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RISK ALLOCATION FRAMEWORK TO MINIMIZE DISPUTES IN CONSTRUCTION PROJECTS: CASE STUDY OF EGYPT

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Abstract: Risks are generally defined as the variations in the possible outcomes that exist in nature for given situations. Construction projects in Egypt always experience high levels of risks and uncertainties due to their complex and dynamic environments. This, in turn, impacts projects in both time and cost and causes numerous disputes between parties. Usually, project participants allocate risks by aversion where owners tend to shift risks to the primary contractor, who in turn transfers them to the subcontractors. As a result of this, risks are not necessarily allocated/ re-allocated to the party that is best able to manage them efficiently and effectively. So as a step forward in the approach of mitigating these risks and decreasing their negative effects, an extensive literature review was conducted to identify the most prominent and evident risks in the construction industry in the Middle East and especially in Egypt. These risks were validated and more risks were gathered by the means of experts' one-to-one interviews. And then, a framework to properly allocate those risks to the most suitable party was developed by the aid of a survey questionnaire that was formed to assess the perceptions of experts in the construction field including owner representatives, contractors, as well as consultants on risk allocation. The allocation of each risk was either in favour of the owner, the contractor, or to be shared between both parties. The survey also assessed two other factors; the risks' frequency in the construction process and the risk significance in causing construction disputes. The results were gathered from the respondents and were analyzed, calculations were applied to the results to arrive to the most suitable allocation of risks between the project parties that if implemented, will significantly decrease the dispute level in Egyptian construction projects. Moreover, six actual construction projects in Egypt were used as case studies to validate the framework and the results were in favor of the framework developed.

1 Introduction

Construction of a project involves a lot of relevant activities to reduce the gap between the conceptual and execution stages. For a construction project to be viewed as complete, the project team needs to experience and overcome numerous abnormalities and uncertainties. One of those challenges is the 'Construction Risk', which is dominant in most if not all of the construction projects. The risk is usually characterized as an instance of uncertainties where the results fluctuate from the planned or anticipated ones, leading to misfortunes, losses, disputes and unforeseen returns. The risk is thought to be a potential difficulty particularly in the construction industry, considering the investments and time barriers.

Project risk management is one of the important aspects of the project management. Because of the uncertainty of construction risks, the losses due to risk directly impact all project participants' benefits as well as the relationship between them causing numerous disputes. Risk allocation is explicitly one of the causes that raise significant concerns by practitioners and researchers well as. Risk allocation is the process of allocating risk events with related and responsible project participants. It also provides another way for project participants to identify and classify risk issues (Issa et al. 2015). The concept of risk allocation is the process that allocates the potential risk loss or returns to each project participant to promote them for improving the enthusiasm of risk controlling and reducing the cost of risk-taking. One of the primary goals of risk allocation is to minimize disputes in construction contracts. Also, risk allocation is crucial to project success (Odunusi and Bajracharya 2014). The risk allocation process can be performed qualitatively and quantitatively (Rouhparvar et al. 2014).

In recent years, the researchers for risk allocation were mostly focusing on project risk allocation principles as well as problems in contracts (Hartman and Snelgrove 1996; Hanna and Swanson 2007; Zhenyu et al. 2003; and Dingjun et al. 2007). Allocating project risks is always a thorny problem that project risk management couldn't solve (Gao et al. 2008). Traditionally, in construction projects, owner seeks to pass almost of the risks to a contractor. Due to the discriminatory attitude to the risk allocation and unfair transfer of risks, the parties that these risks are imposed on adopting defensive strategies such as lowering the work quality, imposing large contingency charges, conservative design and eventually resort to claims, disputes, and litigation. Such defensive strategies may lead to project delays and project cost overruns (Nasirzadeh et al. 2013) as well as disputes between parties. The Construction Industry Institute (1993) points out that the predictability of risks can allocate the risks during the construction of a project. The risks, which could be forecasted by the experienced contractors, should be undertaken by the contractor; whereas risk that couldn't be forecasted should be carried out by the owner (Construction Industry Institute 1993; Chuang 2002). "Construction Risks and Liability Sharing," published by American Society of Civil Engineering, proposes a manageable risk allocation principle: the risk should be assigned to the participant who can best manage and reduce the risk (Chuang 2002).

