Owners Risk in Construction Projects

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Abstract:
It is well known that risk is existed in the construction and engineering projects, and the modern development in construction industry led to complicated designs and also complicated construction methods not known before. So that we need now to understand the kind and natures of these new risks to enable us to develop a strategy for modern risk management.

It is well known that the risk management has direct relation with construction management and ability to complete the project in time and within the budget. Accordingly, we need a clarified strategy that notifies the mangers to the possible risks during the project construction period to enable them to mitigate these risks.

The difficulties in constructing new contemporary and modern construction projects where new executing ideas are applied are in evitable and also un known before to the construction mangers so that they need to mitigate these risks which they may face them during the construction phase without having enough previous experiences in these kinds of projects.

This research tends to focus on the specialty of the Risks in modern engineering projects and clarifying when we need to check them and mitigate them.

This study examined the risk allocations during the construction phase of the project and the directions of the International Standard Organization (ISO 31000 – 2009) which is related to the risk management and the methodology of applying the risk management (RM).

Keywords: Risk Analysis, Risk allocation, Project Risk Management (PRM), Project Management, Risk Management.

Introduction

The Construction Industry is a fundamental industry in each country and considered one of the important industries in the world as the world is investing more than 3 trillion dollars every year in this industry, besides we see that around 40% of the economy in the country is depending on the manufacturing and/or installing the construction materials, so that it is normal to see the great interests in this industry all over the world. It is well noted nowadays that the Construction industry has changed significantly over the past twenty years, the new mega engineering projects are becoming more complex as new designs and technology are used.

Also changes came from the big contribution of the private sector in this industry so diversity in the goal of the project's parties whom they are working in the same project makes the management of these kinds of projects is really a challenge.

So that neglecting risks studies in these kinds of mega engineering projects will certainly lead to danger and big possible losses that may affect the existence of the company.

Accordingly, Risk management is an important task for the construction managers and must be performed properly for avoiding failures and losses.

Risk has been defined in Merriam Webster, Inc.'s (1997) dictionary it is the

possible loss to either parties involve in a contractual agreement or anything that creates or implies a possible hazard, which is encounter in reality by every commercial party on a regular basis.

The sources of risks in the construction projects ae divided into two main categories (Fig 1):

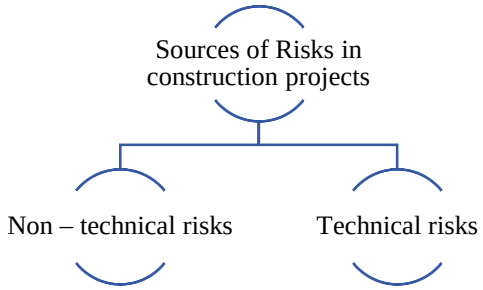

Fig1 – Sources of risks

Non-technical Risks are risks not related directly to engineers' performance and engineering decisions.

Technical risks are risks related to engineers and their performance before and during the project life cycle.

The technical risks of the construction (where the contractor work will be finished at the end of maintenance period) are divided into three phases (Fig 2):

1- Tendering and pricing
2- Construction phase
3- Maintenance

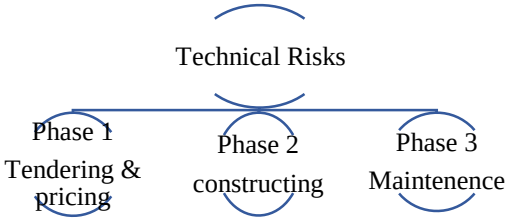

Fig2 – Sources of risks

Each phase has its own kinds of risks beside the common risks which will last till the end of the project like the decennial liability.

We will examine in this article the index and percentages of these risks till we reach to percentages values for risks that will help the owners in figuring the risks ratios and enable them to focus on the very important issues which have more effects on the risks of the project. That will minimize the risks of the project.

5.1.5. Discussion

As the Engineering projects are widely varied in volumes, characteristics, and natures there is no absolute one best technique could be applied for all projects. In this study, we are focusing on main guide lines technique which could be applied on most projects.

The contractors' traditional major concerns in the engineering project are time, and cost (finishing the project within the contractual time and according to cost estimates).

Challenges:

Because of diversity of Engineering projects and the new developments in method of construction and materials used we can say that each project is a challenge in itself.

