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Risk assessment in construction projects of Iraq

By

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Abstract

Construction projects are unique in nature. One of its most notable qualities is the length of time that may result in a change of circumstances, resulting in many risks as a result of the long implementation period and the several stages, beginning with the project foundation and ending with final delivery. This raises the level of uncertainty and the probability of risks, which has a negative influence on the economics of construction contracts. To manage risks in such projects, the researcher visited a number of sites in numerous governorates across Iraq after collecting papers and literature on the subject of risk management in construction projects. The researcher prepared unique forms displaying the probability of the risk arising and the magnitude of its effect after extracting a large number of them. After that, the forms were distributed to a group of specialists. Following a statistical analysis of the findings, the researcher came up with a set of conclusions and recommendations for managing risks in Iraqi building projects.

Keywords: Risk assessment, Construction management, Iraq projects, Risk analysis

1.1. Introduction

The construction field is known to be one of the most sector consists of a wide range of activities and events that have a close relationship with economic sectors, which made it an important and reliable indicator of the movement of the national economy. It is also characterized as it contains the most uncertainty due to the large number of risks in the construction projects due to their special nature, these risks can interact with each other in a complex way, which negatively effects on cost, time and quality of projects, and despite the fact that risks are an adjoining feature of construction projects due to the long implementation period, but these risks can be reduced so that they do not have a negative effect on project aims.

1.2. Risk Management

The uncertainty is one of the life’s features, in organizations and projects [1], representing a clear threat for the business, but also in itself is a significant opportunity that must be taken [2]. There is a close connection between risk and uncertainty, so the risk is the uncertainty measured, and uncertainty is a risk that cannot be measured [3].

Risk is a multifaceted concept [4], which is defined as the probability of a damaging event happening in the project, affecting on its objectives [5] but not always coupled with negative results. Risk may also represent opportunities, but the fact is most of the risk generally has negative results that led persons to only consider on the negative side of the risk [6]

Now, risk management is an integral part of project management [1], where one of the most difficult tasks is determining what are the project’s risks and how should they be prioritized [7]. This is a key process and most of project managers know that risk management is essential for good project management [8].

Risk management is defined as the process of identifying and assessing risk, and to apply methods to reduce it to an acceptable extent [9]. Then, the main purpose of project’s risk management is to identify, evaluate, and control the risk for project success [10]. Overall, risk management process includes the following main steps: (a) Risk planning; (b) Risk identification; (c) Risk assessment (qualitative and quantitative); (d) Risk analysis; (e) Risk response; (f) Risk monitoring, and (g) Recording the risk management process [11].

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In the last four decades the risk management research has grown considerably in the construction industry [12] given that construction projects are exposed to risk at the time of their coming into existence and are perceived to have more inherent risk due to the involvement of many contracting parties such as owners, contractors and designers, among others [13].

1.3. Risk assessment

Risk assessment is a systematic approach to recognizing and characterizing risks, and evaluating their significance, in order to support decisions about how to manage them. ISO 31000 defines it in terms of its components as “the overall process of risk identification, risk analysis and risk evaluation [11].

In order to complete the risk assessment in construction projects in Iraq, the researcher, with the help of experts, identified a number of risks, and then evaluated them scientifically and knew their impact on the projects, as follows:

1.3.1. Questionnaire phase

Based on the previous facts, a closed questionnaire form was divided by researcher into two sections as follows:

1- The first section: included questions about the personal information of the sample questionnaire, which included engineering specialization in addition to the number of years of experience.
2- The second section: It was divided into two parts according to the elements of the probability of risk occurs and degree of risk effects on the objectives of the construction project

With the help of the experts, twenty risks were selected from the total risks that occurred during the implementation of a number of construction projects visited by the researcher. After finishing up the preparation of the questionnaire form, it was distributed to the respondents and clarified the answering mechanism by giving the necessary time for doing the questionnaire. The researcher then collected forms for statistical analysis of the results.

