the impact of the funding outage	(%21.91) 71	(%34.87) 113	(%43.2) 140	2,049	middle	%68.3	1
The magnitude of the impact of mismanagement of the contractor's cash flow	(%23.76) 77	(%36.72) 119	(%39.5) 128	1,997	middle	%66.6	2
Total	(%25.37) 411	(%35.3) 572	(%39.32) 637	1,981	middle		

4.3. FINANCIAL RISKS

Table 7 shows the financial risks

It is clear from the table that the size of the impact of financial risks is medium, as it is clear that Funding interruption is the first financial risk and its average size is 68.3%

-Delayed disbursement of payments according to the contract is the least financial risk with a medium impact size and a relative importance of 64%

4.4. EXTERNAL DANGERS

Table 8 shows the external dangers.

It is clear from the table that the size of the impact of external risks is medium, as it is clear that

-The emergence of disputes during the implementation phase between the project parties and the delay in resolving them is the first external risk, and its size is an average of 69.8%.

-Security instability is the least external risk with a medium impact size and a relative importance of 62.6%.

Table 8. The impact of external dangers

danger	weak	middle	big	average	effect size	Relative importance	arrangement
The magnitude of the impact of the difficulty in obtaining the necessary permits for work	90 (%27.77)	114 (%35.18)	120 (%37.03)	1,937	middle	%64.6	2
The magnitude of the impact of the emergence of disputes during the implementation phase between the project parties and the delay in resolving them	68 (%20.98)	103 (%31.79)	153 (%47.22)	2,095	middle	%69.8	1
The size of the effect of enacting new government laws that affect work	99 (%30.55)	102 (%31.48)	123 (%37.96)	1,920	middle	%64.0	3
The size of the impact of security instability	103 (%31.79)	109 (%33.64)	112 (%34.56)	1,877	middle	%62.6	4
Total	360 (%27.77)	428 (%33.02)	508 (%39.19)	1,957	middle		

4.5. ADMINISTRATIVE RISKS

Table 9 shows the administrative risks

According to Table 9, Poor communication within the scope of work is the first administrative risk, and its average size is 67.2%.

-Machinery breakdown and material shortage are the least administrative risks with an average impact size and a relative importance of 60.8%.

Summary of the risks types in this study can be presented in Table 10

- Contractual risks are the most important types of risks facing. It is clear from table. 10 that the respondents agreed on the existence of risks facing engineering construction projects, and these risks have a medium impact size, as it is clear that:
- engineering construction projects, with a relative importance of 70.87%
- Human risks are the least risks facing engineering construction projects, with a relative importance of 62.27%.

4.6. RESPONSIBLE FOR THE RISKS

The following table 11 shows the responsible for the risks.

It is clear from table 11 that the person responsible for the risks differs according to the type of risk, as shown:

- The owner is most responsible for contractual risks (38.19%), followed by the consultant with (33.87%), financial (56.35%), followed by the contractor with (23.45%) and external (34.56%), followed by the contractor with (31.94%).
- The contractor is most responsible for design risks (39.87%), followed by the consultant (31.41%), natural (33.95%), followed by the owner (25.61%), human (61.18%), followed by the owner (19.44%), administrative (54.81%), followed by the owner (23.02%).
- Natural risks, financial risks and external risks. There are significant percentages that are not due to any of the owner, consultant or contractor.

Average use of risk reduction methods before implementing projects

According to Table 12, Which using the standard triple Likert scale, which has three degrees 1 for do not use, 2 for sometimes used, and 3 for always used with the average cutoff points 1.67 for do not use, 2.34 for sometimes used, and more than 2.34 for always used. the results can be summarized as

Quantitative risk analysis methods for requirements, supplies and time periods are used accurately as the highest value and a means to reduce the risks of construction engineering projects before project implementation with an average of 2.312 and a rate of (77.1%), which is a medium value .

Contracting with specialized experts is the least means to reduce the risks of construction engineering projects before executing projects with an average of 1.992 and a rate of (66.4%), which is an average value.

Table 9. The impact of the administrative risks

danger	weak	middle	big	average	effect size	Relative importance	arrangement
The size of the impact of ineffective communication between the contracting parties	98 (%30.24)	106 (%32.71)	120 (%37.03)	1,914	middle	%63.8	4
The magnitude of the impact of mismanagement of project information and resources	87 (%26.85)	98 (%30.24)	139 (%42.9)	2,000	middle	%66.7	2
The magnitude of the impact of machinery failure and material shortages	100 (%30.86)	134 (%41.35)	90 (%27.77)	1,823	middle	%60.8	5
The magnitude of the effect of the difference between real quantities and complex quantities	88 (%27.16)	105 (%32.4)	131 (%40.43)	1,975	middle	%65.8	3
The size of the impact of poor communication in the scope of work	84 (%25.92)	98 (%30.24)	142 (%43.82)	2,017	middle	%67.2	1
Total	457 (%28.2)	541 (%33.39)	622 (%38.39)	1,946	middle		