2 Background

Many attempts have been made in literature to assess the proper allocation of the risks to the party most suitable to handle it. However, efforts were always country-related and include a great deal of subjectivity. In this section, some of the previous studies in the subject field will be studied.

In the United States of America, studies related to risk importance and allocation were conducted by Kangari (1995). He created a survey questionnaire based on a previous survey done by ASCE with the basic idea of trying to analyze if any significant changes had taken place in the contractor's perception towards risk allocation. One hundred large contractors were surveyed, and their responses showed their perceptions on rating the importance of given risks and how they could be allocated to either the owner, the contractor, or shared between both. Twenty-three different risks were selected to be included in the survey, and for a risk to be associated with the concerned party, a minimum response rate of 70% was expected by Kangari. The results of data analysis have allocated nine risks to the contractor, seven to the owner, four were shared, and the remaining risks were left undecided. Safety in construction projects proved to be the most serious risk for the contractors followed by quality of work while the least important risk was the changes in governmental regulations.

Similar efforts were also made by Kartam and Kartam (2001) and Al Bahar and Crandall (1990) towards an efficient risk allocation technique between the various parties in a construction project. Both studies utilized subjective approaches for risk allocation purposes.

In the study of Hameed and Woo (2007), both questionnaires and in-depth interviews were used for data collection as tools to test the views of construction industry participants in issues related to risk importance and risk allocation. The questionnaire was divided into three sections. Section one included the general information about the respondent and the company while section two assessed the importance of various risks in term of their impact on the project delay, and section three was related to risk allocation to either the contractor, the owner, or shared by both parties. The number of respondents used for the data analysis was 57, most of which were very experienced in the construction field. The ten top significant risks identified in the results of data analysis are 1. Delays in resolving contractual issues, 2. Delayed payment on contracts, 3. Political uncertainty, 4. Financial failure, 5. The scope of work definition, 6. War threats, 7. Suppliers/Subcontractors poor performance, 8. Change in work, 9. Defective design, 10. Labour and equipment productivity. On the other hand, the result of risk allocation data analysis showed that out of thirty-one chosen construction risks, thirteen construction risks were allocated to the contractor; seven were allocated to the owner and eleven were shared between the contractor and owner. Although it is recognized that the risk should be transferred to the party that is in the best position to deal with it, the survey indicates that Pakistani contractors are often responsible for most of the risk. Contractors consider themselves responsible for taking care of the risks associated with physical and environmental problems. The risks of this type include differing site conditions and adverse weather conditions.

El-Sayegh (2008) conducted risk studies and developed a questionnaire to put forward the risk allocation perceptions in the U.A.E. construction industry. The questionnaire was distributed to the construction professionals associated with the United Arab Emirates construction market. Only 65 out of 200 contractors surveyed and selected to fill the questionnaire were eligible for analysis as the rest were either incomplete or not returned to the concerned location. The relative importance index (RII) for each risk was calculated, and risks ratings were used to prioritize risks for further quantitative assessment or response planning. Sixty percent of the respondents indicated that risks are not properly allocated in the U.A.E. construction industry. The recommended allocation is for the party that gets more than 50% of the votes for each risk. Risks not achieving the minimum 50% of the votes were regarded as undecided.

Issa et al. (2015) directed a research study on risk allocation and importance in the Yemeni construction industry. For the purpose of this study, fifteen experts and practitioners with more than 20 years of experience were selected to fill the questionnaire designed using the Delphi method. The Delphi method utilized in this research consisted of two rounds and all the selected experts participated in both rounds. The assessment had three purposes: to test the criticality of various risks according to their respective WRF, allocate each risk to the corresponding party and decide what action should be taken to face those risks. The risk factors were organized from the most to the least critical in the following table.

Many different approaches to risk classification have also been recommended in the literature. Review of the literature shows that there is a lack of an accepted method of risk classification among professionals in the construction industry (Tah and Carr 2001 and Zavadskas et al. 2010).

Zavadskas et al. (2010) suggested three levels for project risk classification: external, project, and internal levels along with the source of each level. While Zayed et al. (2008) suggested a hierarchy level of classification based on macro and micro levels.