1.3.2. Mathematical and statistical methods used in analyzing data and drawing conclusions

Statistics is concerned with scientific techniques for gathering, organizing, summarizing, presenting, and analyzing data, as well as deriving accepted conclusions and making appropriate decisions based on this analysis. The researcher presented the data in graphics and shapes for the purpose of analyzing and comparing it. This made it easier to study, analyze, and clarify the data in an easy and effective way when comparing it to other data because it will reflect the most amount of information just by looking at it. They are well analyzed and described, including:

(a) Measures of Central Tendency

The researcher adopted this measure as the typical value in representing a data set, where the researcher made use of the most common average, which is the arithmetic mean (Mean X). The arithmetic mean is defined as the value that if given to each item in the group (a set of values), the sum of the values of the new items would be equal to the sum of the values of the original variables. It is also known as the sum of the observation's values divided by their number [14]. It is calculated as follows:

Equation (1) $\bar{x} = \sum_{k=1}^{n} \frac{x_{i.}\ f_i}{n}$ ------ [14]

(b) Measures of Spread

Concentration measurements are insufficient to adequately characterize a set of data since some samples have the same arithmetic mean despite the fact that their data is distributed differently around their center (the degree of homogeneity of the data). The arithmetic mean reflects the data's center, but it does not tell how far the data is wrapped or spread about it [14]. Therefore, there must be another measure of the central measures to measure the degree of homogeneity or dispersion within this data. Therefore, the purpose of adopting this type of scale was to determine the nature of the distribution of questionnaire surveys to reflect the extent to which they differ and spread from the mean. If the measure

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of dispersion is large, this indicates a heterogeneity between the sampling values. The spread scale will be small when the differences between the sampling values are few. The researcher has adopted the Standard Deviation as a measure of dispersion as it reflects the values of the deviations of the samples from their arithmetic mean (X), and it is calculated as follows:

Equation (2) $s = \sqrt{\sum(xi - \bar{x})^2 . \frac{fi}{(n-1)}}$ --------- [14]

1.3.2.1. Risk analysis procedures

After collecting and sorting the questionnaire forms, the information and data obtained from the questionnaire is tabulated and analyzed. The study was conducted using the statistical program SPSS and the equations presented afterwards. Based on the members' responses, the rate of assessing the chance of acquiring each risk was computed using equation (1) for and then by using equation (2), the standard deviation was calculated as shown in Table 3. The relative importance of each risk was calculated according to its probability of occurrence and as shown in Table (3) based upon the following equation:

Relative importance of the risk according to the probability of its occurrence =
$\frac{\text{the rate of assessment of the probability of the risk}}{\text{the total of the rates of the probability of obtaining for each risk}} \times 100\%$ ------- [15,16]

The relative importance of each of the risks was calculated according to the severity of its effect and as shown in Table (4) and according to the following equation:

relative importance according to its effect $= \frac{the\ rate\ of\ assessing\ the\ risk\ effect}{total\ pf\ the\ rates\ assessing\ the\ effect\ for\ each\ rsik} \times 100\%$ -------[15,16]

The qualitative assessment of each risk was calculated, as shown in Table (5) and based upon the probability-effect matrix mentioned in Figure (1) and according to the following equation [17]

Equation (4) *qualitative assessment of risk = rate of assessing the probability of risk occurrence × rate of assessing the severity of the risk effect on the cost* ------- [17]

The relative importance of each of the risks was calculated according to the qualitative assessment of the risk, as shown in Table (5), according to the following equation:

Relative importance of risk according to qualitative assessment $= \frac{the\ qualtitive\ rate\ of\ assessing\ the\ risk\ occurence}{total\ of\ qualtitve\ assessment\ rates\ for\ each\ risk} \times 100\%$
----------- [15, 16]

The risks were summarized according to the following table, where they were numbered and coded as shown in the table against each of them:

Table (1) Description of the risks and their coding

1	Risk 1	Overlapping the work on the project with other projects in the region
2	Risk 2	Delay in preparing some work supplies due to road blocks due to the security situation
3	Risk 3	Change in designs after approval and implementation
4	Risk 4	The inaccuracy of the bill of quantities and the appearance of an increase in the quantities to be implemented that exceeds 20%
5	Risk 5	There are some problems in the land and soil, which need special treatments that cannot be known before detailed investigations of the soil
6	Risk 6	The difficulty of protecting the work staff due to exposure by some citizens near the project
7	Risk 7	The contractor's lack of understanding of the scope of work and the start of removing the old buildings using simple tools that greatly delayed the work (referring the project to an

		incompetent contractor)
8	Risk 8	Problems in the availability of local technical labor to meet the technical work requirements with special details
9	Risk 9	Delayed approval of the executive plans by the advisory body
10	Risk 10	Violations of the people on the construction project before handing it over to the beneficiary
11	Risk 11	Inaccuracy of the project's topographical surveys by the employer
12	Risk 12	Changing the details of paragraphs in the bill of quantities (technical specifications for paragraphs)
13	Risk 13	Unavailability of plans for the service networks passing through the site, such as (electricity, telephone, water, etc.)
14	Risk 14	Disputes over the project lands with residents by being threatened
15	Risk 15	The difference in the laws binding on foreign companies that supply some of the requirements of the project and the Iraqi law, which led to the delay of the project
16	Risk 16	Problems in the death of workers as a result of falling or as a result of not supporting aspects of deep excavation work and others
17	Risk 17	Malfunction of work equipment such as concrete pumping equipment and the delay in the arrival of spare parts to the work site
18	Risk 18	The designer overlooked the scope of work and neglected a large part of the highly precise project requirements
19	Risk 19	Late payment of advances to the contractor and lack of liquidity
20	Risk 20	Non-cooperation of the relevant authorities and their solidarity with the project

Table (2) Criteria and metrics for assessing the possibility and effect of risks in construction projects [16]

verbal scale (possibility of occurrence)	**Too high**	**High**	**Mid**	**Low**	**Too low**
Scale standard for probability	0.9	0.7	0.5	0.3	0.1
Verbal scale / Degree of effect	Very strong	Strong	Mid	Weak	Very weak
Scale standard for effect	0.8	0.4	0.2	0.1	0.05

The measure of risk for a given risk					
Probability	**=p*I) degree of risk(risk coefficient)**				
0.9	**0.05**	**0.09**	**0.18**	**0.36**	**0.72**
0.7	**0.04**	**0.07**	**0.14**	**0.28**	**0.56**
0.5	**0.03**	**0.05**	**0.10**	**0.2**	**0.4**
0.3	**0.02**	**0.03**	**0.06**	**0.12**	**0.24**
0.1	**0.01**	**0.01**	**0.02**	**0.04**	**0.08**
Effect	0.05	0.1	0.2	0.4	0.8
	Effect on the project objectives (cost, time, and quality)				

Figure (1) the probability-effect matrix

1.3.3. The educational achievement of the respondents' sample

To start the process of statistical analysis of the results of the questionnaire, it is necessary to know the sample individual's educational achievement on which the questionnaire was conducted. Since all respondents from the

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engineers, their exact educational achievement must be clarified. It is also clear from Figure No. (2) that the largest number of respondents are holders of higher degrees (36% PhD, 27% master degrees). There are others who hold a bachelor's degree, and their percentage is estimated at 37%, as shown in the following figure:

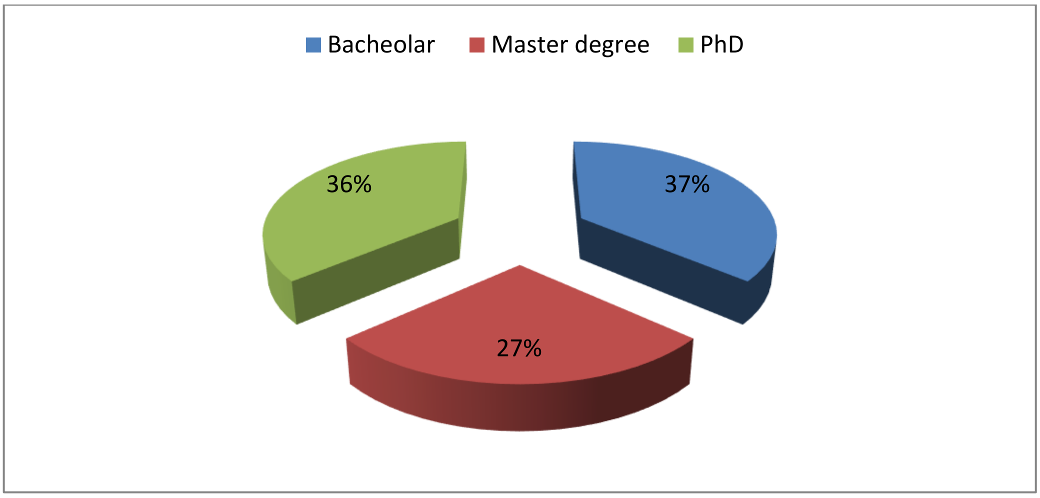

Figure (2) The educational achievement of the surveyed group

1.3.4. Field experience

Figure No. (3) shows the distribution of field experience for a sample of respondents. The results indicate that the largest percentage of respondents have more than ten years of experience. Those whose experience ranges from five to ten years constitute a percentage of up to 45%.

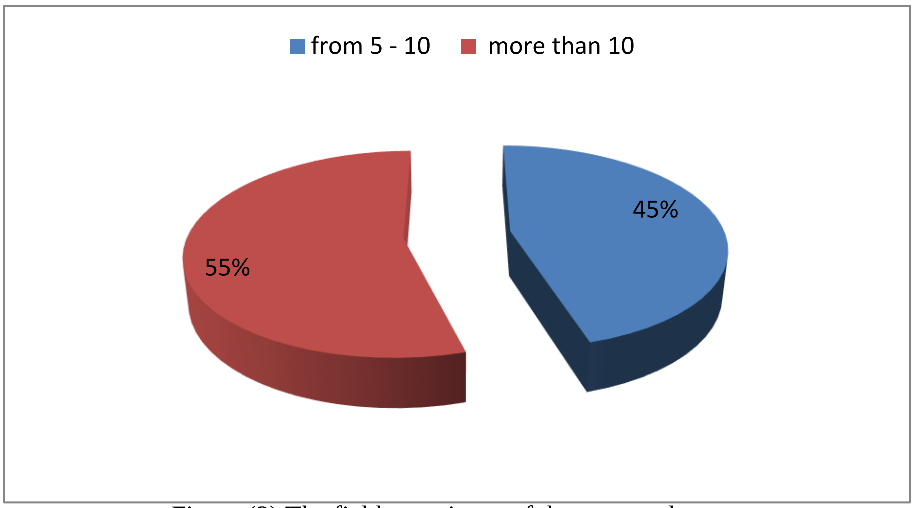

Figure (3) The field experience of the surveyed category

1.3.5. Risk identification and analysis

1- The question included identifying and assessing the probability of occurrence of each of the twenty risks, using five scales (very high, high, medium, low, and very low). Table (3) shows the standard weights for them.
2- A question included determining and assessing the degree of effect of each of the twenty risks, using five measures (too effective, effective, medium effect, low effect, and very low effect). Table (4) shows the standard weights for them.

