

Integrating Project Risk Management and Value Engineering in Tendering Processes

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Abstract : Risk is highest in the early stages of the project lifecycle. This research focuses on practices of risk management in construction companies in order to submit competitive bids which achieve the project constraints and project success criteria within the acceptable profit margin.

Keywords: project risk management, tendering, cost risk, value engineering

1 Background for the Research problem

Construction companies tend to win bids in order to achieve their profit margins and business goals. It is the responsibility of estimation departments to write the bids and achieve the awarding of projects. The problem background arises due to the tremendous pressure to consider the global business challenges facing construction companies and to encounter for the high severity of risks in the industry. Risks from business challenges need to be considered in the top management strategy plans and risks from construction need to be dealt with in an effective risk management framework plan to avoid overruns and losses.

2 Research question

- How do we achieve accuracy, accountability, and consistency in risk-based cost estimation at tender stage?
- How can value engineering address a specific risk event or a series of events when implemented effectively during tendering processes as a risk response tool?

3 Study Objectives

- The purpose of this study is to examine and evaluate how contractor experts manage risks during the tendering process for large scale construction projects and highlighting the use of value engineering techniques as a risk response in a newly awarded project.
- It is important for construction companies to achieve accurate and accountable risk-based cost estimation and to exercise risk management efforts during the planning, environmental and design phases of project development to establish profitable and award winning contracts which are risk planned. The study focuses on the subject matter.

4 Research design and Methodology

The study design will be conducted in three phases:

1. Risk Management and accounting for Risk in Project Cost and Schedule during Tendering

2. Combining risk assessment and value engineering during tendering processes

3. Case study: Conducting value engineering for using slip form instead of traditional formwork in construction companies. Findings will be analyzed and discussed.

5 Risk Management

5.1 Common Risk Category

Risks commonly fall into two broad categories:

- 1) Risks identified by the Project Team (sometimes termed “known unknowns”)
- 2) Risks that are beyond the grasp of the Project Team at a particular point in time (sometimes called “unknown unknowns”).

5.2 Risk Management Processes

The risk management processes starts with identifying the risk based on the project context and inputs and then analysis is conducted using qualitative or quantitative techniques which will study the probability of the risk occurring and its severity. Finally based on the evaluation of the risks, risk treatment or risk response will propose an action response plan to deal with the arising risks. The riskmanagement processes will then be intergraded with the cost estimation processes to create the study model in order to be used during tendering. Risk is integrated into cost estimates during tender phase by determining risks and setting risk reserves in addition to the project base cost estimates.

6 Combining Risk Assessment and Value Engineering

The combination of risk assessment and value engineering is of particular importance in ensuring that the benefits of value and risk management are both best delivered in the management of projects. For value engineering to improve the overall value of the project, risk management must be considered to produce a balanced outcome (Boadi, Kennedy and Couture, 2015). An explicit reference to risk assessment at the early stages of a project ensures that the potential risks are understood, and targets identified through enhanced brainstorming. Value engineering is an important technique that helps in the identification and elimination of unnecessary costs in construction, product design, manufacturing, operations, practices and processes.

For over sixty years of existence and use, value engineering is referred to by different names. While some refer to it as value engineering, others call it value analysis, value methodology or value management. However, the reference to value engineering in different terminologies does not change its concept. The

concept of value engineering as a systematic process can be used to improve a project's value through a critical analysis of its functions by a multidisciplinary team. Value refers to the equivalent in goods, money, services or a fair return for something exchanged. It is most commonly represented in the relationship indicated below:

$$\text{Value} = \text{Function} / \text{Resources}$$

6.1 Value Engineering Job Plan

A job plan in the systematic process of value engineering outlines the specific steps used to evaluate an issue and attain the maximum feasible alternatives that address the issue in consideration. The issue being considered could be a particular event risk(s) that potentially can be dealt with through value engineering in the context of risk assessment (Cretu, Stewart and Berends, 2011). The analysis of functions, as done by a multidisciplinary team through the application of value engineering, helps to improve the value of a project. The multidisciplinary team is a value engineering team that comprises the project stakeholders and experienced professionals. A well-organized job plan that includes about six phases as a minimum is followed by the multidisciplinary team. The value engineering job plan comprises the following six sequential phases (Rao and Ranade, 2014):

- i) The Information Phase
- ii) The Function Analysis Phase
- iii) The Creative Phase
- iv) The Evaluation Phase
- v) The Development Phase
- vi) The presentation Phase

