RISK IDENTIFICATION AND RESPONSE METHODS: VIEWS OF LARGE SCALE CONTRACTORS WORKING IN DEVELOPING COUNTRIES

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Abstract

Risk management, as it relates to construction, is vital to the successful undertaking and completion of any construction project. One way to effectively manage project's risks is to develop more reliable means of identifying the most critical risks and the associated effective response methods. Research studies have extensively addressed this aspect of risk management. However, a small fraction of this research focused on identification of the critical risks encountering contractors working in the construction industry of developing countries, and few tackled identifying the risk mitigation measures employed in such an industry by domestic, international, and multinational contractors.

This paper presents a comprehensive methodology that addresses the risk identification and response methods for developing countries represented by Egypt. The paper is based mainly on the approaches used by large contractors either domestic or international.

The investigation, via a comprehensive questionnaire survey, tries to identify the most critical and significant risks that face the contractors working in the Egyptian construction industry and their associated effectively employed risk mitigation/elimination measures. Twenty-nine (29) construction project risks are classified into six (6) main categories according to their type and hundred and forty (140 risk) mitigation/elimination measures are introduced to overcome the impact of risks under each of these risk categories.

According to the collected data and the results of the statistical analysis procedures employed, the most critical risk encountered by the contractors working in the Egyptian construction industry are: 1)the financial inability of the client; 2)the improper management of construction projects; 3)inflation and interest rates; 4)in-house cash shortage; and 5)Foreign exchange and convertibility. 101 risk response methods were found to be effective from the 140 methods introduced. The most commonly used risk response method was the risk reduction technique.

Introduction

Risk is inherent in all human endeavors and the risk elements involved are diverse and varied (Odeyinka, 2000). Many researchers believe that the construction industry is one of the riskiest economy sectors because risks can affect productivity, performance, quality, and budget of a construction project (Ahmed et al., 2002; Kangari, 1995; Tah and Carr, 2000).

The common view of risk is that it is a negative event that results in loss, hazard, harm, and adverse consequences on the project (Mason, 1973; Moavenzadeh and Rossow, 1976). However, an increasing number of researchers are currently developing their definition of risk as an exposure to loss or gain from involvement in the construction process (Odeyinka, 2000; McKim, 1992; Healey, 1982; Perry and Hayes, 1985).

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Each party in a contractual relationship will perceive risks from their unique perspective. Owners, who are the ultimate beneficiaries of the contract, may only be considering the project from a construction industry share or production requirement perspective. Their greatest overall risk could reside in the ultimate product and not with the finished facility. Consultants' risks are not as extensive as the owner's or the contractor's and are, to a great extent, limited to design risks. A contractor's overall business risk can be thought of as a portfolio of risks made up of individual project risks. This portfolio changes frequently as some projects are completed and new projects are added. Unlike the designer, construction contractors work at higher risks created by the complexity of design and estimating total project costs (Smith and Bohn, 1999).

Risk management is becoming a crucial process to the success of construction projects because of such an industry that embraces many uncertainties. Furthermore, in developing countries the construction environment is much riskier due to the continuing evolution of laws and regulations, the high cost value of infrastructure projects that represent the majority of projects in such countries, and the economic and political instability.

Contractors working in these countries are in need of a simple but effective tool to help them properly identify the risks that they may encounter and the associated response methods to these risks. This study is focusing on Egypt, a developing country in the Middle East with an emerging reformed economical policy, a population of about 70 millions, and an increasing need of infrastructure and industrial projects.

The study has four main objectives:

1. Identify the most critical risks related to the Egyptian construction industry and their perceived criticality from the point of view of large scale contractors;
2. Identify the risk response methods employed by contractors working in the Egyptian construction industry and their effectiveness.
3. Compare the nature of construction risks encountered in the Egyptian construction to other international markets.
4. Develop a spreadsheet file that summarizes the findings of this research, which could help contractors in their preparation of effective risk management process for new projects.

