Journal of Engineering and Applied Sciences 12 (17): 4508-4513, 2017
ISSN: 1816-949X

Addressing Crucial Risk Factors in Jordanian Public Construction Industry

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Abstract: The main objective of this research is to recognize and categorize the most severe risk factors affecting the implementation of construction projects for public client in Jordan. A questionnaire was prepared depending on the literature review and 53 risk factors were identified and categorized into four groups (technical, management, financial and market and political, social and environmental). A survey was carried out and included 108 participants representing clients, consultants and contractors involved in the implementation of public construction works in this country. The analysis of results showed that 8 significant risk factors are technical related, risk factors are management related, risk factors are financial and market related and factors are related to political, social and environmental group. Out of the 53 factors, 20 of them found to have significant effect. The top 10 significant factors are; changes of design by different parties, management problems related to the contractors, design and contract documents errors, conflict in contract documents, lack of planning and budgeting of project, financial problems suffered by contractors, inappropriate communications between client and other parties, loss due to bureaucracy and late approval, material wastage on site rework due to labor mistakes.

Key words: Risk factors, construction projects, probability index, impact index, public projects, Jordan

INTRODUCTION

The Project Management Institute (PMI) recognizes nine knowledge fields. The management of risk is one of them (Project Management Institute, 2013). Implementing risk management operations will have clear advantage in terms of identifying and analyzing risk and elaboration of the operations recognized by the construction projects in addition to the optimum utilization of labor, material and plant and equipment (Pheng and Chuan, 2006).

The building and construction works are complex and active. This may be due to numerous feedback operations, so many parties participating who have different experience and concerns (Dey and Oyunlana, 2004).

The management of risk assists the parties engaged in the process of construction (contractor/sub-contractors, consultants/designers, clients, suppliers and others) to face their commitments and minimize the unfavorable impact on the achievement of the management of the project in terms of time, cost, quality, safety, etc.

In Jordan, the construction projects in general and public works in particular, facing various types of risks through the several phases of the project. The majority of these projects do not predict risk forecasting before and during the tendering stage.

The risk in construction should be recognized as events that affect the project objectives. Many of these risks regarded to construction operations can be estimated in acceptable manners (Al-Bahar and Crandall, 1990). The most recognized effects of risk related to project management are:

- The chance of not completing the project within the budget
- The chance of not finishing the project within the program set
- Not accomplish the expected quality and operational requirements
- Not achieving the health, safety and environmental requirements

Risk management-definition and context: The expression "Risk management" in the field of construction is concerning with identifying, analyzing and reacting to the risk associated with the implementation of the project. The management of risk included the maximizing of the performance of appropriate activities and reducing the effect of adverse activities.

British standard institute defined risk as "the uncertainly included in project plans and possibility of something happened that can affect the probability of achieving business or project objectives".

In a project situation, it is a chance of an operation or activity take place that will have an effect upon objectives. It includes the chance of losing or gaining or deviation from the predicted or planned outcomes as an outcome of the uncertainty associated with following a particular course of action. Accordingly, risk has two aspects. The first is the probability or chance of an action occurring and the second is the results of effect of it does.

Risk management is an integral section of effective management and fundamental to acquire successful business and project outcomes in terms of time, cost, quality and effective procurement of goods and services, risk management exhibits a clear way of assessment and dealing with future uncertainty.

Classification system of risk: The risk has been classified in many ways. Project Management Institute (2013) categorized risks related to construction projects as external risk and internal risk. The internal risk is concerning of all works whether they are national or international. More details are given by Aleshin (2001) to the classification of the risk. This researcher suggested political risk, commercial risk, social risk, property risk, safely risk, etc. The risk may also be classified to national or international (Ahmed and Wood, 2010).

The aims of the research: The aims of this research can be briefly listed below:

- Exploring and classifying the risk factors concerning the public construction in Jordan
- Using frequency, severity and total effect to rank the factors causing risk in construction of public project in this country

Literature review: In project management, one of the most critical factors affecting the process is risk. Many research works were conducted in the field of risk management in construction at the developed and developing countries. Carrying out a literature review to the previous research works in the field of risks associated with project management in construction projects.

