Combining a Value Engineering (VE) Study with a Cost Risk Assessment (CRA)

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Introduction

Continuous improvement is very important in developing a successful, useful and valuable Value Engineering (VE) program. The Washington State Department of Transportation (WSDOT) has been performing value engineering studies since 1984. Over the past 23 years several improvements and changes to the value engineering program have been implemented to keep up with the needs of the department and to fulfill the needs of our project managers.

Project delivery on time and within budget is one of our main performance measurement commitments to the public and the Washington State legislature. Recently, the WSDOT went to line item budgeting, which limits the flexibility to move money from project to project. With the recent volatile construction market, accurate cost estimating has become a very difficult and important part of project delivery, in order to meet our performance measurement of on time and within budget.

The need to incorporate the validation of cost estimates and the identification of risks and their impacts to the project schedule and budget resulted in a request that they be included in the value engineering process. The incorporation of these items into the value engineering process allows the department to optimize the opportunities for adding value to the project.

Cost estimating and Cost Risk Assessment (CRA) have become very important to project management. The ultimate goal of combining these studies is to reduce or eliminate risk, which will result in improved ability to deliver projects on time and within budget.

This paper includes the following:

1) Terminology used in the combined CRA and VE process at WSDOT
2) CRA/VE Overview
3) Identification of the benefits of combining the CRA and VE process
4) Criteria for which projects are the best candidates for the process.

Terminology

To clarify the terminology referred to in this paper the following definitions are provided:

Base Estimate

The base estimate assumes that the project will go as planned and includes a project contingency added to the project's cost to compensate for unknown factors. This is typically a set percentage; WSDOT has historically used 4%.

Risk Based Estimating

The Risk Based Estimate (RBE) promotes a clear recognition of project threats and opportunities and acknowledges the variability in the base cost and duration estimate. It also allows a reasonable control over the project cost and schedule.

One major objective of the RBE is to provide a sound estimate by blending together the two main components of the estimate. The first component, the Base Estimate, represents the estimate when the project goes as planned. The second component comprises the overall contribution of risk events that will cause the project to turn out differently than planned.

Risks Identification and Quantification

A risk event could have a positive or negative effect. When the event reduces the cost or duration, the risk is named "opportunity", which is considered as a positive impact to the project. When the event increases the cost or duration, the risk is named "threat", which is considered as a negative impact to the project.

Cost Risk Assessment (CRA)

CRA is a term used to describe a broad program of risk based assessment being conducted within the WSDOT. CRA is also a term that describes a workshop process similar but less intense than a Cost Estimate Validation Process® (CEVP). Risk management is an integral part of the WSDOT Project Management Process.

Overall, the purpose of the CRA is to provide a sound base estimate and add to that the set of risk events that will cause the project to turn out differently than planned. Identification and quantification of risk events will provide the VE team with knowledge of those events.

Risk Management Plan (RMP)

The RMP is the main file that allows the user to input project data and risk information and performs the simulation calculations for three thousand iterations.

The RMP spreadsheet fulfills two major functions:

1. Project's cost/duration data entry and results presentation
2. Project's risks identification, analysis, and management.

If a risk is terminated, the risk status is changed to "Retired", the risk is disabled, and its impact on the cost or duration eliminated.

If the risk is not on the critical path, the risk impact on schedule is eliminated.

Cost Risk Assessment/Value Engineering Overview

Since the VE and the CRA processes have several similar tasks and require similar teams, there are advantages, in cost, time savings, and speculation improvements by combining the two processes.

This allows the team to speculate on the risks and try to mitigate them as part of their recommendations.

The components of a combined CRA/VE Study are:

Pre-Workshop

- Executive Summary
- Request for VE Study
- Request for CRA. CRA is the formal name of the risk based estimate workshop.
- Study Identification

Workshop

- Investigation Phase
  - Risk Based Estimate of Existing Design
    - Cost Estimate Review/validation
    - Risk Elicitation (schedule and cost)
    - Risk Analysis (using Self Modeling Risk Management Plan Spreadsheet)
- Speculation Phase: This phase is enhanced by adding speculation ideas on how to maximize the opportunities and reduce or eliminate the threats (risks) to the project.
- Evaluation Phase: This phase describes and evaluates each risk and screen them based on qualitative analysis. Typically risk is added as one of the evaluation criteria.