Some new projects especially where new construction methods and materials are to applied are new challenges and contain big risks in timing at least, that off course will have big effect on cost as a natural consequence of prolongation if the project did not complete within the contractual time period.

It is noted that if the prolongation was merely because of the contractor then the contractor is to pay liquidated damages to the owner adding to that he is to bear its own expenses during the prolongation period.

So that it is recommended to study the risk in the new projects very carefully and accurately and then prepare risk management plans for mitigating the risks. Shenhar and Dvir, 2007 [1] clarified the four aspects of the novel projects:

(1) the uniqueness of the constructed facility;

[1] Shenhar, A. and D. Dvir, 2007. Reinventing Project Management: The Diamond Approach to Successful Growth and Innovation. 1st Edn., Harvard Business School Publishing India Pvt. Limited, Boston,

ISBN-10: 1591398002, p 288, pp: 276.

(2) the innovation of the building technology or of the construction process;
(3) the complexity of the system design and its subsystem assemblies; and
(4) the criticality of the time frame requiring a fast pace and time-critical construction effort. Therefore, a highly complex construction project can be a unique, complicated system design that uses breakthrough technology and requires a rapid development process.

PROJECT RISK ANALYSIS TECHNIQUES

The main process of construction projects risk analysis demands appropriate and efficient techniques.
There are many techniques could be applied among them the Monte Carlo simulation technique which is widely used and effective.
Johnathan Mun[2] clarified that Monte Carlo simulation is a type of parametric simulation where specific distribution parameters are required before simulation can begin. The alternative approach is non-parametric simulation where the new historical data is used to tell the story and no distributional parameters are required for the simulation to run
Monte Carlo Simulation.
Monte Carlo simulation method is a computerized mathematical technique that allows evaluations in quantitative analysis for the risks in our decisions related to certain issue.

By using Monte Carlo simulation method, we can see the possible outcomes of our decisions and probabilities of them that enable us to evaluate the impact of risk more accurately.

Monte Carlo method calculations started by building a model for possible result that will be by submitting values, and probabilities (within range) for any uncertain factor. The computer will then calculate the results and repeat the calculations the repeating trials could reach to hundreds or thousands of times using a different set of random values taken from the probability functions. Then the computer will distribute the possible outcomes.

The main idea and the way of computer calculations is that the Probability distributions are more realistic in analyzing uncertainty in the risk variables' analysis. So, in this way Monte Carlo simulation will furnish us with more comprehensive view of what could possibly happen in future and how much it will be likely happened.

definitions:

Business Dictionary defines the risk as the probability or threat of damage, injury, liability, loss, or any other negative occurrence that is caused by external or internal vulnerabilities, and that may be avoided through preemptive actions.
Risk: is an event has a likelihood of occurrence, and is having negative impact on at least one of the main objective of the project (i.e. program, cost, quality and safety).
Uncertainty: is a factor which cannot be assessed accurately. Accordingly, its future effects and consequences cannot be accurately expected.
Opportunity: A positive and uncertain event, if it occurred it will help in achieving goals.
Risk and opportunity are sharing the elements, of likelihood of occurrence and level of impact.

[2] Johnathan Mun, " Modeling Risk – Applying Monte Carlo simulation real options, analysis forecasting and optimizing technique, Willey financing publishing 2006, p 591, pp 77.

Risk assessment: is identified by Georgie Pabov et al[3] as follow: Risk assessment is part of risk management which provides a structured process that identities how objectives may be affected, and analysis the risk in item of consequences and their probabilities before deciding on whether further treatment is required. Risk assessment attempts to answer the following documental questions:

- What can happen and why (by risk identification)?
- What ae the consequences?
- What is the probability of their further occurrence?
- Are there any factors that mitigate the consequence of risk or that reduce the probability of the risk?
- Is the level of risk tolerable or acceptable and does it require further treatment?
- When we need to study the risk and mitigate the consequences.

Chapman[4], grouped construction risks into four Heads of risks that are
1-environment
2-industry
3-client
4-project.

Kamal M. Al-Subhi Al-Harbi focused in his researches on using experts when studying the risks, he stated[5]: Expert choice does provide facilities for performing sensitivity analysis, where the decision-maker can check the sensitivity of his judgements on the overall priorities of contractors by trying different values for his comparison judgements.