According to their survey on the subject of risk management related to Build-Operate-Transfer (BOT) projects in China, Wang *et al.* (2000) concluded the following; the most critical risks are changes in law, delay in approval, expropriate and bribery. The way to regulate reduction of the effect of each of the risks was discussed too. In their study, Hastak and Shaked (2000), categorized all risks into three main categories. These are country risks, market risks and project risks.

Kartam and Kartam (2001) in their study which is related to Kuwaiti construction works, they indicated that constructors accept more risks related to nonstructural and legal reasons rather than other types of risks. Also, the study specified that the application of formal risk analysis system is not very usual in this country's construction industry.

Another study by Thomas *et al.* (2007) considered risk analysis perception to estimate the criticality of risk, the capacity of risk management and risk factors which may be accepted by stakeholders in BOT projects. Their study included major parties such as government's project participants, developers, lending offices and major Indian consultants/designer's specialists in BOT contracts. The research concluded eight types of risks as very critical but their effect on risk agreement by stakeholders were extremely different.

Wong and Hui (2006) conducted a survey included building contractors. They proposed sixty factors in a questionnaire distributed by post. The study revealed that the most recognized factors are cash availability, pervious experience of the contractors, uncertainty in costs estimates and size of project.

In the United Kingdom carried out a survey based on questionnaire to discover performance in risk allocation. The study revealed that some risks should still be possessed within the public sector or be divided with the private sector.

Kansal and Sharma (2012) conducted a study to evaluate the usage and method of risk identification systems of the construction industry. Their study concentrated on large scale industrial projects and infrastructure projects.

Ahmad and Wood (2010) studied the most influential mitigation measures taken into consideration by engineers involve in the construction process to manage the financial risks for the projects they are involve in. The study suggested other means of risk unwillingness.

In their study, Mahendra *et al.* (2013) suggested applying of risk management techniques which is inclusive of well-documented steps for the settlement of all kinds of ventures that most likely to take place through the different phases of construction project.

Renuka *et al.* (2014) examined the crucial risk factors and its assessment systems through comparison study of many international mega construction contracts. They concluded that risks play a significant function for the completion of project within the planned duration and planned budget.

MATERIALS AND METHODS

To achieve the objectives of the study, the methodology described below was followed:

Questionnaire: Depending on the literature review a questionnaire was prepared which contains two sections. The first section includes questions to find the sample characteristics participated in the survey (type of organization-client, contractor, consultant, etc., years of experience, size and types of project the respondents involved, etc.). The second section of the questionnaire has the factors affecting the construction process. In this study, 53 risk factors were considered, allocated to four groups. These are technical group (19 factors), management group (12 factors), financial and market group (13 factors) and finally political, social and environmental group (9 factors). The participants involve in the study were asked to estimate the level of frequency (probability) of occurrence and degree of impact each risk factor has. Likert scale of 1-5 was used as 1 represents "very small" and 5 represents "very large" for probability of occurrence and 1 represents "very low" and 5 represents "very high" for level impact.

Site visits: Many construction site visits and interview were carried out in the main cities in the country (Amman, Zarqa, Irbid and Aqaba).

Questionnaire distribution: This is carried out by hand.

Analysis of date: Details of the procedure followed will be presented and thoroughly discussed in the next section.

Writing up conclusion: Based on the data analysis, conclusions, recommendations represented to identify the significant risks; suggestions for remedial measures were also presented.

RESULTS AND DISCUSSION

Size and characteristics of the survey sample: The survey sample representing all parties involved in the construction process. Number of questionnaire sent and received is shown in Table 1.

The majority (78%) of the respondents have engineering experience of more then 15 years in implementing public sector's projects. The clients included in this survey were different ministries and municipalities while the contractors were selected from the first and second class only. The respondents participated in the survey were involved in different kinds of civil engineering of projects.

Table 1: Size of the sample

The respondents	No. of sent	No. of received	Percentage
Clients	70	36	51
Consultants	70	32	46
Contractors	70	40	57
Total	210	108	52

Table 2: The risk factors included in the survey

Groups	No. of factors	No. of significant factors	Average (TI)
Technical risk group	19	8	48.69
Management risk group	12	6	49.05
Financial and market risk group	13	5	44.27
Political, social and environmental risk group	9	3	43.12
Overall risk group	53	22	47.05

The importance of risk factors: As mentioned before, the study covers 53 risk factors distributed over 4 groups. Rating the importance (significance) of each factor was carried out depending on the frequency (probability) and severity (impact) of each factor. The most significant factors taken into consideration for each group are those with total effect index value above the average of the group.