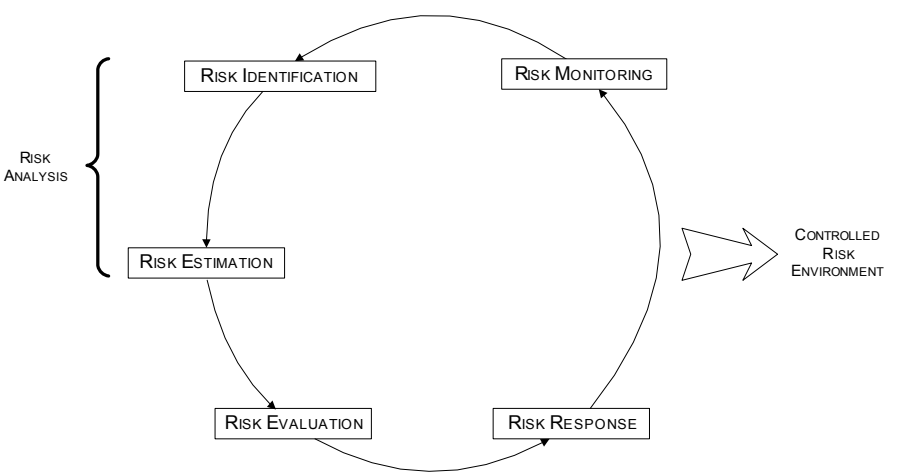

Figure 1: Controlled Risk Environment (after Baker et al., 1999)

Risk Management Process

Researchers, to a great extent, have agreed on the risk management process. However, some difficulties still exist on the terminology and steps' categorization. The five-step process introduced by Baker et al (1999) seems to have gained popularity because of its simplicity. The five-step process is captured in Figure 1.

Risk identification includes selection and classification of potential risks associated with a construction project. The primary basis for identifying risks is historical data, expert judgment, and adequate insight. Once identified, risks can be classified using a Hierarchical Risk Breakdown Structure (HRBS). Figure 2 shows an HRBS presented by Tah and Carr (2000) that allows risks to be separated into those that are related to internal sources and those that are prevalent in the external environment.

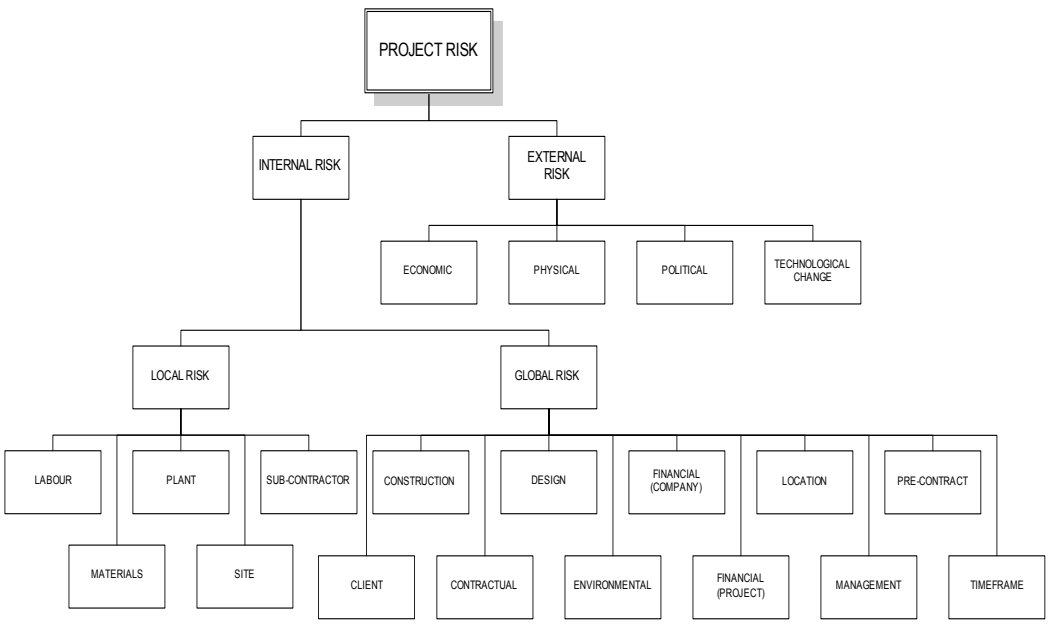

Figure 2: Hierarchical risk breakdown structure (after Tah and Carr, 2000)

Risk estimation or quantification is concerned with assessing the consequences of a certain risk. Risk estimating could include either quantitative or qualitative techniques.