K. Jayasudha and B. Vidivelli[6] make a survey through questionnaire distributed to 200 construction companies about the engineering risks in the engineering projects. 155 company replied effectively. The result of calculating the standard deviation and the mean of the values for 90 events were as follow:
The construction Risk, and Management Risk have the maximum risk rating. Below is the table of the results:

Table no. 1
Risks in construction projects.
Source: K. Jayasudha and B. Vidivelli

SL	Description of Risk	Mean	Std. Dev
1	Incomplete Design	3.019	1.00
2	Inadequate site investigation	3.0129	1.00
3	Improper project planning and budgeting	3.0645	1.01
4	Inadequate specification	2.8839	0.93
5	Excessive approval procedures in administrative government departments	2.7871	0.86
6	The contractor does not pay worker wages in due time	2.8581	0.84
7	Tight Project Schedule	3.0065	.71

[3] Georgie Pabove and al, " Risk Assessment, a practical guide to assess", Published by Wiley 2016, p 450 pp 2

[4] *Chapman R.J., "The Controlling Influences on Effective Risk Identification and Assessment for Construction Design Management", International Journal of Project Management, Vol. 19m 2001, pp. 147-160.*

[5] *Kamal M. Al-Subhi Al-Harbi, "*International Journal of Project Management 19 (2001) 19±27*"*, published by www.elsevier.com/locate/ijproman", p 9, pp8

[6] *K. Jayasudha and B. Vidivelli "ANALYSIS OF MAJOR RISKS IN CONSTRUCTION PROJECTS",Department of Civil and Structural Engineering Annamalai University, Chidambaram, ©2006-2016 Asian Research Publishing Network (ARPN).VOL. 11,2016, NO. 11, p8, pp5*

8	Inappropriate time allocation	2.8774	.76
9	Insufficient time to prepare bid	2.8645	.81
10	Unsuitable construction program planning	2.8516	0.87
11	The worker does not abide by regular work-hours	2.7806	0.75
12	Plans of design are incompatible with execution.	2.9355	0.88
13	Many modifications on designs are made during execution.	2.9484	0.76
14	The designer does not follow up designs and changes made on them.	3.0000	0.89
15	Inability to execute the project within specified timetable.	2.8710	0.94
16	Necessary technical skills are not available	3.2065	0.87
17	Low productive efficiency of the worker.	3.0774	0.80
18	Some materials do not arrive at the assigned site.	3.1290	0.86
19	Absence of trained manpower.	3.0065	0.86
20	Selection of material and equipment	2.8323	0.91
21	Equipment failure	3.0452	1.00
22	Shortage of labours	3.0516	0.89
23	Shortage of equipment	3.0710	0.95
24	Quality variations by the labours	2.9097	0.84
25	Shortage of equipment	3.0710	0.95
26	Changes in material types and specifications during construction	2.9742	1.10
27	Undocumented change orders	3.0710	1.01
28	Labour disputes	3.0774	0.93
29	Designs are changed by the engineers	3.1806	0.89
30	Actual quantities differ from the contract quantities	3.1290	0.96
31	Defective design (incorrect)	3.2387	1.34
32	Not coordinated design (structural, mechanical, electrical, etc.)	3.2000	1.29
33	Inaccurate quantities	3.1355	1.23
34	Lack of consistency between bill of quantities, drawings and specifications	3.1806	1.25
35	Rush design	3.3290	1.11
36	Awarding the design to unqualified designers	3.2968	1.25
37	Breach of contract by project partner	2.9355	0.97
38	Improper verification of contract documents	3.0581	