Number of factors included in each group of the questionnaire, number of significant factor within the group and the average "Total Effect Index" are shown in Table 2.

Presentation of the results of the survey in terms of the probability index, impact index and total effect index for the four groups are shown in Table 3-6 while the results for the 53 factors included in the survey are shown in Fig.1.

The most significant 20 factors among the 53 factors (The total effect index greater than the average) are those shown in Table 7 ranked according to this index.

Table 7 shows that there are 20 "most significant" management risk factors affecting the construction projects. Among these factors 9 of them (45%) are technical risks, 6 factors (30%) are management factors, 3 factors (15%) are financial and market related and only two (10%) representing the political and social risk factors.

The reliability of factors analysis: Cronboch's alpha (Cα) test was utilized to examine the reliability of the risk management factors. Table 8 presents the cronbach's alpha for the 4 groups and overall factors. The criteria suggested by Nunnally (1978) for the interpretation of the consequences of the results of the analysis was used as: Cα> 0.8, "Excellent"; 0.8> Cα > 0.7 "Good"; 0.7> Cα>0.5 "Satisfactory" and Cα <0.5 'Poor'.

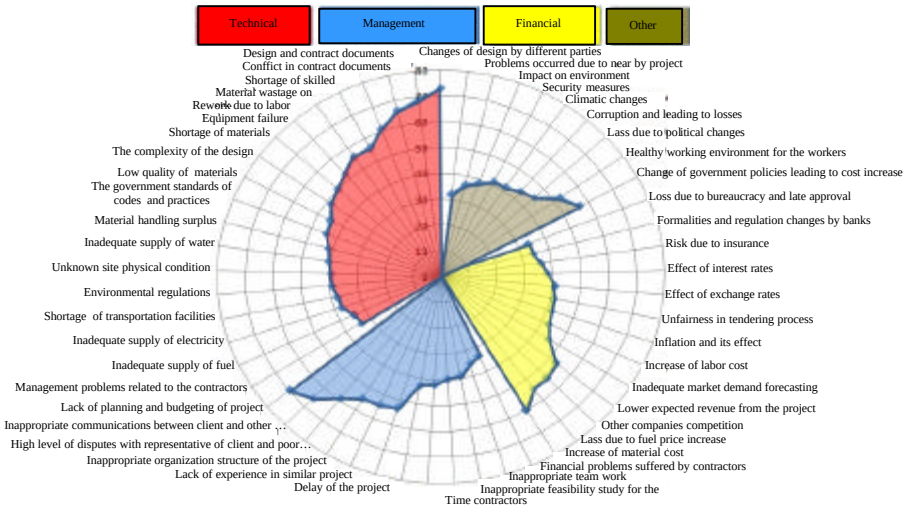

Fig. 1: The risk factors considered in the study

Table 3: The technical related risk factors

Type of risk	Probability of risk occurrence		Impact degree on risk		Total risk effect	
Technical risk factors average 48.69	(a)	Rank	b	Rank	a×b	Rank
Changes of design by different parties	84.68	1	86.33	1	73.10	1
Design and contract documents errors	85.21	2	80.58	3	68.66	2
Conflict in contract documents	82.12	3	80.67	2	66.24	3
Shortage of skilled labor	78.67	4	77.64	4	61.07	4
Material wastage on site	76.48	5	72.98	7	55.81	5
Rework due to labor mistakes	72.84	6	76.48	5	55.80	6
Equipment failure	70.38	7	74.61	6	52.51	7
Shortage of materials	68.94	8	72.71	8	50.12	8

Table 4: The management related risk factors

Type of risk	Probability of risk occurrence		Impact degree on risk		Total risk effect	
Management related factors average = 49.05	a	Rank	b	Rank	a×b	Rank
Management problems related to the contractors	85.37	1	81.47	2	69.55	1
Lack of planning and budgeting of project	79.67	2	82.37	1	65.62	2
Inappropriate communications between client and other parties	78.61	3	75.14	3	59.06	3
High level of disputes with representative of client and poor relations	73.47	5	74.67	5	54.86	4
Inappropriate organization structure of the project	72.46	6	74.68	4	54.11	5
Problems related to subcontractors	74.68	4	71.39	6	53.31	6

