

Risk Analysis for Construction Contractors in Egypt and Yemen

Ibrahim Abdul Rashid¹, Abdel Moneim Sanad², Mohammed Alhazmi³

¹ Professor of Construction Management, Faculty of Engineering, Ain-Shams Univ., Cairo, Egypt.

² Professor of Construction Management, Faculty of Engineering & Technology, Arab Academy for Science, Technology & Maritime Transport. Cairo, Egypt.

³ M.Sc. Student, College of Engineering & Technology, Arab Academy for Science, Technology & Maritime Transport. Cairo, Egypt

³*mmn_hazmi@hotmail.com*

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Abstract. Usually, construction industry exposed for many of the risks that may affect the quality of execution and duration of the projects. This paper will discuss the key risk factors that affect the construction contractors in the Arab Republic of Egypt and the Republic of Yemen during a field study that included 108 contractors in Egypt, in addition to 124 contractors in Yemen. The contractors, distributed on five categories saluting, were surveyed by the study and their views on the most important risks that they are exposed to were recorded. Then Contractors' answers were introduced to a statistical analysis program (SPSS) taking into account the statistical measures adopted.

The study concluded that the main risk factors faced by construction companies in Egypt and Yemen were somewhat close and may be reported as follows

1- Losses due to war, civil disorder, revolutions.....etc.

2- Financial risks including: (Losses due to inflation, cost overrun, delay in progress payment by owner, Devaluation and varying rate of exchange, Cost overrun due to planning estimation.)

Keyword. Risk Analysis, Construction, Contractors, Egypt, Yemen

1. Introduction

Every human endeavor or action involves risk. In our daily life, one faces a variety of situations involving many unknown, unexpected, frequently undesirable and often unpredictable factors. These factors can be conveniently compiled under the category of risk ^[1]. No construction project is free of risks. The situation becomes worse for the contractors due to the competitive environment of the construction sector. These risks can affect schedule, costs and quality objectives. It can also be argued that risk can be an element of omnipresence in every sector of construction. The construction industry is a significant component of most countries. Economics of the construction industry is a vital part of the Egypt and Yemen economy. It provides jobs for about one and half million people creating a 6.055% slice of the Yemeni's gross domestic product.

In Egypt, the industry directly employs about 5 million people and accounts for about 5.95% of the national GDP, making it one of the largest sectors of the economy. For this reason, definition and analysis of risk facing contractors is an important part of the decision making process and allow avoiding problems in construction companies. There are not many established studies regarding risk factor which face the construction contractors is this field in Yemen and Egypt, The main objectives of the study can be summarized in the following points.

1-Identify the sources of risks which face the contractors in construction projects.

2-Identify the probability of occurrence and impact for cash risk

3-Identify the importance of risks facing the contractors based on the probability of occurrence and impact of the risk.

4-Provide a proposal for construction contractors to respond to risks.

1.1 Risk types and classifications

Too many trials were made to categorize or classify the different risks in construction. Risks were classified according to either their nature or their consequences (controllable, quantifiable). All classifications were mainly done as a prerequisite to the management of the identified risks

1.1.1 Classification by Nature

Al-Bahar and Crrandall ^[2] proposed classification of risks that classifies the potential risks according to their nature and potential consequences. Their classification scheme is composed of six categories. They are:

- (1) Acts of God
- (2) Physical
- (3) Financial and economics
- (4) Political and environmental
- (5) Design
- (6) Construction related risks.

1.1.2 Classification by Consequences

This classification describes common features that all the different risks may follow. This was done as a prerequisite for managing risks. Levitt et al. ^[3] categorized risks into two types controllable and uncontrollable. Controllable risks reflect variations in human performance such as number of design omissions, low worker productivity and material wastage. Uncontrollable risks are random variables such as material price escalation, weather and unpredictable changes in underground conditions or properties.