Table (3) The probability of the risk occurrence

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No	Risk description	Total of frequencies according to research sample					Arithmetic mean	Assessment	Standard deviation	Relative importance
		very high	High	Mid	Low	very low				
1.	Risk 1	3	2	5	1	0	0.627	Mid	0.2053	5.256
2.	Risk 2	2	5	3	1	0	0.645	Mid	0.1809	5.408
3.	Risk 3	5	2	1	3	0	0.663	Mid	0.2656	5.559
4.	Risk 4	3	6	2	0	0	0.718	Mid	0.1401	6.020
5.	Risk 5	1	2	6	1	1	0.518	Mid	0.2088	4.344
6.	Risk 6	2	2	2	4	1	0.500	Mid	0.2683	4.193
7.	Risk 7	3	2	4	2	0	0.609	Mid	0.243	5.107
8.	Risk 8	2	3	3	1	1	0.527	Mid	0.2457	4.418
9.	Risk 9	1	2	8	0	0	0.572	Mid	0.1348	4.796
10.	Risk 10	2	2	3	4	0	0.536	Mid	0.2335	4.494
11.	Risk 11	1	5	3	2	0	0.590	Mid	0.1868	4.947
12.	Risk 12	4	2	4	1	0	0.663	Mid	0.2157	5.558
13.	Risk 13	6	2	1	2	0	0.718	High	0.2442	6.020
14.	Risk 14	4	3	1	3	0	0.645	Mid	0.2586	5.407
15.	Risk 15	2	2	2	3	2	0.481	Low	0.2892	4.033
16.	Risk 16	3	3	3	1	1	0.609	Mid	0.2586	5.107
17.	Risk 17	1	2	3	4	1	0.463	Low	0.2335	3.882
18.	Risk 18	3	2	4	1	1	0.590	Mid	0.2586	4.946
19.	Risk 19	3	4	3	1	0	0.663	Mid	0.1963	5.558
20.	Risk 20	2	3	5	0	1	0.590	Mid	0.2256	4.947

Table (4) Assessment of the degree of risk effect

No	Risk description	Total of frequencies according to research sample					Arithmetic mean	Assessment	Standard deviation	Relative importance
		very strong	Strong	Mid	Low	very low				
1.	Risk 1	2	3	5	1	0	.3550	Mid. effect	0.2423	4.595
2.	Risk 2	3	4	4	0	0	.4360	Effective	0.25	5.643
3.	Risk 3	2	6	3	1	0	.4270	Effective	0.2332	5.526
4.	Risk 4	4	2	3	1	1	.4320	Effective	0.31	5.59
5.	Risk 5	3	3	2	3	0	.3910	Mid. effect	0.2879	5.07
6.	Risk 6	2	3	3	2	1	.3320	Mid. effect	0.2629	4.2966
7.	Risk 7	1	3	5	2	0	.2910	Mid. effect	0.2022	3.767
8.	Risk 8	4	2	4	1	0	.4450	Effective	0.2944	5.759
9.	Risk 9	1	5	3	1	1	.3230	Mid. effect	0.2065	4.19
10.	Risk 10	2	1	4	4	0	.2910	Mid. effect	0.2662	3.766
11.	Risk 11	2	3	3	2	1	.3320	Mid. effect	0.2629	4.296
12.	Risk 12	2	4	3	2	0	.3640	Mid. effect	0.246	4.72
13.	Risk 13	5	2	2	1	1	.4860	Effective	0.3178	6.288
14.	Risk 14	3	1	4	3	0	.3550	Mid. effect	0.2978	4.594
15.	Risk 15	2	2	3	4	0	.3090	Mid. effect	0.2662	3.998
16.	Risk 16	0	2	5	3	1	.1950	Weakeffect	0.115	2.523
17.	Risk 17	2	6	2	1	0	.4090	Effective	0.2211	5.293
18.	Risk 18	5	3	2	1	0	.5180	Effective	0.2857	6.703
19.	Risk 19	7	2	2	0	0	.6180	Effective	0.26	7.997
20.	Risk 20	2	6	3	0	0	.4180	Effective	0.2088	5.409

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Of the results obtained to assess the possibility and the risks effect, the qualitative assessment of each of those risks will be calculated by equation (4) and then assessed based on the (probability-effect) matrix. This matrix gives a qualitative assessment of each risk based on the two factors of probability and effect, which are shown in Figure (3-1).

The figure shows the qualitative assessment of each risk and the relative importance of those risks based on their qualitative assessment. The researcher believes that the relative importance of the risks based on their qualitative assessment gives a clearer show of the priority and importance of those risks, due to their dependence on the two factors of probability and effect together as in Figure (3-4). Sometimes, the possibility of getting the risk may be high, but its effect is low, or it may be the opposite. We note that the relative importance of risk on the basis of probability or effect may not give an accurate picture of the priority to be given to that risk.