Another classification of project risk by Baloi and Price (2003) is pure risk versus speculative risk. Pure risk involves situations that can only end in a loss. For example, the risk of an accident or earthquake is a pure risk. Speculative risks, on the other hand, are situations that might end in a loss or a gain. For example, the risks of change in exchange rate or scope change are speculative risks. Speculative risks are dynamic and evolving while pure risks are more static due to their nature. Insurance does not deal with speculative risks but deals with pure risks only.

It is also usual to classify project risks into sets of classifications like dynamic/static, corporate/individual, internal/external, positive/negative, acceptable/unacceptable and insurable/non-insurable (Baloi and Price 2003).

Tah and Carr (2001) suggested a two-level hierarchy classification of project risks. The two levels are external and internal risks that was later adopted and modified by El-Sayegh (2008).

3 Methodology and Surveying Process

After analyzing the previous literature in the field of risk allocation, the research method was decided to include a sequence of one-to-one expert interviews that are based on the Delphi method, followed by a survey questionnaire that is sent to the interviewed experts and the results of the questionnaire was then analyzed to draw conclusions regarding the most efficient risk allocation framework for Egyptian construction projects. In the following sections, a detailed description of the steps taken towards obtaining significant results are discussed.

3.1 Survey Sample Selection

The sample size required for the survey is determined using the following formula (Kish, 1995)

no = (p * q) / v2 Equation 1

n = no / [1 + (no / N)] Equation 2

Where, no: first estimate of sample, 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 target population size, and n: the sample size.

The total population considered from the registered list obtained from the Egyptian Federation for Construction and Building Contractors (EFCBC) consisted of 60000 personnel. To get the maximum sample size required, the value of (p) and (q) were both taken as 0.5 (Marzouk and El-Rasas 2014). The maximum standard error allowed (v) in this study is 10%. Therefore, no = 3, and the minimum sample size required for the contractors in this study is: n = 25.

Since the number of contractor companies in Egypt is more than the number of consultant companies and owner representatives (Marzouk and El-Rasas 2014), therefore, it is sufficient to utilize the same sample size for owner and consultant representatives as for contractors. This means that the maximum sample size required for this study including all parties = 75 with a respective percentage of 33% for each party.

3.2 Experts' Demographics

An invitation to participate in the study was sent out to 164 experts in the construction field. The invitation included a description of the nature of the study and a detailed explanation of the required steps (two rounds of interviews followed by a survey questionnaire). Out of all the invitations sent, only 79 invitees agreed to take part in the study. The expert demographics were classified as shown in the following figure.

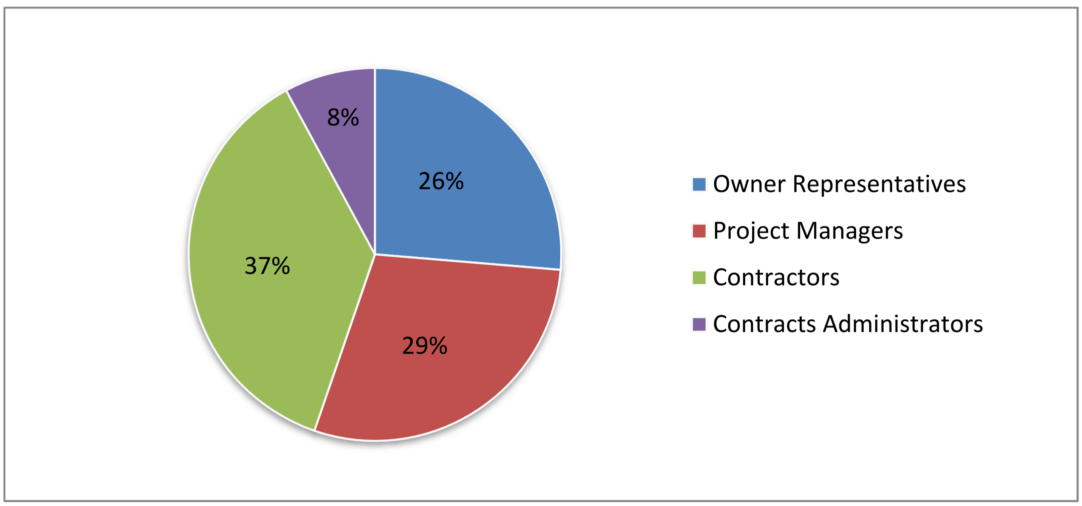

Figure 1 Experts' Professions and Backgrounds

Moreover, the majority of the respondents had more than 10 year of experience in the construction field, representing a percentage of 63%, and most of the respondents worked in large firms with more than 150 employees.