1.2 Previous studies

Porter ^[4], identified the risk factors facing the Russian construction industry. The survey consisted of 46 questions the risks are grouped into four main groups:

- External risks to the project team: complexity of the project, site limitations, remoteness, availability of suppliers, inflation, labor and equipment availability, labor and equipment productivity, etc.
- Internal risks to the project team: the team's track record in construction project management, team's educational and technological experience and competency to undertake the project successfully, sufficient financial sources, etc.
- Project planning and execution risks: input from all groups involved, permits and regulations, scope definition, etc.
- Organizational structure and systems risks: reward structure, operating procedures, dispute resolution processes, etc.

Shofoluwe and Bogale ^[5] conducted a study to assess the risk management practices of major contracting firms in the United States. The study found that most contractors had formal written procedures for risk management, indicating an awareness of the importance of risk management in construction business. Also, contractors of all various work specialties had similar perception towards the importance of project risks. Analysis of the findings shows that 7 of the 14 construction project risks were ranked by the general contractors to be very important or severe. These risks include: safety, defective design, quality of work, financial risk and incompetence of subcontractors and Claims and disputes and Inflation & sudden changes in price (in descending order).

2. General Study Approach

The research procedure for this paper includes the following:

- Clear understanding of the problem being studied
- Definition of the research objectives
- Description and justification of the point of departure
- Identification of fundamental research issues
- Definition of all the elements and components that comprise the investigation

A clear methodology to perform the investigation, and summarizing in the following points (as shown in figure 1) :-

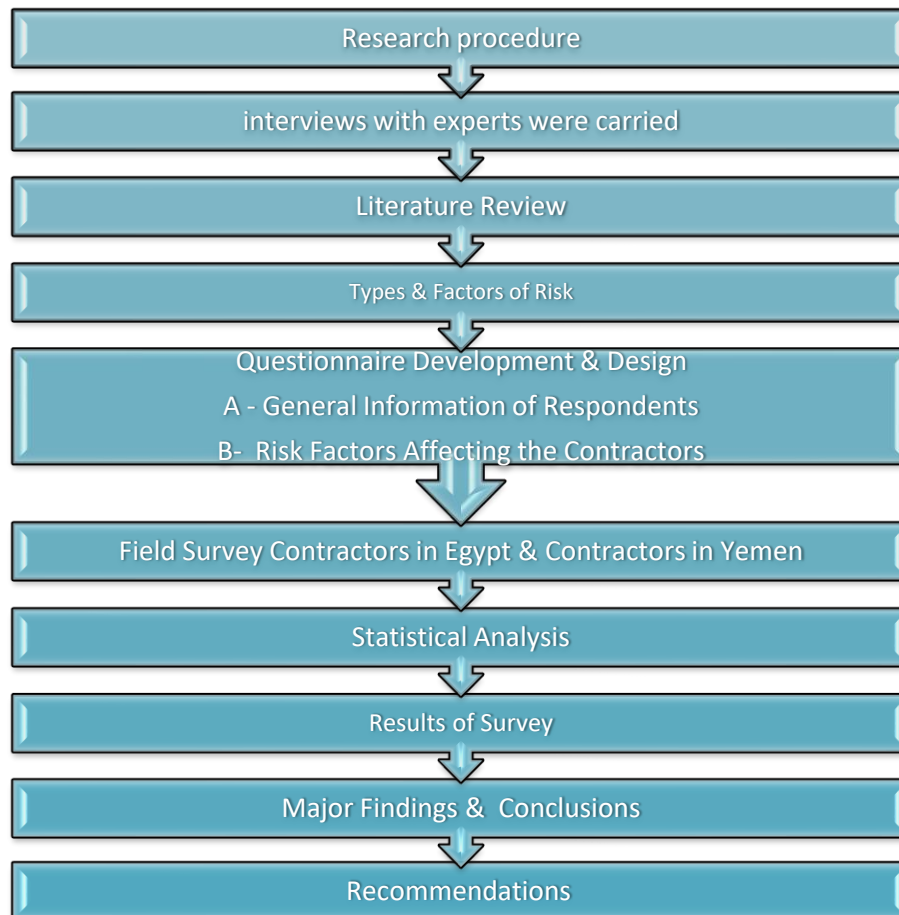


Fig.(1). Study Approach Diagram

3. Research Survey

3.1 Questionnaire Survey Approach

Due to the non-availability of organized information relating to risk analysis and assessment in construction contractors in Egypt and Yemen construction industry, a mail questionnaire survey approach was considered. This approach is well recognized and widely used in both social sciences and management research studies.

