

Risk Management in Construction Projects

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Abstract—Risk is involved in any construction projects. Management of risk is the key for a successful project. Risk management is useful for both client and contractor. Risk management goes into three main processes and they are; Risk identification, Risk assessment and Risk response. Implementation of the process of risk management before the start of any phase of the project will lead to less impact on cost, time and quality of the project. Project risk mitigation will reduce dispute between the contractor and the client as well reduce the risk for both contractor and client. Therefore, a well-prepared contract can list all risks associated with a project and assign suitable mitigation for these risks. The objective of this paper to identify all risks that the contractor or client may face during the execution of a project. The risks will be identified and analyzed based on experience and necessary mitigation for the identified risks will be presented. In this paper, project risks are classified into three categories based on project phases which are FEED and tendering risk, execution risk and commissioning and operation risk. All the major risks under each category are identified, assessed and mitigations assigned to each of the risks. It should be emphasized that risk management is an excellent tool to manage the risk in each phase of a project. Applying the risk management technique on projects will enhance project performance and efficiency in terms of cost, time and quality for both the client and contractor.

Index Terms—risk management, risk Assessment, risk identification, risk response.

I. INTRODUCTION

Construction project are exposed to high degree of risk from the start of project until the end of the project. Risk can be defined as any event or occurrence which might affect the achievement of project goals. Therefore management of risk is important to achieve project objectives and ensure timely delivery. Risks in construction projects might come up in different phases of a project such as Front End Engineering Design (FEED) & tendering, Execution, and Commissioning & Operation of the project. In the development of the FEED package, consideration shall be given to risk reduction events to limit the risk exposure of the Client as well as

the Contractor in order to achieve the objective of the project.

Risk management in construction projects is to deal effectively with uncertainty and unexpected events that could affect successful and timely completion of the project. If risks are not identified early during a project, it creates a lot of exposure and uncertainties to the project life cycle thereby affecting such aspects as cost, schedule and quality of the project. In addition, it could also create exposures in the area of Health, safety and Environment. Hence, risk management allows project managers to identify, analyze, respond and control the risks of the project. This is the reason why risk management is very important for the successful achievement of a project. In drafting the contract, the contracting strategy should clearly define the responsibilities of the client and contractor and such should be specific and understandable. This is to make sure that the risk is clear for both the contractor and client thereby avoid future dispute.

The importance of risk management in construction projects have been reported by several authors. It was concluded that risk management is essential to construction activities in minimizing losses and enhancing profitability [1]. It was found that risk management when successfully implemented on a project, offers the chance to gain a clear understanding of the goals, duties and contents of the service and the feasibility of the project [2]. It was stated that risk management will not remove all risks from the projects, its main objective is to ensure that risks are managed most effectively [3].

An example showed that formal risk analysis and management techniques are rarely employed by Pakistani construction industry owing to the lack of experience and knowledge in these area with resultant problems of delays, low quality and low productivity on projects [4].

It was concluded that Risk management is a technique that should be applied within the construction industry to achieve the goal of construction industry [5].

Often risk is ignored or dealt with in an arbitrary way on construction projects and it is common practice to add a 10% contingency to manage risk [6]. However it is often the unidentified hazards for which provision has not been made that will have the most significant impact on a project.

The risk is a measurable part of uncertainty and is assumed as a deviation from the desired level, therefore the risk analysis is so important for project selection and coordination of construction work [7]. Thus the task of effective risk management in construction is the prevention of losses caused by exposure to risk for example accidents, loss of money or time, damage to property or loss of reputation. Risk management in construction is designed to plan, monitor and control those measures needed to prevent exposure to risk. To do this it is necessary to identify the hazard, assess the extent of the risk, provide measures to control the risk and manage any residual risks [7].

It was stated that risk management is a technique that should be applied within an industry to achieve the goals of the industry, therefore it is necessary to spread awareness and create interest amongst people to use risk management techniques in the industry [8].

It is noticed from literature that researchers have demonstrated the importance of the risk management techniques in construction project. Therefore, in this paper, the use of the risk management mitigation and its input into the development of a new contract will be considered. Examples of the practical risks on a typical project and the necessary mitigation will be discussed.