3.3 One-to-One Interviews

The expert interviews aimed to identify the main risks experienced in the Egyptian construction industry as well as their relative importance and suggesting the most suitable risk classification technique. Based on the Delphi method chosen for this section of the study, two rounds of interviews with experts in the construction field were conducted. In the second round of interviews, a summary of the main findings of the first round was given to each expert before further questions were asked.

This series of interviews identified thirty-seven main risks in the construction industry that were further classified and categorized along with their classification, relative importance and significance in causing construction disputes as discussed in the results section.

3.4 Survey Questionnaire

Following the interview rounds, a survey questionnaire was constructed to assess the perceptions of experts in the construction field regarding risk allocation followed by another round of interviews to finalize and verify the allocation methodology.

The first component of the questionnaire covered general details or background information about the respondents, which mainly focused on the party to which the expert belongs (contractor, owner, project management consultant, …etc.).

The second component was the main survey question, which can be further broken into two main sections.

The first section asks the respondents to fairly allocate given risks to the party they think is most suitable to handle the risk, regardless of what happens in practice. The party options are the owner, the contractor, and risk sharing between the owner and the contractor.

The second section tests the frequency of the risks to happen in construction projects in Egypt. The answers for this section range from very frequent, to rare.

The challenge was the great number of risks identified and that it was of great importance to keep the questionnaire quick and easy to complete. This was crucial, as there were too many risks to be allocated, and frequency rated. Therefore, for the ease of answering, the main answering technique chosen was a simple tabular format in which respondents select the choices of their preference quickly and easily.

3.5 Scoring System

After the experts' interviews, the relative importance and significance in causing disputes of each identified risk is to be calculated using the Analytical Hierarchy Process (AHP) to assign one importance factor to each risk based on the interviewees' opinions. The AHP method was selected rather than the to reduce the subjectivity in the methods implemented in the literature.

The risk frequency section scoring is done through an ordinal scale. This ordinal scale is a qualitative 3 points scale, namely very frequent, common and rare. This scale will be transformed into an interval scale by assigning a weight to each interval to facilitate the required parametric statistics. No scoring is needed for other sections of the questionnaire; however, the greatest percentage for a specific result is taken as the decision. Scoring will be as follows (after Al-Salman 2004 and Sunday 2010):

"Very frequent" equals 5 points, "Common" equals 3 points, and "Rare" equals 1 point.

Frequency Index of each risk category will be calculated as follows:

$$F1 = 5*X1 + 3*X2 + 1*X3 / (X1 + X2 + X3) \qquad \text{Equation 3}$$

Where:

F: Frequency Index (F1 denotes risk number 1 in this case), X1: no. of respondents answering "Very Frequent", X2: no. of respondents answering "Common" and X3: no. of respondents answering "Rare".

The allocation section results of the questionnaire were to be collected from the respondents and then minimum percentages of 70% were required for a risk to be allocated to a certain party. That is perceived as most suitable to handle it according to experts' perceptions.

4 Results and Discussion

Based on the experts' interviews, the risk classification technique chosen for this paper was a categorization adopted from El-Sayegh (2008), where construction risks are divided into internal and external risks. Where internal risks are those experienced within the project because of one party, and external risks are those beyond all parties' control.

4.1 Risks' Identification and Classification

The thirty-seven risks identified and categorized based on interviewees' perceptions are listed below in Table 1.