3.2 Questionnaire development and design

Questionnaires are extremely critical components of the research process because they identify which information is important and the opinion of the participants about the problem discussed.

Questionnaire survey was one of the other ways of data collection carried out among selected construction practitioners involved in construction projects. These specialists were working in contractor construction companies.

The questionnaire was identified from interviews with contractor's construction and through literature review. The survey questionnaire was administered by the means of two different ways. Firstly, through e-mail and fax, and postal questionnaire, and secondly, through distribution by the researcher to the selected contractors (project managers, managing directors, chairmen, engineers) operating in the Egypt and Yemen contractor industry. The personal delivery approach was deliberate to ensure that respondents fully understood the aim of the study and that no part of the questionnaire was ambiguous to any of the respondents.

A questionnaire was developed to assess the perceptions of consultants, and contractors on the relative importance of risk analysis and assessment for contractors industry. The questionnaire consists of two parts. Part (A) is related to general information about the contractors. The respondents were requested to answer general information (for e.g. work experience, organization, annual volume of construction work). Part (B) includes the list of the potential risk factors facing the contractors during construction projects. It contains seventy-one risk factors, for each risk factor there are two main questions, one for measuring the probability of occurrence and the other for measuring the degree of impact of each factor when it will occur. Both the probability of occurrence and impact of degree are based on a five-point scale. These five points are (very high), (high), (moderate), (low), and (very low) for probability of occurrence and also for degree of impacts. (PMBOK 2000)⁽¹⁾.

The questionnaire was translated into Arabic to make it easy and clear.

3.3 Sample Selection

The total population of the study is all the classified construction contractors in Egypt and Yemen. A sample is selected to represent the whole population. Three conditions are maintained in order to ensure that the sample is representation of the population (Equal chance, Appropriateness, Independence)

3.4 Sample size

The sample size that would represent the population for the survey was calculated based on the following formula (Kish, 1995)⁽²⁾

$$n = \frac{n^0}{1 + \left(\frac{n^0}{N}\right)} \dots \dots \dots \text{equation 1}$$

$$n^0 = \frac{p*q}{v} \dots \dots \dots 2$$

Where:

n_0 = First estimate of sample size

p = the proportion of the characteristic being measured in the target population

$q = 1-p$

v = the maximum percentage of standard error allowed

N = the population size

n = the sample size

For the purpose of getting the maximum sample size, the values of (p) and (q) were taken as 0.5 for both. The maximum standard error allowed (v) in this study was taken as 5%.

3.5 Sample Size in Egypt

According to the Egyptian Federation for Construction & Building Contractors in Egypt in 2010 AD ^[6], the approximately number of contractors in Cairo and Alexandria and Ismailia and Suez without the contractors having the seventh grade is 12500 contractors, which is the whole population. The size of the sample is determined by using the equation (1), which is shown in Figure (2).

Out of 150 questionnaires sent, 108 responses were received out of which 5 were incomplete and discarded. The response rate of 72% percent is considered to be very good for this kind of a Field survey

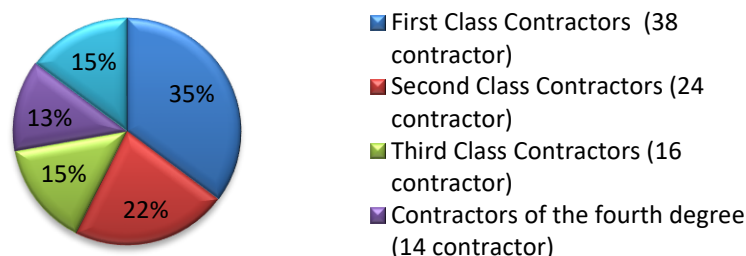


Fig.(2). Sample Size in Egypt

Sample Size in Yemen

According to the Ministry of Public Work and highway in Yemen in 2012 AD, the approximately number of contractors in Sana'a and Aden and Taiz and Ibb is 555 contractors, which is the whole population. The size of the sample is determined by using the equation (1) and shown in Figure (3).

