

Assessment of risk management and evaluate the level of risk in construction project: Case Study

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Abstract. This study illustrates the risk assessment and analysis which was made as a requirement in the beginning of the project of a stadium. Risks at project are classified into ten items so that it is easy to manage and monitor them. Simple model is adopted in assessing risks such that it is easy to be understood and modified in contrast with the complex models that produce misleading. Sharing, mitigation and accepting risk are strategies adopted in the final assessment. In the case of sharing risks, it is shown that contracting strategy must be based on risk allocation. . In planning for risk, purpose must be clear as well as responsibilities and this can be shown precisely in a form of Risk Plan. The objective that this study serves is to identify the cost needed for the whole project from the stage of design to the finishing works. This includes all facilities in the stadium like the concrete frames, buildings and so. The study was very important to provide information to the contractor (a private company) and made confidence in that the estimated cost and time needed for achieving the objectives of the project are realistic and based on sound information. The experience gained from previous similar projects was an advantage factor in that most of problems were clear. The most important problem was the likelihood of delay, which, in the worst case will lead to dramatic increasing in costs. Therefore, the assessment of this risk was principal task in the study although it is necessary to take care for all potential risks. The study shows that risks at construction projects carried by many parties found to be changing according to internal or external changes and the change of priorities can be seen by simulating changes in ranking in each case. It is shown also that badly risk communication leads to real problems as in the case of making thought of building the stadium to be late. The cost of the delay which is the primary risk was calculated for each part of the project. For the construction activities, these were assumed to be the overhead. The time costs calculated was in maximum (\$ 1,500,000) which is about (10%) of the total cost of the project.

1. Background of the Project

The project under study is a stadium planned to erect in Iraq with an area of 12,500 square meters and a capacity of 10,000 persons as shown in figure (1). From the viewpoint of the practice obtained from previous similar projects it was obvious that sever risks will be involved and this situation affected the decision of constructing the new project. Risk communication played a great role in making this project to be late too much. However, constructing the new project is important due to increasing of sport activities. The final choice of location was made in the same of an old stadium taking in consideration the risks involved in the cost and in the ground type. Because of sudden decision was taken to make Olympics in the city the client proceeded with a critical condition of time (finishing the work) and hence delivery of the stadium project was limited induration . Time is the main risk in this case and all parties was recognizing this fact and the consequences that may be resulted . The client was going to enter in contracting with many potential risks. The contractor formulated a team consisting of engineers, finance and legal specialists in order to complete bidding works in a limited period. In view of time issues of the project and impacts of scheduling, although the scheduling process tends to be more deterministic than a repetitive construction project for example (especially in the uncertain environment of work in Iraq) , the time cost is the main key risk of the project under study [1].



Figure1: Project of Stadium

2. Literature review

Risk Management is considered one of most important managerial functions in construction projects This is so because it make the potential difficulties more clear and applicable in most cases to be overcome . To make good management, the key factor is identifying the potential risks which can be represented as additional costs. A questionnaire study made by Mana Ghahramanzadeh showed that the most critical risks which are influencing construction projects significantly revealed to be one of: cash flow, lack of financial resources, inflation, price fluctuations, and late payment which in a sense all can be considered to be outcomes of costissues [2]. To deal with cost increasing risk many approaches have adopted . A research using a probabilistic cost forecasting method has been developed using the Beta S-curve that provides confidence bounds on predictions [3]. The main goal of such probabilistic methods is to reduce as possible the uncertainty involved in all parts of project. However , in any adopted approach , the final risk plan should be conducted for all concerned members in the project In the report of York City Council prepared for risk management of the Community Stadium Project (2013) it is written that "The ineffective risk management leads to project costs escalating and leave the authority unable to implement an affordable scheme"[4] .

3. Methodology:

The process of themanaging risk followed a procedure from three steps:

- Risk identification
- Risk analysis
- Response

At tender stage, the management actions were limited to quantifying the risks and the strategy for allocation risks between the parties involved in the project. This led to two types of response: first is to transfer some risks to another party and the second is to accept others. The risk assessment and analysis in this study were to quantify impacts such as delay to the overall implementation time. [5] The measure used to assign the likelihood of each kind of risk as will be shown is based on a scale of three degrees. This will simplify calculation and thus make evaluation of risks more easy to be analysed [6].

3.1. Risk Identification

The risk identification involved work to complete check sheets by specialist groups (responsible for the construction proposals). These sheets identify the risk, the parts of the project likely to be affected, the probability of the risk and its potential impact on performance, cost and schedule. Ten major risks were predefined. Each risk was entered into an evaluation process to make ranking and classification by category and ownership. Efforts were made to ensure that errors and duplications were minimized. The risks were classified into three categories: [6]

- Engineering Risks
- Time Schedule Risks
- Supply Risks

Each of these risks have sub-categories as described in the following sections.