Risk evaluation deals with the impact of risks. Evaluating the impact is based on the assessed consequences and the probability of occurrence of that risk. Kerzner (1998) introduced the following equation showing this concept:

$$\textit{Impact of risk} = \textit{(likelihood of risk)} \times \textit{(consequence of risk)} \qquad (1)$$

Risk response handles taking the appropriate actions to minimize or avoid the impact of risks. The risk response actions include the following: 1) risk avoidance; 2) risk sharing; 3) risk reduction; 4) risk transfer; 5) risk acceptance with contingency; and 6) risk acceptance without contingency.

Finally, risk monitoring aims to monitor the status of identified risks and ensure the proper implementation of planned responses and review their effectiveness.

Literature Review of Similar Studies

Wang el al (2000) conducted a study for evaluation and management of foreign exchange and revenue risks in China's BOT projects. The study was initiated by conducting unstructured interviews to filter the risks collected from the literature. This step was followed by a survey via a questionnaire in order to evaluate the criticality of risks. The study identified and proposed responses for about fifty (50) risks associated with BOT power projects in China.

Bing et al (1999) conducted a research to investigate the critical factors in International Construction Joint Ventures (ICJV) in East Asian countries and the most common and effective measures that the industry participants adopted for risk management. The research ranked a total of fifty-eight (58) risks categorized in three (3) main groups.

Smith and Bohn (1999) performed an investigation into the use of contingency in small construction firms. The main conclusion suggests that these firms assume proportionally greater business risk that suggested in the literature on contingency.

In their evaluation of Florida general contractors' risk management practices, Ahmed et al. (2002), via a questionnaire survey and in-depth interviews, evaluated the practices of risk analysis and management adopted by the general contractors in Florida construction industry and presented a comparison with four other US states considered to have highly profitable and modernized construction industry. The results revealed that in the Florida construction industry, risk analysis and management techniques are rarely used by the general contractors due to lack of knowledge coupled with doubts on the suitability of these techniques for the construction industry.

Research Methodology

In order to achieve the main objectives of this investigation, a specific research methodology has been followed.

The research was initiated by conducting literature review and performing unstructured interviews with expert practitioners in the construction industry. The data gathered from the literature and the practitioners were used to develop a comprehensive questionnaire. A questionnaire survey was administered to a carefully-selected group of qualified engineers in the construction industry. The data collected from the construction industry via the questionnaire survey was then processed by the means of statistical analysis for the purpose of generalizing its findings, as much as possible, to the entire Egyptian construction industry rather than the targeted sample. These findings were disseminated into a simple spreadsheet file developed to aid engineers working in the construction industry in preparing effective risk management processes for their new projects.

Figure 3 presents a schematic diagram of the methodology adopted in this research.

Questionnaire Development

The questionnaire consisted of three main parts over eleven (11) pages. The questionnaire content was finalized after conducting an extensive review of the relevant literature and consulting