Out of 150 questionnaires sent, 124 responses were received out of which 5 were incomplete and discarded. The response rate of 82.67 % percent is considered to be very good for this kind of a Field survey.

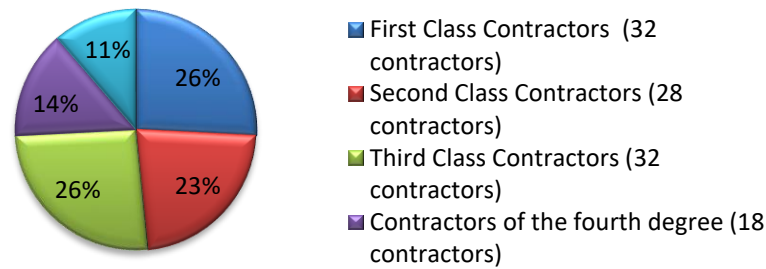


Fig.(3). Sample Size in Yemen

3.6 Data Analysis

3.6.1 Statistical Techniques

This section is intended to explain the statistical concepts will be mentioned in the interpretation of the results of the questionnaire

1. Mean

It is the most widely used measure of central tendency. It is commonly called the average. The mean is sensitive to extremely large or small values

2. Standard Deviation

It shows how much variation or dispersion exists from the average (mean), or expected value. A low standard deviation indicates that the data points tend to be very close to the mean; high standard deviation indicates that the data points are spread out over a large range of values.

3. Significance level (sig)

Report for the p-value to tell readers if the result is significant. The P value is a probability which ranges from 0-1. Usually, if Sig is less than 0.05 then the effect is significant.

❖ Mean, standard deviation, significance level, were calculated by using statistical program "SPSS".

3.7 Qualitative Risk Analysis

Process involves determining what impact the identified risks will have on the project objectives and the probability they'll occur. It also ranks the risks in priority order according to their effect on the project objectives. This helps determine if Quantitative Risk Analysis should be performed or if you can skip right to developing response plans. The qualitative risk analysis process also considers risk

tolerance levels, especially as they relate to the project constraints (scope, time, cost, and quality) and the time frames of the potential risk events ^[7].

3.7.1 Tools and Techniques for Qualitative Risk Analysis:

Risk Probability and Impact

Probability: A risk is an event that "may" occur. The probability of it occurring can range anywhere from just above 0 percent to just below 100 percent. (Note: It can't be exactly 100 percent, because then it would be a certainty, not a risk. And it can't be exactly 0 percent, or it wouldn't be a risk). **Impact:** A risk, by its very nature, always has a negative impact. Impact can be assessed in terms of its effect on: time, cost, quality. Analysis of risks using probability and consequences helps identify those risks that should be managed aggressively.

Table (1). Risk probability and impact

Scale	Probability	Impact	Weight
Very low	Unlikely to occur	Negligible impact	0.9
Low	May occur occasionally	Minor impact on time, -cost or quality	0.7
Medium	Is as likely as not to occur	Notable impact on time, cost or quality	0.5
High	Is likely to occur	Substantial impact on time, cost or quality	0.3
Very high	Is almost certain to occur	Threatens the success of the project	0.1

Probability/Impact Risk Rating Matrix

A probability and impact matrix assigns an overall risk rating to each of the project's identified risks. The combination of probability and impact results in a classification usually expressed as high, medium, or low. According to A Guide to the pmp book high risks are considered a red condition, medium risks are considered a yellow condition, and low risks are considered a green condition. This type of ranking is known as an ordinal scale because the values are rank-ordered from high to low.

4. Study Results

The Questionnaire is aiming at measuring the sources of risks, which are more significant in the terms of probability of occurrence and degree of effect. For obtaining precise results, based on the Statistical Package for the Social Sciences (SPSS) to perform the analysis process as per the followed statistical standards, represented in the mean, mean rank, and the standard deviation).