6.2 Integrating Cost Risk Assessment and Value Engineering

Value engineering and cost risk assessment augment each other well. The value engineering team through participation in the risk evaluation process gets a better project overview and the issues around it to understand the project risks. The combination of the two processes helps to utilize the resources efficiently (Woodward, 2005). Value engineering phases are integrated into the process of risk assessment in various ways. Under the information phase, a risk register is developed, and the contingencies and the bid items reviewed to mitigate risks. The members of the project team are expected to explain the development of the risk register to the value engineering team. The education mainly concerns the potential event risks and the baseline project. The secondary function of reducing risks is performed at the function analysis phase. At the creative phase, members of the value engineering team brainstorm on how to respond to the event risks identified in the information phase. Risk assessment is then incorporated as an evaluation criterion at the evaluation stage. The team formulates recommendations that aim to reduce risk at the development phase. They include risk assessment recommendations for value engineering that modifies the original design.

6.3 Identification of Value Engineering Alternatives

The value engineering team defines the opportunities and threats during the risk assessment workshop. These opportunities and threats are then carried over into the brainstorming list for

evaluation by the value engineering team along with other ideas defined (Woodward, 2005). The generation of ideas depends on the identified functions at the functional analysis phase. The value engineering team members then make an additional speculation on the 'reduce risk' function in order to address the risk factors that are identified during the risk assessment process. The so developed ideas are evaluated and then drafted into recommendations.

6.4 Development of Risk Response Strategies

The development of the risk response strategies is primarily done to capitalize on any opportunities and reduce the impact or likelihood of any threats (Boadi, Kennedy and Couture, 2015). These risk strategies although not all can be defined by the value engineering team. A small focus group of the project team members, together with the project manager and the subject matter experts can complete the risk response strategies as the value engineering team develops the recommendations. The project manager and the team can address several risks. These include the scheduling risks, staffing risks, and the management risks. The value engineering team addresses the more technical risks that deal with construction and design. Developing the risk response strategies is a coordinated effort between the leader of the value engineering team and the risk lead team to establish the risks that require a response and those that require further development. The additional risks that can potentially be created by the implementation of the value engineering recommendations are also defined.

6.5 Incorporating Value Engineering Recommendations into Risk Analysis

The VE team analyzes the effects of the risk response strategies in a number of dimensions in terms of ability to modify the chances of occurrence of the event risk and the schedule or cost impact of the event risk or both. Not all recommendations by the value engineering team would fit in the initial risk profile as response strategies. Some of the recommendations add value to the project as opposed to mitigating the risk. Depending on the decrease or increase in the schedule or cost, such proposals are treated as an opportunity or a threat. The project team then quantifies the effects of the recommendations in terms of program or budget. They assess the likelihood of implementing each recommendation in order to finalize on the model quantification. The project management or the project team allocates this probability. This involves a decision on whether or not to include the recommendations of the value engineering team within the project based on their viability. At the completion of the process, the description and quantification of the value engineering recommendations and the risk response strategies is included in the risk register.

7 Case Study: Risk assessment for a 40story building

7.1 Risk identification phase

The Project Team should initially identify risks and prepare a preliminary risk register with potential responses in order to conduct value engineering functions.

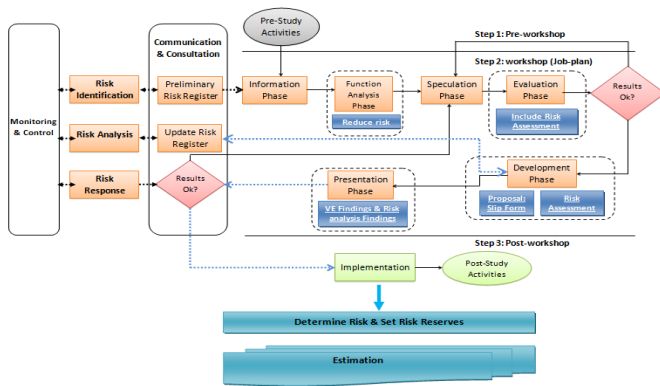


Fig.1 Risk management combined with VE processes

7.1.1 Inputs provided for the risk identification

- Project scope, schedule and budget (estimate)
- Tender Construction Drawings
- Project Specifications
- Tender Queries
- Progress Reports from Previously handed over projects: P-1-Lakeside & P-2-CAMPCO