39	Lack of enforcement of legal judgment	2.9677	1.05
40	Uncertainty and unfairness of court justice	3.0581	1.06
41	Competition from other similar projects	3.0774	.96
42	Increase of Labour costs	3.2129	.83
43	Increase of Material price	3.1548	1.01
44	Unfairness in tendering	3.0645	1.00
45	Unrealistic price variation in material	3.2000	1.06
46	Inadequate forecast about market demand	3.1742	1.09
47	Change of top management	2.9548	0.88
48	No past experience in similar projects	3.2258	0.95
49	Internal management problems	3.0774	0.92
50	Improper project feasibility study	3.1161	0.90
51	Poor relation and disputes with partner	3.2129	0.95
52	Project delay by the management problems	3.1613	0.99
53	Loss due to fluctuation of interest rate	3.1419	0.78
54	Change in bank formalities and lenders	3.0387	0.68
55	Loss due to rises in fuel prices	3.1161	0.81
56	Late payment by clients	3.2645	0.81
57	Cash flow problem	3.1613	0.79
58	Price fluctuation	3.3806	0.79
59	Tax rate increase	3.1290	0.77
60	Foreign currency exchange rate fluctuation	3.1548	0.81
61	Inflation	3.2710	0.82
62	Funding / Payment shortage	3.3226	0.70
63	Cancellation in giving loan	3.3161	0.86
64	The owner lags behind in paying the contractor.	3.2258	0.87
65	65 Construction prices are low.	3.1806	0.91
66	66 Competition in pricing projects.	3.0774	0.73
67	67 Large number of Construction companies	3.2516	0.74
68	68 Specialists in project financial analysis are not employed	3.0258	0.80
69	69 Inexperience when pricing tenders	3.2516	1.02
70	70 Changes in laws and regulations	3.0903	0.88
71	71 Changes in laws and regulations	3.1484	0.92
72	72 Requirement for permit and late approvals	2.9935	0.94
73	73 Loss incurred due to Corruption and Bribery	3.1742	0.97
74	74 Natural Disaster (Floods, earthquakes, etc.)	3.3484	1.20
75	75 Difficulty to access the Site (Very far, Settlements)	3.2645	1.08

76	Adverse weather conditions	3.1355	0.88
77	Pollution and Safety rules	3.2968	1.17
78	Problems from near project	3.0194	1.08
79	Local People support for project	2.8129	1.04
80	Accidents on workers	2.9613	1.30
81	Unexpectedly falls of the floors	3.3419	1.31
82	Electrical fires occurred	3.1161	1.29
83	Vehicle crashes on workers	3.0968	1.32
84	Being struck on the equipment	3.1290	1.15
85	Poor quality of materials procured due to damaged in structure	3.0516	1.27
86	Damage to equipment	3.1935	1.16
87	Labour injuries	3.2258	1.10
88	Wastage of materials by workers	3.4645	1.11
89	Equipment and material fire	3.3161	1.16
90	Theft of materials at site	2.9484	1.19

The above schedule is a useful practical result of survey. We could depend on it for further studies.
We studied this schedule and reach to conclusions states the percentages of risk which is clearer for the owner.
On the other hand the International Standardization Organization published the Practical Guide of risk management

In this guide, we see the ISO 31000[7] views about risk management, we quote from them the following: In many organizations, the management of risks with positive consequences is separate from the management of risks with negative consequences.
ISO 31000:2009 standard is clear in this view so it that the risk management process according to the ISO 31000:2009 (shown in Figure 3 Below) could be used for managing risks regardless of risks' nature, or their consequences.

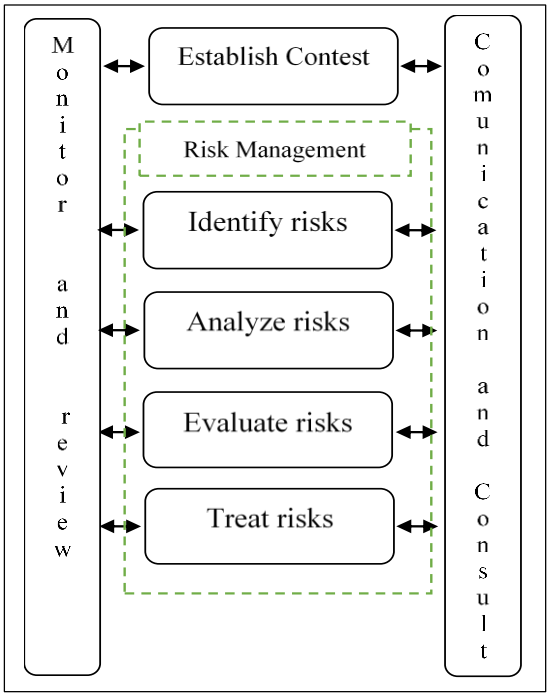

Fig 3 – ISO Risk Management

The ISO 3100:209 risk management steps are mentioned in fig. 3.
The construction process is in fact a continuous changing of the project environment so that studying of risks must follow the daily changes.
The volume of risks in the construction project starting high and reduced during the progress of project period till it disappear when the project is finished, handed over and all liabilities are fulfilled completely including the decennial liability period.
In some projects, there is no decennial liability period because the project is

[7] ISO 3100-2009 A practical Guide for SMEs, published by ISO, 2015, p 22, pp 15

designed for certain period like two years exhibition in this case the liability period will be two years only not ten years.