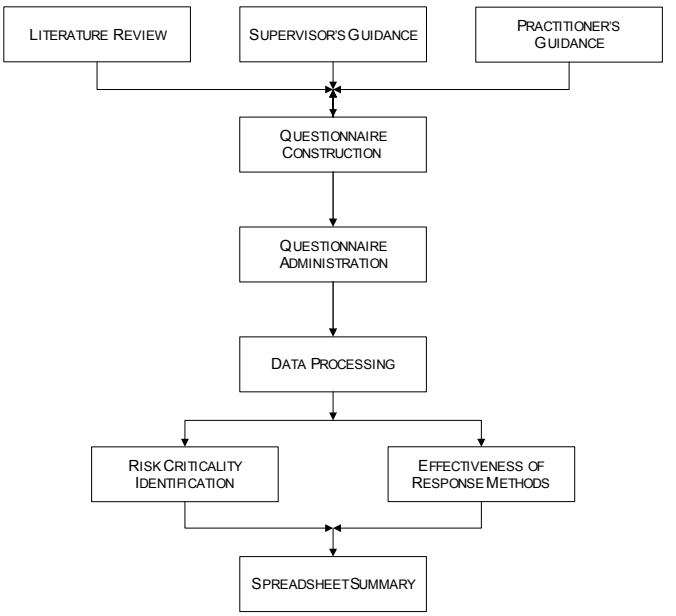

Figure 3: Schematic diagram of the research methodology

qualified and competent practitioners working in the field of construction. This questionnaire essentially contained a list of specific risks and a list of specific response methods from four response techniques: 1) retention; 2) reduction; 3) transfer; and 4) elimination.

The first part of the questionnaire included background information about the respondent, i.e. 1) name, 2) designation, 3) name of company he/she works for, 4) company nationality, 5) company ownership type, 6) types of projects acquired, 7) locations of project acquired, 8) experience, 9) contact information, and 10) asking respondent's permission for authorization of disclosure of his/her personal information for the sole purpose of this research. Some of the abovementioned information were labeled 'optional' to keep, as much as possible, the respondents privacy. The information labeled 'optional' was the name, company name, and contact information.

The second part of the questionnaire dealt with criticality of risks. In order to facilitate the process of identifying construction project risks from the perspective of the contractor, it was decided to classify risks according to their type. Hence, six main risk categories were identified: 1) financial and economic risks; 2) construction and design risks; 3) political/government risks; 4) client-generated risks; 5) subcontractors-generated risks; and 6) miscellaneous risks. A total of 29 different risks were grouped under these categories as shown in Table 1. The six subsections collectively included 29 close-ended questions using a 5-point Likert scale. An instruction of the indication of each point on the Likert scale was provided on top of the section. The scale points ranged from 1 (not critical at all) to 5 (exceptionally critical). Blank spaces were provided for the respondents, at their option, to list other key risks that were not listed in the questionnaire.

The third section of the questionnaire covered the effectiveness of risk mitigation measures. This section was divided into six subsections, one for each of the six risk categories. The six subsections collectively included 29 blocks each containing the response methods associated with the 29 risks. The response methods covered retention, reduction, transfer, and elimination

Table 1: Risks Included in the Questionnaire Survey

Risk Group	Risk Factors
[A] **Financial and Economic Risks**	– Foreign exchange and convertibility – Cash shortage – Inflation and interest rates – Competition.
[B] **Construction and Design Risks**	– Improper design – Improper project management – Constructability – Site safety – Low construction productivity – Defective work – Resourced unavailability – Defective material.
[C] **Political/Government Risks**	– Political instability – Change in laws – Corruption – Approvals and permits – Expropriation
[D] **Client-Generated Risks**	– Financial ability – Changing needs – Response to Claims – Possession of site
[E] **Subcontractors-Generated Risks**	– Technical qualifications – Financial ability – Variation of bids
[F] **Miscellaneous Risks**	– Differing site conditions – Physical damages – Force majeure – Partnership risks – Environmental protection

Table 2: Number of response methods per each risk category

	Elimination	Transfer	Reduction	Retention	Total / Category
[A] Financial	4	-	18	-	**22**
[B] Construction	6	7	22	5	**40**
[C] Political	5	3	18	2	**28**
[D] Client	5	-	6	6	**17**
[E] Subcontractors	1	3	10	-	**14**
[F] Miscellaneous	4	3	10	2	**19**
Total / Technique	**25**	**16**	**84**	**15**	**140**

techniques. The 29 blocks collectively included 140 close-ended questions. Table 2 displays the number of response methods used for each category of risks from each response technique. The complete listing of the 140 risk response methods are listed in Orabi (2003).