Table 10. The impact of the various types of risks

risk type	weak	middle	big	average	effect size	Relative importance	arrangement
contractual risks	(%22.76) 295	322 (%24.845)	(%52.39) 679	2,126	middle	%70.87	1
design risks	477 (%29.444)	485 (%29.938)	658 (%40.616)	1,955	middle	%65.17	4
Natural hazards	(%33.95) 330	(%23.14) 225	(%42.9) 417	1,935	middle	%64.50	6
human risks	(%29.7) 385	(%38.81) 503	(%31.48) 408	1,868	middle	%62.27	7
financial risks	(%25.37) 411	(%35.3) 572	(%39.32) 637	1,981	middle	%66.03	2
External dangers	(%27.77) 360	(%33.02) 428	(%39.19) 508	1,957	middle	%65.23	3
Administrative risks	(%28.2) 457	(%33.39) 541	(%38.39) 622	1,946	middle	%64.87	5

Table 11. The responsible for the risks

risk type	Owner	Advisor	contractor	Contractor and owner	Contractor and consultant	everyone	otherwise
contractual risks	495 (%38.19)	439 (%33.87)	359 (%27.7)	(%0.23) 3	(%0) 0	(%0) 0	(%0) 0
design risks	451 (%27.83)	509 (%31.41)	646 (%39.87)	(%0.18) 3	(%0.18) 3	(%0) 0	(%0.49) 8
Natural hazards	249 (%25.61)	198 (%20.37)	330 (%33.95)	(%0) 0	(%0) 0	(%0) 0	195 (%20.06)
human risks	252 (%19.44)	243 (%18.75)	793 (%61.18)	(%0) 0	(%0) 0	4 (%0.3)	(%0.3) 4
financial risks	913 (%56.35)	222 (%13.7)	380 (%23.45)	(%0) 0	(%0) 0	(%0) 0	105 (%6.48)
External dangers	448 (%34.56)	307 (%23.68)	414 (%31.94)	(%0) 0	(%0) 0	7 %0.54) (	120 (%9.25)
Administrative risks	373 (%23.02)	349 (%21.54)	888 (%54.81)	(%0) 0	(%0) 0	3 %0.18) (	(%0.43) 7

Table 12. The average of risk reduction before implementing

way to reduce risk	Do not use	sometimes used	always used	average	average use	Relative importance	arrangement
Using quantitative risk analysis methods ,for requirements supplies and time periods accurately	36 (%11.11)	(%28.08) 91	197 (%60.8)	2,312	middle	%77.1	1
Make a schedule of mine that can be updated and developed	41 (%12.65)	(%45.98) 149	134 (%41.35)	2,117	middle	%70.6	5

Continued Table 12

way to reduce risk	Do not use	sometimes used	always used	average	average use	Relative importance	arrangement
Add a reserve of resources and time as a reserve for project risks	46 (%14.19)	(%33.64) 109	169 (%52.16)	2,203	middle	%73.4	3
Using methods of implementing similar projects instead of relying on creative methods	54 (%16.66)	(%28.39) 92	178 (%54.93)	2,206	middle	%73.5	2
Improving communication between all parties to the project	28 (%8.64)	(%49.07) 159	137 (%42.28)	2,163	middle	%72.1	4
Contracting with specialized experts	67 (%20.67)	(%43.51) 141	116 (%35.8)	1,992	middle	%66.4	8
Reduce the scope of the project to avoid high-risk activities	80 (%24.69)	(%26.85) 87	157 (%48.45)	2,072	middle	%69.1	7
Use of modern systems integrated) computer (programs	53 (%16.35)	(%41.66) 135	136 (%41.97)	2,089	middle	%69.6	6
Total	405 (%15.62)	(%37.15) 963	1224 (%47.22)	2,144	middle	%71.5	

5. Conclusion

This study presented risk and crisis management for engineering projects, solutions and proposals for environment security. Statistical analysis was used to analyze the data as an introduction to the stage Interpretation and generalization of the results to reach proposals and recommendations for environmental security. This study concluded that the difference in architectural and construction plans is the first design, Misunderstanding of plans, conditions, and specifications is the least risk, and its size is an average of 67.4%, Design risk with an average impact size and a relative importance of 63.4%, Difficulty accessing the site is the first natural hazard and its size is average at 65.3%, Wind and rain are the least natural hazards with an average impact size and a relative importance of 63.6%, Existence Non-permanent and technically unqualified employment, non-compliance of workers with the schedule are the most important human risks and in the first place with an average of 1.883 and a relative importance of 62.8%, The low quality of the materials used is the least human risk in the ranking, with an average of 1.843 and a relative importance of 61.4%.is 68.3%, Delayed disbursement of payments according to the contract is the least financial risk with a medium impact size and a relative importance of 64%, The emergence of disputes during the implementation phase between the project parties and the delay in resolving them is the first external risk, and its size is an average of 69.8%, Security instability is the least external risk with a medium impact size and a relative importance of 62.6%, Poor communication within the scope of work is the first administrative risk, and its average size is 67.2%, Machinery breakdown and material shortage are the least administrative risks with an average impact size and a relative importance of 60.8%, engineering construction projects, with a relative importance of 70.87%, Human risks are the least risks facing engineering construction projects, with a relative importance of 62.27%.

ACKNOWLEDGE

I would like to express my special thanks to project owners, contractors and consultants for their time and efforts they provided in designing a questionnaire.

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