Table 2
Classification of non-technical risks
Source: K. Jayasudha and B. Vidivelli

	Type of risk	Description
	Non- technical risk	
A1	Management	No past experience in similar project. Inadequate forecast about market demand. Internal management problems. Improper project feasibility study. Necessary technical skills are not available. Awarding the design to unqualified designers. Inexperience when pricing. Improper planning and budgeting. Improper verification of contract documents. Many modifications on design material or specifications are made during construction. Undocumented change orders. The owner lags behind in paying the contractors. Competition from similar projects.
A2	Legal	Lack of enforcement of legal judgment. Requirement for permit and late approvals. Excessive approval procedures in administrative government departments. Uncertainty or unfairness of court justice.
A3	Political	Changes in laws and regulations. Loss incurred due to corruption and bribery.
A4	Environm	Natural disaster (floods, earthquakes…). Adverse weather conditions. Pollution and safety rules.
A5	Financial	Changes in laws and regulations. Changes in bank formalities and lenders. Cash flow problem. Loss due to fluctuation of interest rate. Unfairness in tendering. Increase of labor cost. Increase of material prices. Unrealistic prices variation in material. Losses due to rises in fuel prices. Prices fluctuation. Tax rate increase. Foreign currency exchange rate fluctuation. Inflation. Funding/ payment shortage. Cancellation in giving loan. Specialists in project financial analysis are not employed. Loss incurred due to corruption and bribery.
A6	Time	Tight project schedule. Insufficient time to prepare bid. Inability to execute the project within specified timetable.

Table 3
Classification of technical risks
Source: K. Jayasudha and B. Vidivelli

	Type of risk	Description
	Technical risks	
B1	Planning	Inadequate site investigation. Difficulty to access the
B2	Design	Incomplete Design. Inadequate specifications. Plans of design are incompatible with execution. Designs are changed by the engineers. Actual quantities differ from the contract quantities. Defective design. Not coordinated design (elec. , mecha…) . Inaccurate quantities. Lack of consistency between bill of quantities, drawings & specifications. Rush design.
B3	Construction	The contractor has no fair contract. Contractor does not pay worker wages in due time. The worker does not abide by regular work-hours. Low productive efficiency of the worker. Some material does not arrive at the assigned site. Absence of trained manpower. Selection of material and equipment. Equipment failure. Shortage of labors. Shortage of equipment.
	Construction	Quality variations by the labors. Labor disputes. Problems from near project. Local people support for project. Accidents on workers. Unexpectedly falls of the floors. Electrical fires occurred. Vehicle crashes on works. Being struck on the equipment. Poor quality of material due to damages in structure. Damage to equipment's. Labor injuries. Wastage of material by workers. Equipment and material fire. Theft of materials at site.

Depending on the results of the above mentioned schedule and after studying carefully its results we found that the results still need some developments to be able to be used easily in practice.
So that further researches and studies on many projects in the Arabic Gulf area (depending on the results of the above schedule) had been performed.
We reached to the fact that owners wants to have more simple and practical information, the percentages method is for them.
So that we need to quantify the results in percentages.
To do that we considered that the total of the Risks mean values are equal to the %100. We see that the total amount of risks' mean value for schedule A is 148.8, and the total amount of risks' mean value for schedule B is 108.94

The grand total (C) is the additions of both A+B which is equal to 257.75 is considered by us %100 of risk percentage.
C= 148.81 + 108.94
C= 257.75
Now for each head of risk we divide the risk amount by the total sum of risks so we get the percentage of each head of risk.

Results:
The results of percentages' calculations are included in the tables 4, 5, and 6 below.