Table 1: Identified and Classified Risks

External Risks	Internal Risks
Acts of God	Delayed payment to contractors
Difficulty in claiming insurance compensation	Owner's unreasonably imposed tight schedule
War threats and political instability	Owner's improper intervention
Labor strikes and disputes	Change of design requirements by owners
Changes in laws and regulations	Lack of scope of work definition by owner
Corruption and bribes	Delays in obtaining site access and right of way
Criminal acts	Owner's breach of contracts and disputes
Conflicts due to differences in culture	Owner's sudden bankruptcy
Inflation and sudden changes in prices	Defective design
Currency fluctuation	Deficiencies in drawings and specifications
Shortage in manpower supply and availability	Frequent changes in design by designers
Unexpected inclement weather	Drawings and documents not issued on time
Unforeseen site conditions	Accidents during construction
Delays in resolving disputes	Poor quality of work
Unfairness in tendering	Low productivity of labor and equipment
	Unpredicted technical problems in construction
	Contractors' incompetence
	Lack or departure of qualified staff
	Subcontractors' poor performance

	Subcontractors’ breach of contracts
	Delay of material supply by suppliers
	Quality problems of supplier material

4.2 Risks’ Relative Importance and Significance

The relative importance (RI) and effect on causing disputes of each identified risk were calculated using a pair-wise comparison using the Analytical Hierarchy Process (AHP) as given in Table 2.

Table 2: Risks’ Relative Importance

Risk Factor	RI
War threats and political instability	0.479
Change of design requirements by owner	0.468
Contractors’ incompetence	0.411
Unexpected inclement weather	0.390
Owner's improper intervention	0.374
Labor strikes and disputes	0.368
Difficulty in claiming insurance compensation	0.368
Conflicts due to differences in culture	0.358
Unfairness in tendering	0.358
Shortage in manpower supply and availability	0.353
Inflation and sudden changes in prices	0.327
Unforeseen site conditions	0.286
Owner's breach of contracts	0.268
Corruption and bribes	0.263
Owner's sudden bankruptcy	0.261
Drawings and documents not issued on time	0.247
Delayed payment to contractors	0.242
Criminal acts	0.240
Currency fluctuation	0.240
Changes in laws and regulations	0.235
Owner's unreasonably imposed tight schedule	0.234
Subcontractors' poor performance	0.232
Delays in resolving disputes	0.216
Acts of God (Force majeure)	0.216
Unpredicted technical problems in construction	0.211
Quality problems of supplier material	0.211
Low productivity of labor and equipment	0.200
Deficiencies in drawings and specifications	0.192
Defective design	0.182

Subcontractors’ breach of contracts	0.179
Lack or departure of qualified staff	0.179
Lack of scope of work definition by owner	0.174
Accidents during construction	0.142
Delays in obtaining site access and right of way	0.126
Delay of material supply by suppliers	0.121
Poor quality of work	0.116
Frequent changes in design by designers	0.094

4.3 Risks’ Frequency Calculation

The frequency score of each risk was calculated using Equation 3 to determine the possibility of occurrence of each of the identified risks. The results of the frequency calculations are

Table 3: Risks’ Occurrence Frequency

Risk Factor	Frequency
Change of design requirements by owner	4.079
Currency fluctuation	3.649
Delay of material supply by suppliers	3.613
Subcontractors' poor performance	3.500
Delayed payment to contractors	3.468
Delays in resolving disputes	3.427
Poor quality of work	3.427
Low productivity of labor and equipment	3.427
Drawings and documents not issued on time	3.416
Inflation and sudden changes in prices	3.342
Frequent changes in design by designers	3.263
Defective design	3.211
Quality problems of supplier material	3.132
Deficiencies in drawings and specifications	3.132
Lack or departure of qualified staff	3.053
Corruption and bribes	3.000
Shortage in manpower supply and availability	2.974
Owner's unreasonably imposed tight schedule	2.947
Accidents during construction	2.868
Unforeseen site conditions	2.842
Contractors’ incompetence	2.818
Delays in obtaining site access and right of way	2.818
Unpredicted technical problems in construction	2.789
Owner's improper intervention	2.763
Lack of scope of work definition by owner	2.658

Subcontractors' breach of contracts	2.632
Difficulty in claiming insurance compensation	2.387
Owner's breach of contracts	2.351
Unfairness in tendering	2.316
Labor strikes and disputes	2.237
Unexpected inclement weather	2.091
War threats and political instability	2.079
Changes in laws and regulations	2.000
Conflicts due to differences in culture	1.816
Owner's sudden bankruptcy	1.789
Criminal acts	1.737
Acts of God (Force majeure)	1.711

4.4 Risks' Proposed Allocation

The proposed methodology of proper allocation of the identified risks to the most suitable party to handle the risks based on experts' perceptions as well as implemented calculations is shown in the table below.