At this point in the process it is possible for the team to recess and then reconvene in a week or so for the development phase. Before recessing the team members will receive specific assignments to focus on during the recess. Among assignments may include risk identification, rough risk quantification, and recommended risk response strategies.

- Development Phase
  - Development of Recommended Design
  - Risk Based Estimate of Recommended Design
    - Review the Cost Estimate based on data provided during the evaluation phase
    - Review Risk Elicitation based on data provided during the evaluation phase and any other recommended changes

- Risk Analysis (using Self Modeling Risk Management Plan Spreadsheet)

- Presentation Phase: The presentation will be enhanced since better project cost and duration data is available. The Risk Management Plan created during this process will specify what can or should be done in order to control and monitor the risk impacts on the project cost and schedule.

Post-Workshop

- Distribution of Report
- Recommendation/Implementation report will include mitigation strategies as specified by the Risk Management Plan
- Continuous management of the Risk Management Plan

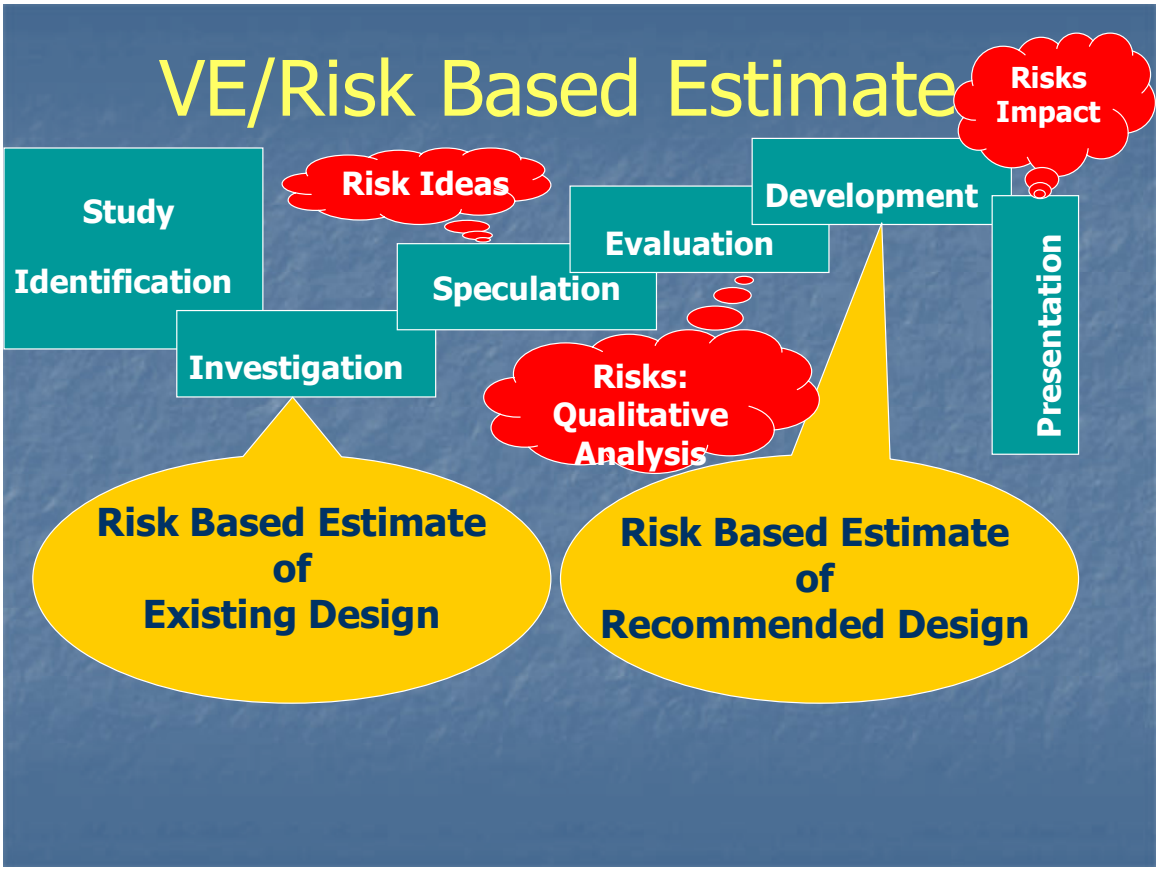

Figure 1

Risk Based Estimate Integrated in Value Engineering Study

Example Agenda

SR 9, 176th to Marsh Rd.