II. METHODOLOGY

It is important to have a methodology which can minimize risk for all parties involved in the project. No project can be totally risk free. However considerable amount of risk can be minimized by carefully drafting the contract document.

The methodology should be arrived at by identifying the risks in the project, the areas which affect the performance of the project to a great extent, analyze them and define the suitable responses in order to mitigate these risks.

There are many tools and techniques to identify the risk such as documentation review, brainstorming of stakeholder of the project, Delphi Technique – consulting a team of experts anonymously, interviewing, root cause analysis, assumption analysis, SWOT (strength, weakness, opportunities and threats) analysis, and the checklist analysis which can be developed based on historical information and knowledge that has been collected from previous similar projects.

The responses for the identified negative risks can be managed by using the following strategies such as avoid risk, transfer risk, mitigate risk and accept risk.

III. RISK CATEGORIES

In this paper, construction risks are categorized based on the different phases of a project. Based on project phase risk categorization, the risks of construction projects can be classified into three categories as shown in Fig.1.

All risks classified under every category will be identified, and a response will be assigned to each.

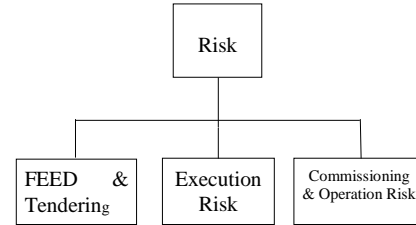


Figure 1. Categories of Risk

A. FEED and Tendering Risk

There are many risks that might occur in this phase of a project.

1) Inexperienced bidders allowed to bid for the project

In the qualification of bidders for the project, the client must ensure that qualified and experienced bidders are invited to bid. Political factors and external influences/interest must be avoided. Award of the project to an inexperienced bidder will be a risk to the project.

2) Poorly defined scope of work

The scope of work should be clear, unambiguous and specific as much as possible. Poorly defined scope of work will lead to many gaps and consequential changes which will be a major risk to the project.

3) Scope creep

The project scope of work could grow and get more complex by the addition of more requirements by the stakeholders. This will cause a risk to the project.

4) Undefined battery limit and interfaces of project with existing facilities

If the battery limit and interfaces with existing facilities is not clearly defined in the scope of work for the new project, this will cause a cost and time impact on the project which will be a major risk to the project. The interfaces can be physical interfaces such as piping, pipeline, electrical and instrumentation cables or even other interfaces such as with other stakeholders for example in obtaining operating licenses.

5) Compliance to laws and regulations

The laws of a country changes over time and most clients are not in complete control of this change. A major change in law such as environmental law, and such others may cause a major risk to the project.

6) Polluting the environment

If the design of the plant or the new project not meeting the environmental regulations. This will cause a risk to the project

A.7 Land Reservation, Power Reservation and Control system (DCS/ESD/F&GS) reservation with existing system:

If the reservation not secured before floating the project into the market. This will cause addition time and cost to project.

A.8 Unexposed Site Condition:

If the existing facility not exposed and all underground facilities not identified. This will cause a time and cost impact.

B. Executing Risk

There are many risks might occur in this phase of project

1) Shortage in manpower and unskilled manpower

Some of contractors are not providing the required manpower to complete the project and as well the skilled manpower to increase the productivity of project. This will cause a delay to the project as well as a loss of contractor profit.

2) Unsafety Behavior of contractor

Some of contractors are not providing the required skilled safety officers to guide the labors to complete their task in safety manner. This will cause a risk to the project

3) Unexperienced designers

Some of contractors are not providing the required skilled design engineers to complete the detailed design of the project as specified in the contract. This will cause a risk to the project

4) Commodity Price Fluctuation

Commodity price risk is the threat that a change in the price of a raw material will adversely impact a manufacturer who uses that raw material. The raw materials can be cotton, wheat, oil, sugar, copper, aluminum and steel. Unexpected changes in commodity prices after the submission of Bid will have a cost impact and risk to the contractor.