Table 4: Proposed Risks' Allocation

Owner	Contractor	Shared
Delayed payment to contractors	Unforeseen site conditions	Acts of God (Force majeure)
Unfairness in tendering	Shortage in manpower supply and availability	Difficulty in claiming insurance compensation
Drawings and documents not issued on time	Labor strikes and disputes	Delays in resolving disputes
Frequent changes in design by designers	Quality problems of supplier material	Unexpected inclement weather
Deficiencies in drawings and specifications	Delay of material supply by suppliers	Currency fluctuation
Defective design	Subcontractors' poor performance	Inflation and sudden changes in prices
Owner's breach of contracts	Subcontractors' breach of contracts	Conflicts due to differences in culture
Owner's sudden bankruptcy	Lack or departure of qualified staff	Criminal acts
Owner's unreasonably imposed tight schedule	Contractors' incompetence	Corruption and bribes
Owner's improper intervention	Unpredicted technical problems in construction	Changes in laws and regulations
Change of design requirements by owner	Poor quality of work	War threats and political instability
Lack of scope of work definition by owner	Low productivity of labor and equipment	
Delays in obtaining site access and right of way	Accidents during construction	

5 Case Studies

To validate the proposed methodology of risk allocation, six case studies of claims and disputes between construction parties in small-scale construction projects in Egypt were utilized in this study. The proposed methodology was offered and explained to the project parties and a set of meetings and discussions were held to analyze the applicability of the framework.

The reasons of the disputes in those projects were first analyzed and compared with the identified risks in this study. In the table below, a summary of the causes of the disputes is given.

Table 5: Dispute Causes in the Six Projects Analyzed

Dispute Cause	Case Number						Proposed Allocation
	1	2	3	4	5	6	
Defective design	√						Owner
Delay of material supply by suppliers	√	√			√	√	Contractor
Subcontractors' poor performance	√	√					Contractor
Lack or departure of qualified staff		√					Contractor
War threats and political instability		√	√	√		√	Shared
Contractor's incompetence		√					Contractor
Labor strikes and disputes			√				Contractor
Delays in obtaining site access and right of way				√	√		Owner
Drawings and documents not issued on time				√			Owner
Change of design requirements by owner				√	√	√	Owner
Unforeseen site conditions					√		Contractor
Unexpected inclement weather					√		Shared

After that, the proper allocation arrived at by this study was proposed to the parties in dispute. The project parties' positive feedback validated the proposed framework as the parties in 5 of the 6 case studies agreed to the terms of allocation proposed in this study and approved it fairness and logic.

6 Conclusion and Recommendations

The overall purpose of this study was to shed the light on practices of risk allocation in the construction industry of various countries as a means to minimize disputes in the construction industry and applying them in Egyptian construction projects through proposing an allocation framework aiming to allocate the risk burden to the part most likely to be able to handle it. The methodology of the study included assessing the perceptions of experts in the construction field regarding the risk allocation most suitable to be applied in projects, as well as computing calculations on the results obtained from the survey phase related to risk frequency, importance and allocation to propose the framework that if implemented, will significantly decrease the dispute level in the construction projects.

During the framework construction phase, thirty-seven construction risks were identified. After applying the frequency and importance calculations on the survey results, thirteen risks were allocated to the contractor; thirteen to the owner and eleven were to be shared between both parties.

The proposed framework was analyzed and validated through actual case studies from real small-scale projects in the Egyptian construction market. The findings confirmed the framework's mechanism and disputes were resolved applying the proposed methodology.

Therefore, it is recommended that the framework is applied onto larger scale project to assess its suitability and applicability. It is also encouraged to perform similar studies in other regions and countries to test the differences between the perceptions of parties of different backgrounds and cultures. Also, contractual terms implementing the proposed allocation can be adopted to ease and facilitate the application of the framework in construction projects.

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