3.2. Engineering Risks

Engineering risks include those risks associated with design as well as execution of the project. In this project special design was made. The main problems were that the design provided was based on the location of an old building to be demolished. Risks may be released as follows:

1. Uncertainty of the ground conditions
2. Too large spans of beams (Risks of reduction in reliability)
3. The trusses in design drawings are arched ones. (complex in time and fabricating)
4. Works will involve heavy equipment working in dangerous conditions

3.3. Time Schedule Risks

Time schedule risks arises basically from the fixed timing for delivery, delay in supplying materials and in the dates of finishing of various activities especially the complicated ones. List of time schedule risks was prepared as follows:

1. Failure of delivery the project works on time. This will affect the reputation of the contractor company and its market place.
2. Risks of delay in a number of complicated activities (the large span beams and the arched trusses)
3. Risks of unavailability of materials and equipment that imported usually from foreign suppliers

3.4. Supply Risks

The contractor had a good practice in the process of purchasing and strong relations with the suppliers of the various components needed in the project. Still there was a number of risks regarding those components which must be imported from foreign suppliers and unusual situation due to short time needed for supplying materials.

4. Risks of increased costs resulting from limited time needed for supplying materials
5. From the contractor practice there was a risk involved in the way by which the components numbered and arranged especially the structural parts. This may create difficulties in assembling structures and hence a risk of time, cost and quality. [7]

4. Risk Assessment

The risks, had been identified were assessed and analysed in three stages:

•**First stage:** Risk allocation to identify parties should carry or share each risk. This led to proposals regarding the contracting strategy, the project management and execution in such a way included provisions for the transfer of risk from the contractor or for sharing risks with other parties, including contractors and suppliers. The ten major risks were those risks allocated to the contractor except the risk of ground conditions that was shared with the client by inputting a clear condition regarding it in the contract documents with the agreement of the client.

- **Secondstage:** Those risks allocated to the contractor or shared by him were reviewed and categorized according to whether or not they were included in the estimates. That is, they either allowed were included in the estimates and schedule or it was assumed that management action would be taken to avoid or reduce them. In the former case, the estimate and schedule were risk adjusted and in the latter the analysis were based on risks being mitigated. The second was found as the situation.
- **Thirdstage:** Those risks retained by the contractor, either in whole or in part, were those arising from the influence of market forces on the costs of resources and materials. These risks were included in the subjects of risk modelling and analysis to determine their likely impact on the project. Contractor had a good practice in the process of purchasing and strong relations with the suppliers of the various components needed in the project. Still there was a number of risks regarding those components which must be imported from foreign suppliers and unusual situation due to short time needed for supplying materials.

4.1. Criteria for Risk Assessment

1-Likelihood of Occurrence

Measure used to assign the likelihood of each kind of risk is based on a scale of three degrees. That is the greatest likelihood is of (3) and the unlikely risk is of (1) degree only. This will simplify calculation and thus make evaluation of risks more easy to be analysed [6]

2-Risk Intensity

Measure of three degrees also is used to assign the intensity of each risk. that is the impact of each event separately. The philosophy of choosing this approach is the same of the previous one.

3- Level of Risk

Measure of this step is obvious. The expected risk will equal the result of multiplying the likelihood of each kind of risk (from 1) with the impact of each risk (from 2). Thus risks will be measured by scale of (9) points

$$\text{Level of Risk} = \text{Likelihood of Occurrence} \times \text{Risk Intensity}$$

4.2. Review of Risks

Two risk analyses were developed, time schedule risk and cost risk. The **cost** risk analysis included the impact of the schedule risk expressed in terms of the time costs. The development of the work and review of the results was an iterative process that fell into two phases:

1. Development of the schedule risk analysis and review of the results.
2. Development of the cost analysis based upon the basic estimate.

4.3. Schedule Risk Assessment

The first assessment of potential delay to the implementation, and hence delay to the commencement of payment earning operation, was made for not to exceed estimate. It was based on the schedule main stages and the potential impact of the major risks on achieving them. The worst case was used in the estimate, although it should be noted that certain risks were excluded.

- Minimum duration. Completion, 1 months earlier than the contract.
- Most likely duration. Completion, 1 months late
- Maximum duration. Completion, 2 months delay

The cost of the delay was calculated for each part of the project. For the construction activities, these were assumed to be the overhead. The time costs calculated was as follows:

- Minimum: - \$ 200000
- Most likely: +\$ 550000
- Maximum: +\$ 1500000

It is assumed here that the delay occurs at the peak of the construction activities and would affect the civil works, the mechanical and electrical works and the project management. [8], [9].