Table (5) Impact degree (qualitative assessment)

No	Risk description	Qualitative assessment rate	Assessment effect rate	Probability assessment rate	Assessment	Relative importance %
1	Risk 1	**0.222585**	**.3550**	**0.627**	high	**4.784772**
2	Risk 2	**0.28122**	**.4360**	**0.645**	high	**6.045212**
3	Risk 3	**0.283101**	**.4270**	**0.663**	high	**6.085647**
4	Risk 4	**0.310176**	**.4320**	**0.718**	high	**6.667661**
5	Risk 5	**0.202538**	**.3910**	**0.518**	high	**4.353834**
6	Risk 6	**0.166**	**.3320**	**0.500**	Mid	**3.568399**
7	Risk 7	**0.177219**	**.2910**	**0.609**	Mid	**3.809567**
8	Risk 8	**0.234515**	**.4450**	**0.527**	high	**5.041224**
9	Risk 9	**0.184756**	**.3230**	**0.572**	high	**3.971585**
10	Risk 10	**0.155976**	**.2910**	**0.536**	Mid	**3.352919**
11	Risk 11	**0.19588**	**.3320**	**0.590**	high	**4.210711**
12	Risk 12	**0.241332**	**.3640**	**0.663**	high	**5.187764**
13	Risk 13	**0.348948**	**.4860**	**0.718**	high	**7.501119**
14	Risk 14	**0.228975**	**.3550**	**0.645**	high	**4.922134**
15	Risk 15	**0.148629**	**.3090**	**0.481**	Mid	**3.194985**
16	Risk 16	**0.118755**	**.1950**	**0.609**	Mid	**2.552803**
17	Risk 17	**0.189367**	**.4090**	**0.463**	high	**4.070705**
18	Risk 18	**0.30562**	**.5180**	**0.590**	high	**6.569724**
19	Risk 19	**0.409734**	**.6180**	**0.663**	high	**8.807798**
20	Risk 20	**0.24662**	**.4180**	**0.590**	high	**5.301437**