Table 5: The financial and market related risk factors

Type of risk	Probability of risk occurrence		degree of Impact on risk		Total risk effect	
Financial and market factors average = 44.27	a	Rank	b	--Rank	a×b	Rank
Financial problems suffered by contractors	76.38	1	78.46	1	59.92	1
Increase of material cost	74.58	2	73.12	4	54.53	2
Loss due to fuel price increase	72.82	3	74.67	2	54.37	3
Other companies competition	71.95	4	73.48	3	52.86	4
Lower expected revenue from the project	68.24	5	66.47	5	45.36	5

Table 6: The political, social and environmental related risk factors

Type of risk	Probability of risk occurrence		Degree of impact on risk		Total risk effect	
Political, social and environmental factors average = 43.12	a	Rank	b	Rank	a×b	Rank
Loss due to bureaucracy and late approval	72.45	1	78.32	1	56.74	1
Change of government policies leading to cost increase	71.39	2	72.98	2	52.10	2
Healthy working environment for the workers	70.48	3	64.28	4	45.30	3
Loss due to political changes	62.79	4	69.47	3	43.62	4

Table 7: Ranking of the most significant risk factors

Type of risk	Total risk effect	Rank	Groups
Changes of design by different parties	73.10	1	Technical
Management problems related to the contractors	69.55	2	Management
Design and contract documents errors	68.66	3	Technical
Conflict in contract documents	66.24	4	Technical
Lack of planning and budgeting of project	65.62	5	Management
Financial problems suffered by contractors	59.92	6	Financial
Inappropriate communications between client and other parties	59.06	7	Management
Loss due to bureaucracy and late approval	56.74	8	Political, social
Material wastage on site	55.81	9	Technical
Rework due to labor mistakes	55.80	10	Technical
High level of disputes with representative of client and poor relations	54.86	11	Management
Increase of material cost	54.53	12	Financial
Loss due to fuel price increase	54.37	13	Financial
Inappropriate organization structure of the project	54.11	14	Management
Problems related to subcontractors	53.31	15	Management
Other companies competition	52.86	16	Technical
Equipment failure	52.51	17	Technical
Change of government policies leading to cost increase	52.10	18	Political, social
Shortage of materials	50.12	19	Technical
The complexity of the design	48.24	20	Technical

Table 8: Reliability analysis

Factors	Cronbach's alpha	Results
Technical	0.765	Good
Management	0.548	Satisfactory
Financial and legal	0.479	poor
Political, social and environmental	0.638	Satisfactory
All factors	0.648	Satisfactory

CONCLUSION

The objective of the research was to identify and grouping the risk associated with construction projects in the public sector in Jordan. Ranking of factors was carried out based upon total effect index. To identify the significant factors in these projects, thorough literature review was done. This review and interviews revealed 53 risk factors. These factors were allocated to four groups.

A questionnaire was prepared and answers collected from 36 clients, 32 consultants and 40 contractors. The analysis of the questionnaire revealed the following:

- Total number of risk factors that showed significant effect was 20 out of 53
- The significant factors were distributed as
- The 10 most significant factors among the 53 factors included in the survey were the following
- Nine factors were technical related
- Six factors were management related
- Three factors were financial and market related
- Two factors were political, social and environmental related
- Changes of design by different parties
- Management problems related to the contractors
- Design and contract documents errors
- Conflict in contract documents
- Lack of planning and budgeting of project
- Financial problems suffered by contractors
- Inappropriate communications between client and other parties
- Loss due to bureaucracy and late approval
- Material wastage on site
- Rework due to labour mistakes

RECOMMENDATIONS

The study revealed the following recommendations: Parties involve in the construction process have to estimate, accurately and consider risks. This can be made by taking into account a risk premium to offers and time estimates. Cash flow management should be practiced by parties involved in the implementation of construction projects. This is necessary to prevent financial failure. In addition, dependence on loans from banks should be reduced. Hiring project management company, especially for large scale projects, to be engaged in design and construction phases.

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