4.4. Final Risk Assessment

Including schedule risks mentioned above, the risk analysis was performed using a spreadsheet model. The final model is shown in Table (1). The model will permit later to make the necessary allowances for the risk categories (described before) to be added to the base estimates for the construction and project management. The model consists of the expected severity, the likelihood of each risk and then the final values of risks. This simple model has the following advantages [10]:

- It is easy to understand.
- It can be modified easily.
- It avoids the need to correlate separate components of a complex model that do not behave independently so that produce misleading will not result.

Table 1: Risk analysis

Risk Description	Risk levels		
	Likelihood	Intensity	Level
Ground conditions	3	2	6
Spans of beams	3	3	9
Arched Trusses	2	2	4
Safety	2	2	4
Project Delivery	3	3	9
Complicated Activities	2	2	4
Materials	1	1	1
Shipping	2	1	2
Arrangement and Numbering	1	1	1
Article I. Market	2	1	2

5. Expected Consequences

Consequence represents impact that occurrence of the event will have on cost and schedule of the work [2]. Each issue will be evaluated on these three types as shown in table (2)

Table 2: Expected Consequences (Cost impact is in million dollars)

	Marginal : M	Significant : S	Critical : C
Cost Impact	< \$ 0.1	\$ 0.1- \$0.5	> \$0.5
Schedule Impact	None	Milestone	Date of Finish

6. Risk Categorization Matrix

Here is the Matrix of the Risk Categorization which is based on three categories as shown below in table (3)

- Low = 1 to 3
- Medium = 3 to 6
- High = 6 to 9

Table 3: Risk Seriousness

	Seriousness		
	Marginal : M	Significant : S	Critical : C
Very likely	Medium	High	High
Likely	Low	Medium	High
Unlikely	Low	Low	Medium

7. Risk Reporting and Monitoring

Risk reporting is very important issue that involves documenting risk identification, analysis, treatment and monitoring. Risk monitoring may involve actions such as responses to the risks and evaluation new risks if any. This takes in account any change to previous risks may occur. In the case under study the reporting has been carried out and the monitoring of risks assumed to be started from the moment of approval of this study. Table (4) shows the summarized plan for each individual risk to be reported and monitored where: [8]

B.C: Bearing Capacity

V.L:Very Likely,L:Likely, UN: Unlikely

Sig.: Significant, Med.: Medium, Mar.: Marginal

Crt.: Critical

Ex. M: Executive Manager

8. Conclusions

The conclusion that can be defined from this research are:

1. Risks at Stadium project are classified into ten items so that it is easy to manage them. Simple model is adopted in assessing risks such that it is easy to be understand and modified in contrast with the complex models that produce misleading
2. The risk at construction projects carried by many parties can change according to the internal or external changes and the change of priorities can be seen by simulating changes in ranking in each case.
3. Badly risk communication leads to real problems as in the case of making thought of building the stadium under study to be late
4. Contracting strategy must be based partially on risk allocation
5. Purpose must be clear from risk analysis as well as responsibilities. This can be shown precisely in a form of Risk Plan.

Table 4: Summarized Risk Plan

Element	Expected Events	Likelihood of Occurrence	Consequence	Seriousness	Risk Categorization	Action required?	Likely Cause	Mitigation Action & Responsibility
1	Ground Conditions	Lack of B.C	V.L	Increasing Time and Costs	Sig.	High	Yes	Information will not be Available
2	Spans of	Loads in	V.L	Reduction	Crt.	High	Yes	Lack of Heavy Factor of

	beams	access of design		of Reliability				Control on Sightseers Behaviour	Safety, : Designers
3	Arched Trusses	Delay of Execution	L	Increasing Time and Costs	Sig.	Med.	No	Complicated Design	Accept Risk. : Ex. M
4	Safety	Accidents	L	Safety hazards	Sig.	Med.	Yes	Method of Executing	Insuring Safety,: Ex. M
5	Project Delivery	Delay in delivery	V.L	Effects on Reputation	Crt.	High	Yes	Fixed Date for Delivery	Increased Control of productivity: Ex. M
6	Complicated Activity	Delay in Delivery	L	Increasing Time and Costs	Sig.	Med.	No	Complicated Design	Accept Ris . : Ex. M
7	Material	Not available on Time	UN	Increasing Time and Costs	Mar.	Low	Yes	Special Materials not Available in Local Markets	Suitable Provisions in Purchasing :Purchases Manager
8	Shipping	Delay or Damage	UN	Increasing Time and Costs	Sig.	Low	Yes	Lack of Control	Suitable Provisions:Purchases Manager
9	Arrangement & numbering	Unknown system of structural parts	UN	Increasing Time and Costs	Mar.	Low	Yes	Lack of Control	Suitable Provisions: Purchases Manager
10	Markets	Change in Prices	UN	Increasing Costs	Sig.	Low	No	Instability of Markets	Accept Risk. : Ex. M

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