The questionnaire results are divided into two main sections. The first section is related the contractors' answers for the general questions, but the second one is

related to the contractors answers about (71) sources of risks, where the answer of each source is divided into two parts. The first part is related to probability of occurrence and the 2nd part is related to the degree of impact, if the risk occurred.

For the Questionnaire First Section (General Questions), the results are as follows:-

- For years of experience of Companies in constructional projects execution field, it become clear that nearly 46% of contractors in Egypt have more than 15 years of experience, but 25.9% of contractors in Egypt have experience ranging between 10–15 years of experience, and 14.8% of contractors in Egypt have 5–10 years of experience.

- Whereas, nearly 46% of contractors in Yemen have less than 15 years of experience, but 19% of contractors have experience ranging between 10 – 15 years, and 27.4% of them have experience ranging between 5 – 10 years.

- For the increase in Project period due to contractors' exposal to a risk, it becomes clear that about 98% of them in Egypt delayed in delivering the project on the time agreed upon in different ratios. Where 16.67% of the contractors are always exposed to delay in delivering the project, while 38% of them are often exposed to delay and sometimes 40.7% are exposed to delay in the project period.

- However, in Yemen, all contractors are exposed to delay in the Project period in different percentages, whereas 16.1% of contractors are always exposed to delay, while 40.3 % of them are often exposed to delay and sometimes 43.5% are exposed to delay.

- In respect of cost in the Project overrun the planning estimation due to facing a risk by the contractors, it becomes clear that all contractors in Egypt and Yemen have exposed to cost overrun the planning estimation. The percentages differ from a State to another. However, in Egypt, about 16.6% of contractors are always exposed to increase in the costs, while 37% often suffer from increase in the costs, and sometimes 46.3% suffer from costs overrun the planning estimation.

- However, the percentages differ in Yemen, where about 27.46% of contractors are always exposed to increase in the costs, while 35.5 often suffer from increase in the costs and sometimes 38.8 suffer from costs increase.

But for the second section of the questionnaire, the results of contractors answers on showing that the most important sources of risks which occurred to the construction contractors in Egypt are:-:-

4.1 Probability of Occurrence in Egypt and Yemen

This part contains the most important sources of risks, which had occurred to the contractors in Arab Republic of Egypt and Republic of Yemen according to the contractors' answers where the sources of risks are evaluated as per the mean. So the sources of risks, that got more than 3.00, are "Very Important". However, the sources of risks, which evaluation is ranging between 2.5 and 3.00, are considered "Important", but the sources of risks, which values are between 2.00 -2.50 are "Less Important" and the sources of risks, which evaluation is less than 2.00, are considered "Unimportant". As shown in table 2 and table 3

Table (2). The Most Important Risk Factors for Contractors and The contractor classes most affected by these factors in Egypt

N	Sources of risks	Mean	St. div	Sig
1	Loss due to war, civil disorder, revolution.. etc.	3.787	1.360	0.00
2	Delay in progress payment by the owner.	3.500	1.080	0.000
3	Loss due to inflation (increase the price of materials, plants, labors.. ..etc.).	3.490	1.195	0.075
4	Devaluation and varying rate of exchange.	3.444	1.186	0.039
5	Cost overrun due to planning estimation.	3.296	1.043	0.006
6	Design change by owner or his agent during construction.	3.157	1.033	0.470
7	Delay of construction project.	3.148	1.039	0.016
8	Delay in settlement of contractor's claim by the owner.	3.055	0.829	0.000
9	Cash flow problems faced by the subcontractor.	3.027	0.999	0.088
10	Delay in approval of contractor submittals by the consultant engineer (sample, tables, planning,etc).	2.981	1.022	0.439
11	Subcontractor's law credibility.	2.981	1.110	0.007
12	The conflict between contractor and consultant.	2.953	1.062	0.083
13	Interference by the owner in construction.	2.870	1.033	0.518
14	Poor qualification of supervision staff of consultant engineer.	2.861	0.961	0.299
15	Poor qualification of supervision staff of consultant engineer.	2.796	0.944	0.063

Table (3) The Most Important Risk Factors for Contractors and The contractor classes most affected by these factors in Yemen.