Questionnaire Administration

The members of the target population are the qualified contractors working in the Egyptian construction industry. A construction firm was deemed qualified if it was: i) a large scale domestic contractor that is recorded under class 'one' of building and complementary work categories according to the *Egyptian Federation of Construction Contractors*; or ii) an international or multinational contractor that is currently working in Egypt whether solely or under a partnership with another domestic or international contractor.

The respondent filling the questionnaire had to meet the following criteria: i)a total experience of at least ten years; ii)currently working or has been working, for at least five years, with a qualified contractor according to the criteria set before; and; iii) working in an area related to risk (i.e.: risk management, project management, project controls, tendering, … etc).

Based on these guidelines, the size of the target population of qualified contractors was found to be approximately 150 contractors. When applying a percentage of 10% and using an average of two replies from each contractor, the number of qualified replies should be around 30 responses. Such a number would satisfy the minimum requirement of statistical analysis.

Statistical analysis

The standard method of analyzing quantitative questionnaire data is by submitting them to various statistical procedures. These procedures are categorized under two broad categories: descriptive statistics and inferential statistics.

- *Descriptive Statistics* were used to summarize the data collected and present them in smaller space and easier to read and interpret format. The descriptive statistic procedures were performed on the different multi-item scales and each single item of the research questionnaire: Mean, Range, Mode, Median, Standard Deviation, and Skewness. The different risks and response methods were ranked according to their means in a descending order. This helped in achieving the first two objectives of this study since by this ranking process, the most critical risks facing contractors and the most effective response methods employed to mitigate the effect of risks were identified.
- *Inferential statistics* were used to measure the statistical significance of the results obtained from the descriptive statistics and if they were good enough to indicate a more generalized phenomenon. In other words, inferential statistics were used to generalize the results obtained from the statistical analysis performed on the sample data over the whole population. The inferential statistics procedure used in this research is the analysis of variance (ANOVA), which was performed to specify the variance of the results obtained between different company characteristics (i.e. company nationality and company ownership type). The significance tests are conducted at a 5% level of significance using an F distribution.

Analysis of Results

Company Nationality

Contracting firms of eight different nationalities have shown initial interest to participate in the survey, but only companies of seven different nationalities actually responded. Table 3 shows a breakdown of the response rate according to companies' nationality.

Table 3: Response rate breakdown by company nationality

Company Nationality	Initial interest	Actual response	Response rate (%)	Actual no. of replies	Replies / company
Egyptian	15	9	60	19	2.11
Lebanese	1	0	0	0	0.0
US	4	2	50	5	2.5
French	3	2	67	2	1.0
Greek	1	1	100	2	2.0
Japanese	2	2	100	2	1.0
Korean	1	1	100	1	1.0
Multinational	3	3	100	6	2.0
Total	**30**	**20**	**67**	**37**	**1.85**

Most critical Risks

The means of descriptive statistics were performed on the data collected from the respondents concerning the construction project risks to obtain the mean, minimum, maximum, standard deviation, and Skewness of each risk. The ranking of the 29 construction project risks are shown in Table 4 in a descending order according to their means. The criticality of the 29 construction project risks ranged from the lowest value of 2.50 to the highest value of 4.19.

Risk Responses Methods for the Most Critical Risks.

Of the originally listed one hundred and forty (140) response methods in the questionnaire, one hundred and one (101) were deemed effective to respond to risks in the Egyptian market according to the expert respondents. Only the responses for the top five (5) risks are included in this paper, Tables 5 to 9. The complete set of response methods to their respective risks can be found in Orabi (2003).

The most commonly used risk response technique was the risk reduction technique. Risk transfer and retention response techniques were found not suitable for eliminating and/or mitigating the impact of critical risks such as the financial and economic risks and few of the client-generated and subcontractors-generated risks.