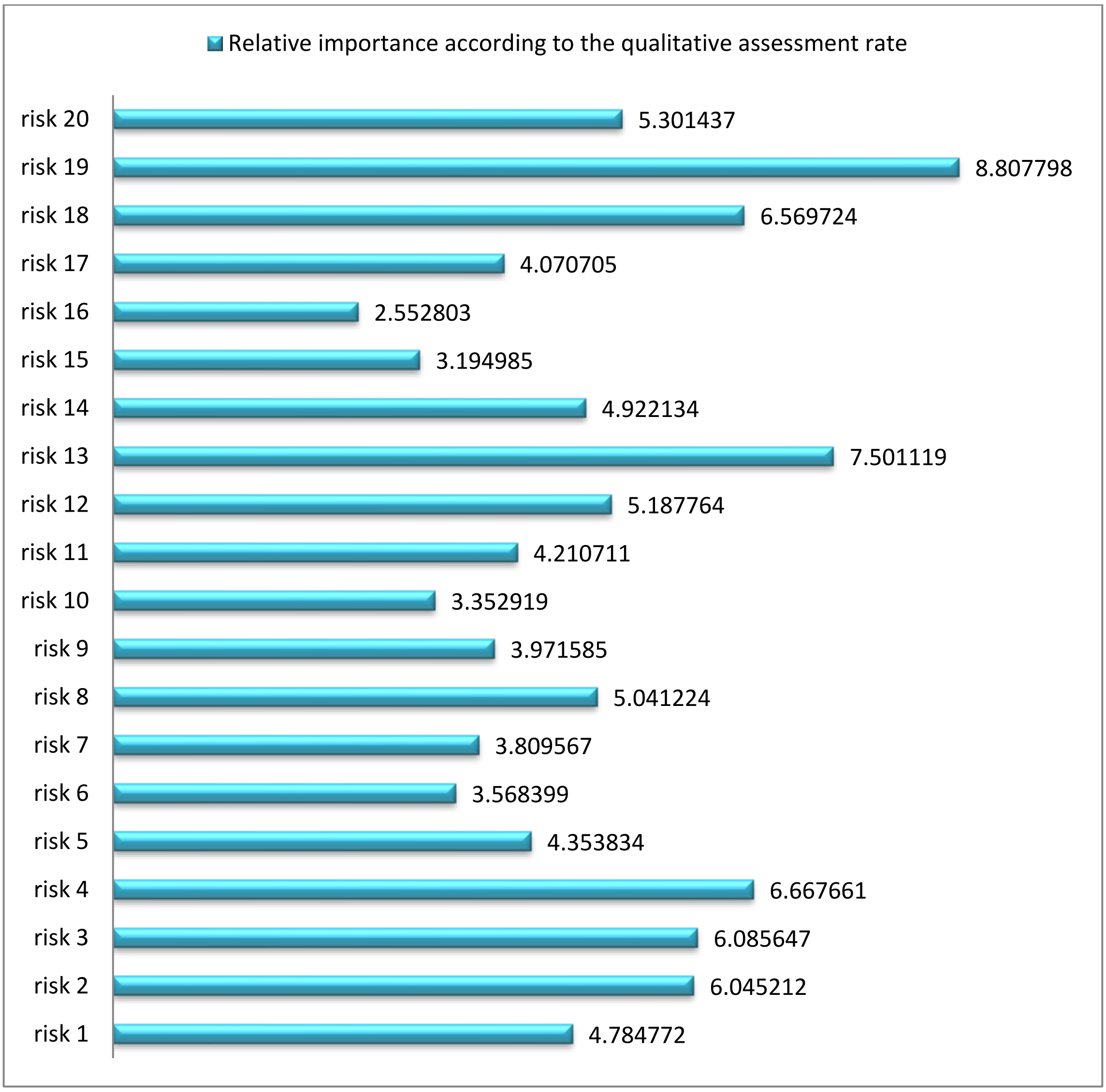

Figure (4) Relative importance according to the qualitative assessment rate

1.4. Conclusions

All of the risks identified in the projects visited are considered substantial. In light of the probability-effect matrix calculated in Table 5, the degree of its assessment ranges between (high and medium). They are risks that must be addressed and handled in accordance with risk management techniques that have been developed in advance. It can also be concluded using a kind of relative relevance based on qualitative assessment rates and the number of participants. The risk of delay in disbursing advances to the contractor and the lack of financial liquidity represents the most important risk according to the relative importance index, which must be considered that it did not occur during the progress of the construction project because of its significant effect on the failure of the project to proceed according to its planned objectives. It is a very accurate indicator when observing the period in which the analysis was conducted.

According to the relative relevance index, the lack of planning for the service networks flowing through the site (such as electricity, telephone, water, and others) is one of the risks that impact building projects. According to the same indicator, where it ranked third, the inaccuracy of the quantity schedule and the appearance of a 20% increase in the quantities required to be implemented has a significant effect on the project's objectives, as well as the rest of the risks whose relative importance converged. A number of observations were drawn from the field visit to the project sites, including that the concept of risk management is unfamiliar to many supervisors or those who manage projects. Risk management is a process that is not often included in the procedures adopted in companies and government departments in Iraq, and has no structure. It was also concluded that there is a confusion between the concept of risk management and the concept of occupational safety.

1.5. Recommendations

Because of its significant influence on the project's three objectives, the researcher suggests that risk management and analysis be taken into consideration and given top priority in building projects in Iraq (time, quality as well as cost). As illustrated by the practical study in the research, the researcher also suggests recognizing all of the risks that were detected in this project management process, as they were rated between medium and high in Iraqi building projects. The researcher also emphasizes the need of setting aside adequate funds for any project before referring it to guarantee that it is completed, regardless of any other obstacles. It also recommends that projects should not be referred for implementation without verifying the necessary plans for the infrastructure of the project area. Failure to refer it to implementation without reviewing the plans and scope of work, a final and comprehensive review to reduce the degree of changes occurring to low degrees. The bills of quantities should be adjusted to prevent increases in any percentage. It also recommends the necessity of holding workshops and introductory seminars for project managers in the country to understand and digest the issues of risk management well and recommend the need to deal with them and allocate specialized administrative departments in this area within the structure of construction projects in Iraq to reduce the occurrence of risks and activate different strategies to deal with them.

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