5) Currency Fluctuation

Currency fluctuation is the result of volatile the exchange rate from one currency to another. If the currency of contract price against other currencies has changed from the time of Bid submission to the time of invoice submission, this would have cost impact and risk to the contractor.

C. Commissioning and Operation Risk

There are many risks might appear in this phase of project

1) Failure in commissioning the project

If during commissioning some equipment fail to work. This will cause a delay to the project as well as a loss of contractor profit.

2) Output product not meeting the specifications:

If during commissioning the equipment succeed to work but fail to meet the output specification. This will cause a delay to the project as well as a loss of contractor profit.

IV. RISK RESPONSES

The suitable responses for the above mentioned risks as follows:

A. Feed and Tendering Risk Responses

A.1 Client conduct prequalification of bidders prior to issue the invitation to bidders. Only the qualified bidders will be invited to bid.

A.2 Client shall conduct several design review with all stakeholders in addition to other studies such as HAZOP, SELL, RAM and QRA

A.3 Client develop a process for managing the change of project during the FEED to control any change requested by project stakeholders to client designers and during the execution phase to control any change requested by stakeholder to contractor.

A.4 Client designers should make the demarcation of the project scope clear for contractor as well as any interfaces with existing facilities should be defined clearly.

A.5 Client shall provide the updated law and regulation and any change in these after bid submission the client shall compensate the contractor

A.6 Client designer must follow the environmental pollution agency rules and guidance and instruct the contractor to follow the same.

A.7 Client designers should reserve the land for proposed project including pipeline and cable routes. To avoid any clashes with other project during the execution of project by contractor.

A.8 Client designers should carry out site survey, slit trenching and topography survey and geotechnical survey. This is to expose the site condition for contractor to avoid any dispute in future.

B. Execution Risk Responses

B.1 The contractor shall submit in his execution plan during the bid submission, the manpower histogram, subcontracting plan and key personnel list along with CV so that the client will be able to evaluate the capability of contractor to execute the project.

B.2 The client shall state in his contract that the contractor shall provide safety officers for every certain numbers of labors working in same area and contractor shall adhere to this requirement.

B.3 The contractor shall submit in his execution plan during bid submission the CV for all lead design engineers as well as the engineering manager so that the client will be able to evaluate the capability of contractor designers to execute the project

B.4 The client shall include in his contract the commodity price fluctuation to tackle any unexpected changes or differences in commodity price at the month of bid submission and moth of Purchase order placement. A payment will be payable to the contractor if the price of the commodity at purchase order placement is higher than the price of commodity at bid

submission. On the other hand, a refund will be payable to client if the price of the commodity at purchase order placement is lower than the price of commodity at bid submission

B.5 The client shall include in his contract the currency fluctuation to tackle any unexpected changes in exchange rate between the contract price currency and certain currencies at the month of bid submission and month of invoice submission. A payment will be payable to the contractor if the exchange rate of the contract currency against other currencies specified in the contract at the time of invoice payment is lower than the exchange rate of the contract currency against other currencies specified in the contract at the time of bid submission. On the other hand, a refund will be payable to client if the exchange rate of the contract currency against other currencies specified in the contract at the time of invoice payment is higher than the exchange rate of the contract currency against other currencies specified in the contract at the time of bid submission.

C. Commissioning and Operation Risk Responses

C.1 The contractor shall appoint quality assurance manager and inspectors to assure the vendors/manufacturers are following quality procedure. Factory acceptance test shall be attended by both contractor and client to make sure the equipment/material is acceptable before dispatching to site for erection.

C.2 If any equipment failed to meet the output requirement, the contractor shall fix it with the assistance of vendors or the client will have the right to apply the punishment stated in the contract.

V. CONCLUSION

Risk management is useful technique for both client and contractor. Identifying the risks during drafting new contract and assign a suitable response to every identified risk will lead to positive impact on project in terms of time, quality and cost.

Highlighting all risks that can be raised during FEED & tendering phase, execution phase and commissioning & operation phase, and assign mitigation for these risk will reduce the dispute between contractor and client and

also reduce the risk for contractor and client. So risk management mitigation should start from drafting the contract.

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