Table 4
Ratios of Owner non-technical risks

A- Owner Non-Technical risks	(Risk=P*I) Total of means	Ratio %
Management	64.59	25.06
Legal	11.78	4.57
Political	6.33	2.46
Environment	9.76	3.79
Financial	47.61	18.47
Time	8.74	3.39
TOTAL A	**148.81**	**%57.73**

Table 5
Ratios of Owner technical Risks

B- Owner Technical risks	(Risk=P*I) Total of means	Ratio %
Planning	6.27	2.43
Design	31.18	12.10
Construction	71.49	27.74
TOTAL B	**108.94**	**%42.27**

Table 6
Owner total risks calculations

Total A + Total B	Total of means	Ratio %
TOTAL A+B	**257,75**	**%100**

The figures 4, 5 , and 6 are reflecting the results of the calculations.

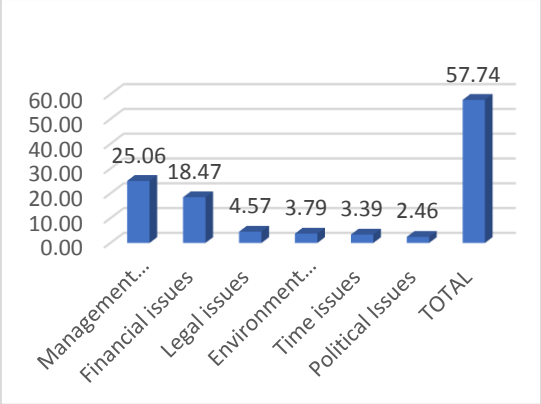

Fig 4 – Owners Non-Tech Risks ratio

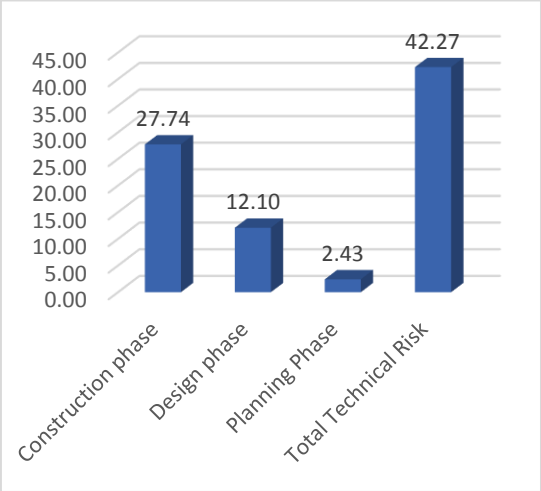

Fig 5 – Owners Technical Risks ratio

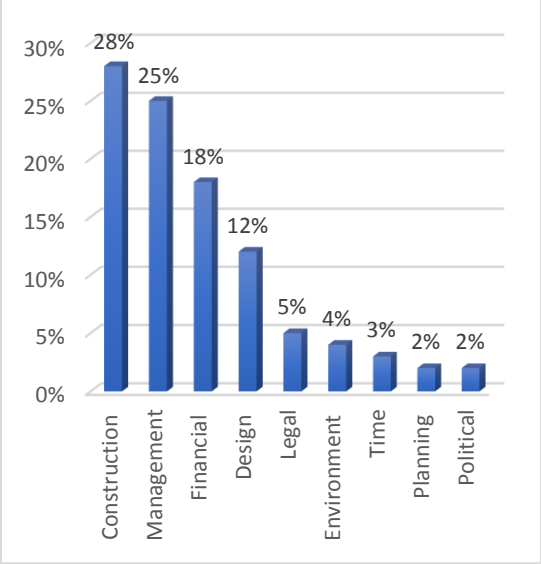

Fig 6 – Owner total Risks ratio

Conclusions:

We recommend the following to the Owner of projects:

1- Complex and novel projects certainly need Risk Calculations.
2- Risk Calculations for novel projects are to be performed by professionals and experts in the field not only by in house auditors.
3- The Owner Non-Technical risk ratio is %57.73 of project total risks.
4- The Owner technical risks ratio is % 42.27 of project total risks.
5- Management, Construction, and financial issues are the fields of main risks so that they need more attention from the owner for reducing their risks to be acceptable and keep the project more profitable.

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