No	Sources of risks	mean	St.div	sig
1	Loss due to inflation (increase the price of materials, plants, labors .etc.).	3.741	1.042	0.065
2	Devaluation and varying rate of exchange.	3.701	1.133	0.975

Table (3) continue.

No	Sources of risks	mean	St.div	sig
3	Delay in progress payment by the owner.	3.685	1.099	0.028
4	Loss due to war, civil disorder, revolution.. etc.	3.532	1.225	0.014
5	Increase wastage of material.	3.508	1.016	0.015
6	Cost overrun due to planning estimation.	3.427	1.169	0.258
7	Interference by the owner in construction.	3.314	1.015	0.013
8	Shortage in supply of water, gas, electricity ..etc	3.233	0.407	0.407
9	Delay of construction project.	3.193	0.959	0.461
10	Effect of subsurface condition (soil composition, existent utilities, high water table ,... ..etc.).	3.179	0.007	0.007
11	Cash flow problems faced by the subcontractor.	3.161	1.171	0.225
12	Original contract duration is too short from the owner.	3.104	0.977	0.745
13	Severe weather condition on the job site (hot weather, cold weather, increase of raining, wind, sandstorm.. ..etc.).	3.096	1.192	0.111
14	Shortage of labor skill & lack of labors' experience.	3.056	1.287	0.001
15	Stoppage of working.	3.048	1.026	0.025

5. Conclusions

• It becomes clear that most contractors in Egypt and Yemen are do not know too much about the risk management techniques. So that it will be more appropriate if introductory seminars are to be held to make awareness for the necessity of risk management to the contractors under supervision of the Egyptian Federation for Construction & Building Contractors in Egypt and Ministry of Public Works and Highways in Yemen or Engineers Syndicate in each of the two countries because they are the responsible authorities for the contractors. Of course, these recommendations will be useful on the long-term, where they represent the first step in the right direction.

• In case of civil or public disorders or war occurred, it is advisable to stop the work until the circumstances become stable and a daily evaluation shall be made

after pursuing the events in progress in order to maintain the laborers and machineries, in addition to maintain what has been accomplished especially in the tension foci.

- The contractors are recommended, before entering into a tender, to study the Owner Economic Situation (whether the financing is governmental or private), his capability to finance the project phases to the end, and study the previous works of owner, if any.

- The contractors are recommended to be transfer some risks to subcontractors or suppliers in case prices inflation is expected to occur so that long-terms contracts shall be signed to guarantee that there is no rise in prices for all included in the tender's items.

- It is advisable to follow-up the State's economic and political situation and the effect of dollar exchange rate on it whether positively or negatively. When estimating the tender's exchange rate, the last rate of dollar shall be considered and taking into considerations of devaluation and varying rate of exchange

- It is recommended to follow up the project works in progress periodically at the same time with control of cost and quality through the project manager or by assignment of a responsible person for the quality and cost control, or by assigning the project manager therein if the project volume is small. So that will guarantee that there is no raise in the project period and cost in addition to no existence of depreciation in material.

- On the owner demand or any amendments on designs whether constructional or architectural, in increase or decrease, shall be registered in an official minutes to avoid holding or any responsibility in consequence thereof in addition to proving a longer period of time to make the owner's changes if required.

- The contractor should find different sources of income to avoid any impeding might occur to the contractor during the project execution because of owner does not fulfill his financial commitments as per the previously stated date.

- Prior to concluding a contract with subcontractors, a previous study should be made for their previous works and for the extent of contractors undertaking to deliver the items, which are authorized to them to be executed according to the contract duration and cost agreed upon and they are in conformity with the specifications to make sure of the subcontractors credibility.