7.1.2 Tools and Techniques

- Historical Review of Projects
- Project Assessment
- Project duration reduced by 50% and hence more time pressure is enforced on labour productivity which may cause serious quality issues arising
- Project technical difficulties involving a high rise structure
- Assumptions and Constraints Analysis.
- Brainstorming
- Cause and Effect Diagrams
- Checklists
- Past Experience

7.1.3 Output from Risk Identification

7.1.3.1 Preliminary Risk Register

From the Risk identification process and as per limitations of the study, it has been revealed that two major risk events are identified which could affect the bid value and possible construction risks. Both risks are reported in the preliminary risk register as the output of the risk identification process which will be forwarded to analysis in order to determine the potential response to deal with the arising risks.

7.1.3.2 Value Engineering Informative process

This register will be informed to the Value engineering team in order to proceed with Value engineering Job plan to determine alternatives for the arising risks and assess the current situation.

7.2 Risk Analysis

Qualitative Risk Analysis has been conducted for this case study as the project discussed is limited to the Labour and formwork system used risks only where it will be responded by implementing risk response activities in order to probability of occurrence and consequence if it does occur.

7.2.1 Applying Qualitative Risk Analysis

1. After reviewing the risk information from the identification step, the evaluation of the likelihood of the risk occurring is carried out as to look on to how likely the risk will occur. All the three identified risks in the risk register are considered high in occurrence.
2. Evaluation of the consequences of the risk occurring is conducted and based on the case study all three risks are high in severity by asking the group “
3. Prioritization of the risks based on the results of the qualitative analysis and Levels of Impact are identified.

7.3 Risk Response

7.3.1 Value Engineering Proposal

The Value Engineering job process was conducted by Technical department and Value engineering team on the arising risk which was informed by the Project management team and tender department through the forwarded risk register with the proposed response to find alternative systems that will aid in reducing costs from such associated risks.

The following has been achieved:

7.3.1.1 Information phase

Risk Register and project information has been communicated to the VE team.

7.3.1.2 Function analysis

VE added the function of reducing risks to their job plan which will be incorporated to their proposals to acquire approval accordingly.

7.3.1.3 Creative phase

The team employed a new technique of tackling the three identified risks as a single risk and proposing a solution that will solve the issue. The team idea lies in finding a more convenient formwork system that will replace the traditional system and in the same time solve the identified risks: Labour risk, Formwork wastage and quality risk and Project constraints –

7.3.1.4 Evaluation Phase

The idea lies in using a more advanced formwork system that will reduce the risk arising from three identified threats as mentioned in the risk register. Hence the evaluation of the system will be based on using a more convenient formwork which requires less labour and has a faster assembly and dismantling timing.

7.3.1.5 Development phase

The Team proposed 2 systems which are the climbing formwork and Slip form. Cost comparisons were conducted.

The choices has been narrowed down to using the BRM slip form system and was compared with the original traditional formwork system used in the project as to reflect how the new system will reduce the costs which is calculated for a 40% reduction in cost.

7.3.2 Risk Response action

Based on the recommendations from VE Team the tender department proposed the following risk response plan

- Mitigate the identified risks by implementing the BRM slip form system instead of the traditional system
- The additional budget from the cost saving conducted shall be kept as risk allowance for arising risks from the BRM system being implemented for the first time in the company

- The project procurement department shall seek to lessen the impact of the new system risks by renting the system and transferring the associated risk to supplier by issuing a full supply and installation contract to them taking under their responsibility third party and safety regulations and the assembly team on their behalf.

8 Findings & Results

- Conducting Risk Management processes during tender resulted in studying the project in a thorough manner and identifying undesirable risks which shall impose a threat to the company operations and cause major schedule and cost overrun.
- Conducting VE functions during the risk assessment process resulted in finding alternatives which reduces the identified risks by reducing the cost of Formwork budget by 40% and achieving a 7day cycle per floor with less associated costs.
- Use & Reporting of Risk-Based Cost Estimation Results
 - Efforts have been made to plan the project delivery within the established cost and schedule budget.
 - Risk Allowance has been minimized as the risk impact has been minimized and further saving was achieved in the formwork budget.

9 Conclusion

- The framework of risk analysis remains the same, but the tools and level of effort vary with the risk analysis level.
- VE is the most effective technique known to identify and eliminate unnecessary costs.
- Having a risk reserve/allowance provides flexibility in managing project risks.

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