Using contractual measures was a key risk response method that was perceived by all types of contractors as the most effective method to eliminate/mitigate the effect of most of the risks considered in this research.

In general, no apparent difference of the perception of effectiveness of the different risk response techniques studied between different company types whether based on nationalities or ownership types was noticed.

Comparison with other international Market

The third objective of this study was to compare the construction risks in the Egyptian market to other international markets. The study of Bing et al (1999) on China's construction market was chosen for that purpose. The top eighteen (18) risks of this investigation had a mean critical score of 3.0 or greater. The list of risks in the study of Bing et al. includes nine (9) of these risks. A closer comparison between the results of both studies indicates that each study identified five (5) risks in the top ten (10) list of the other study. In addition, the most critical risk in both studies was the same, namely; *Client Financial Ability.*

Table 4: The ranking of construction project risks according to their means

Rank	ID	Construction Project Risks	N	Min.	Max.	Mean	Std.	Skewness	
								Statistic	Std. Error
1	D1	Client's Financial Ability	37	2	5	4.19	.776	-.726	.388
2	B2	Improper Management	37	1	5	3.92	1.115	-.849	.388
3	A2	Inflation & Interest Rates	37	1	5	3.89	1.173	-.761	.388
4	A3	In-house Cash Shortage	37	2	5	3.81	.908	-.310	.388
5	A1	Foreign Exchange	37	1	5	3.68	1.292	-.575	.388
6	B1	Improper Design	37	1	5	3.49	1.044	-.194	.388
7	D3	Response to claims	37	1	5	3.49	1.017	-.296	.388
8	B7	Lack of Resources	36	1	5	3.33	1.146	-.468	.393
9	B6	Defective Work	36	2	5	3.31	.951	-.036	.393
10	E1	Subcontractors Technical Qualifications	36	1	5	3.28	1.003	-.064	.393
11	C5	Expropriation	37	1	5	3.22	1.669	-.097	.388
12	B8	Defective Material	37	1	5	3.19	1.050	-.400	.388
13	C4	Approvals & Permits	37	1	5	3.16	.928	-.119	.388
14	F4	Partnership Risks	34	1	5	3.12	.977	.166	.403
15	B5	Low Productivity	36	1	5	3.08	.967	-.174	.393
16	A4	Competition	36	1	5	3.03	1.134	-.057	.393
17	B4	Site Safety	37	1	5	3.03	1.093	.349	.388
18	F3	Force Majeure	37	1	5	3.00	1.374	.204	.388
19	C2	Change in Laws	37	1	5	2.97	1.142	.410	.388
20	E3	Subcontractors Variation of Bids	37	1	5	2.95	.998	.290	.388
21	C3	Corruption	37	1	5	2.95	1.026	.602	.388
22	E2	Subcontractors Financial Ability	37	1	5	2.89	1.125	-.024	.388
23	F1	Differing Site Conditions	36	1	5	2.89	1.036	-.257	.393
24	D2	Client's Changing Needs	36	1	5	2.89	1.008	.056	.393
25	D4	Possession of Site	37	1	5	2.84	1.167	.111	.388
26	B3	Constructability	36	1	5	2.72	.944	.818	.393
27	C1	Political Instability	37	1	5	2.68	1.107	.437	.388
28	F5	Environmental Protection	37	1	5	2.54	.931	.422	.388
29	F2	Physical Damages	36	1	5	2.50	.811	.852	

Table 5: Risk Response Methods for Financial ability of the Client

ID	Response method description	Mean	Std.	Skew.
D11	Ensure that a reputable owner finances the project	3.84	0.834	.017
D12	Specify extension or compensation clauses in contract for payment	3.78	0.917	-.228
D13	Enter into fixed rate loan contract with lending banks	2.86	0.918	-.175
D14	Finance the project from in-house sources	2.58	1.079	.495