- The Owner is recommended to study the project well prior to execution thereof, and granting sufficient time to study and design the project, and to appoint qualified consultant to takeover thereof. Furthermore, the consultant should be aware of the owner's requirements in order to take them into consideration before the project designing. It is recommended to improve the relation between the owner and the consultant on one hand and the contractor from the other hand, and to avoid any conflicts that might be occurred.

- Upon pricing the tender, it is recommended to study the site, make sure of basic services availability such as water, electricity, roads, and what are the increase in cost would be if they were not unavailable.
- The contractor should study the subsurface before bidding and make sure that the owner has made the sufficient sessions to avoid any problems might be occurred during the execution or inconvenience with consultant report with the different site conditions.

6. References

- [1] Hertz, D. B. and Thomas, H., "Risk analysis and its applications, Book Review", *Strategic Management Journal*, Vol. 6, No. 3, 1985.
- [2] Al-Bahar, J. F. and Crandall, K. C., "Systematic Risk Management Approach for Construction Projects", *Journal of Construction Engineering and Management*, Vol. 116, No. 3, 1990.
- [3] Levitt, R. E., Logcher, R. D., and Ashley, D. B. "Allocating Risk and Incentive in Construction", *Journal of Construction Engineering and Management*, Vol. 106, No. 3, 1980.
- [4] Porter, M., "Industry Structure and Competitive Strategy: Keys to Profitability", *Financial Analysts Journal*, Vol. 36, No. 4, 1980.
- [5] Shofoluwe, M. and Bogale, T. "An Investigative Study of Risk Management Practices of Major US Contractors." *14th World Multi-Conference on Systemics, Cybernetics and Informatics, WMSCI 2010*. 2010.
- [6] Heldman, K, "Project Manager's Spotlight on Risk Management", *John Wiley & Sons*, 2010.
- [7] Ahmed, S. M., Azhar, S., and Ahmad I., "Evaluation of Florida General Contractors' Risk Management Practices", *Revista Ingeniería de la Construcción*, 2002, pp 4-10,.

تحليل المخاطر لمقاولي التشييد في مصر واليمن

إبراهيم عبد الرشيد^١ - عبد المنعم سند^٢ - محمد الحازمي^٣

^١كلية الهندسة - جامعة عين شمس - مصر

^٢كلية الهندسة والتكنولوجيا - الأكاديمية العربية للعلوم والتكنولوجيا والنقل البحري - مصر

^٣طالب ماجستير - كلية الهندسة والتكنولوجيا - الأكاديمية العربية للعلوم والتكنولوجيا والنقل البحري - مصر

(قدم للنشر ٢٧/٠٨/٢٠١٥ ، قبل للنشر ٣٠/٠٩/٢٠١٥)

ملخص البحث. عادة ما تتعرض صناعة المقاولات للعديد من المخاطر التي قد تؤثر علي جودة ومدة وميزانية المشروع . هذه الورقة ستقوم بمناقشة عوامل الخطر الرئيسية التي تؤثر علي مقاولي التشييد في جمهورية مصر العربية والجمهورية اليمنية من خلال دراسة ميدانية شملت ١٠٨ مقاول في مصر بالإضافة الي ١٢٤ مقاول في اليمن توزعوا علي خمس فئات حيث استطلعت الدراسة وجهات نظر المقاولين حول اهم المخاطر التي يتعرضون لها بالإضافة الي تأثير تلك المخاطر علي المشروع . بعدها تم ادخال اجابات المقاولين الي برنامج التحليل الاحصائي (SPSS) مع الاخذ بالاعتبار المقاييس الإحصائية المعتمدة . واستنتجت الدراسة ان عوامل الخطر الرئيسية التي تعاني منها شركات المقاولات في مصر واليمن متقاربة نوعا ما وتتمثل في :

- ١- الخسارة نتيجة لحدوث حرب, اضطرابات مدنية, ثورة, اضطرابات شعبيةالخ.
- ٢- المخاطر المالية وتشمل (التضخم .و التأخير في دفع المبالغ المستحق من قبل المالك .و انخفاض قيمة العملة المحلية وتذبذب سعر الصرافة تجاوز تكلفة المشروع عن المخطط له)