Table 6: Risk Response Methods for Improper Project Management

ID	Response method description	Mean	Std.	Skew.
B21	Hire competent project manager and project team	4.00	0.882	-.514
B23	Undertake sound pre-project planning to minimize management risks	3.49	0.961	.040
B25	Establish a fixed standard project management system for all projects to follow	3.22	1.031	.021
B24	Subcontract project management to a specialized organization	2.70	1.051	.036
B22	Centralize project management activities at head office	2.56	0.939	-.279

Table 7: Risk Response Methods for Foreign Exchange and Convertibility

ID	Response method description	Mean	Std.	Skew.
A14	Include compensation clauses for exchange rate in the contract	3.46	1.095	-.628
A12	Use dual-currency contracts with certain portion to be paid in local currency and others in foreign currency	3.22	1.158	-.108
A11	Obtain government guarantees of exchange rate and convertibility, e.g. fixed rate for long period	3.03	1.500	-.310
A13	Use transfer tools to hedge exchange rate , e.g. forward and swap	2.57	0.979	.587

Table 8: Risk Response Methods for Inflation and Interest Rates

ID	Response method description	Mean	Std.	Skew.
A21	Secure standby cash flow in advance	3.47	1.158	-.454
A22	Incorporate escalation clauses for interest, inflation rates and delays in the contract	3.41	1.117	-.128
A24	Ensure that a reputable owner finances the project	3.30	0.996	-.114
A28	Sign fixed or pre-defined prices with material suppliers	3.24	1.140	-.034
A23	Obtain payment and performance bonds from banks	3.24	1.090	.028
A27	Adopt as much as possible domestic product/labor to reduce cost	3.16	1.014	-.005
A25	Specify extension or compensation clauses in contract for payment	3.11	1.008	-.056
A26	Enter into fixed rate loan contract with lending banks	3.05	0.998	-.290

Table 9: Risk Response Methods for Cash Shortage

ID	Response method description	Mean	Std.	Skew.
A34	Ensure that a reputable owner finances the project	3.35	1.060	-.030
A32	Owner to secure standby financing (i.e. more than 100% financing commitments when needed)	3.35	1.274	-.116
A33	Obtain payment and performance bonds from banks	3.16	1.214	-.131
A31	Get Letter of Credit from government	3.05	1.353	-.174
A36	Specify extension or compensation clauses in contract for payment	2.78	1.124	.210
A35	Adopt alternatives to contract payment, e.g. land development rights, or resource swap	2.27	0.693	.110

The fourth objective of this research was to develop a simple spreadsheet file that summarizes the findings of this research. The findings of the study were collected and summarized in a Microsoft® Excel workbook. This workbook contains nine worksheets, the first worksheet is a welcome screen that gives the user two options: either (1) to view risks classified according to their nature or (2) to view risks ranked according to their criticality. The second worksheet lists the names of the six risk categories: (a) financial and economic risks; (b) construction and design risks; (c) political/government risks; (d) client-generated risks; (e) subcontractors-generated risks; and (f) miscellaneous risks. The third worksheet lists the 29 construction risks that were identified by this research in a descending order according to their criticality scores. The remaining six worksheets are for the six risk categories, one worksheet per each category and it includes the risks in this category and the response methods associated with each risk.

Conclusions

The following section presents an overview of this research and a summing up of its findings.

The most critical risks that the contractors working in the Egyptian construction industry experience in their projects were complied in a form of checklist. According to the results of the statistical analysis procedures employed, the most critical risks were found to be:

1. the financial inability of the clients;
2. the improper management of construction projects;
3. inflation and interest rates;
4. in-house cash shortage; and
5. Foreign exchange and convertibility.

According to the number of risk factors deemed critical, the international and multinational contractors perceive the Egyptian construction industry as being riskier than the domestic contractors do.

Under the four different utilized risk response techniques, 101 risk response methods were found to be effective from the 140 methods included in this research. Mainly, the most commonly used risk response technique was the risk reduction technique. The statistical analysis indicated no apparent difference of the perception of effectiveness of the different risk response techniques studied between different company types whether based on nationalities or ownership types was noticed.

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