Cost Risk Assessment/Value Engineering Study
January 22 - 25, 2007
NWR, Dayton Office

Monday, January 22

9:30 am	Team Meet and Greet and Project Team Presentation
11:00 am	Site Visit
12:00 noon	Lunch on your own
1:00 pm	Investigation Phase
2:00 pm	Cost/Schedule Validation
4:30 pm	Adjourn for the day

Tuesday, January 23

8:00 am	Cost/Schedule Validation
9:00 am	Project Risk Elicitation (Identify, Screen, and Quantify Risk Events)
12:00 noon	Lunch on your own
1:00 pm	Speculation Phase
2:30 pm	Evaluation Phase
4:30 pm	Adjourn for the day

Wednesday, January 24

8:00 am	Development Phase
12:00 noon	Lunch on your own
1:00 pm	Development Phase
4:30 pm	Adjourn for the day

Thursday, January 25

8:00 am	Development Phase
11:00 am	Re-evaluation of Risk Elicitation based on recommendations
12:00 noon	Lunch on your own
1:00 pm	Prepare presentation
4:00 pm	Presentation of the findings

Investigation Phase

The CRA/VE team begins the study by investigating the project. The project team provides a packet of information to the CRA/VE team on what is known about the project and what documents are available upon which the CRA/VE team will base the development of their recommendations. Often, CRA/VE teams want to rush right into speculating solutions before they have taken the time to acquaint themselves with the information that is already available.

Good groundwork in the Investigation Phase is important to providing viable recommendations at the end of the study. Combining the CRA with the VE investigation process encourages team building and allows the team members get to know each other and identify areas of expertise.

An important component to review is the risk register, which is completed for every WSDOT project and is part of the project management plan.

Cost Estimate Validation

Once the team is familiar with the project, they set out to validate the construction cost estimate. The estimate is evaluated line by line with group discussion about the unit cost for each item and the quantities involved. If the team feels that adjustments are necessary, they are made to a duplicate estimate so comparisons can be made when this task is complete. The reasons for changes are clearly documented so that the project team can understand what changed and why.

Going through the estimate line by line gives the team a very good understanding of the intent of the project and the construction techniques that are assumed which can lead to discovering opportunities and/or risks that can be used in the Speculation Phase.

Risk Elicitation

After the estimate is validated, the team identifies the risks associated with the project team's design or the base design. The CRA/VE team leader acts as the risk elicitor to assist the team with the identification of risks.

It is important to fully understand what is "known" about a project. Items that are not yet known must also be addressed, including uncertainty. Uncertain events in the future can pose threats or present opportunities. When preparing early estimates, particularly for complex projects, the effects of uncertainty must be considered.

A risk event may hold the possibility of a positive or negative effect on a project. A positive potential presents an opportunity to the project and a negative potential poses a threat to the project. These threats and opportunities can be related to both schedule and cost.

By identifying the risks associated with the base design, the team begins to generate ideas that will not only reduce risks, but also generally reduces costs and increases the value added to the project.

Risk Analysis (using the Self Modeling Risk Management Plan Spreadsheet)

Risk Analysis is the use of available information to determine how often events may occur and the magnitude of their consequences. The WSDOT Cost Risk Estimating Management (CREM) office has developed a Self Modeling Risk Management Plan Spreadsheet using Microsoft Excel.

Once the base cost is established, a list of risks, called a Risk Register is created, including both opportunities and threats. The risk assessment replaces general and vaguely defined contingency with explicitly-defined risk events and includes for each their associated probability of occurrence and impact on project cost and/or schedule. This Self Modeling Risk Management Plan Spreadsheet allows for real time results, which are a necessity for completing this within the CRA/VE study duration.

The new estimate is given in 10% through 90% confidence intervals. WSDOT has elected to use the 90% confidence number. This essentially means that there is a 90% chance of the project being completed at or under this cost and on schedule.

The development of this risk management plan is taken into the next phase, which is the Speculation Phase.

Speculation Phase

During the Speculation Phase, the VE team brainstorms ideas that satisfy the project functions and address the identified risks. A team member can explain an idea to the rest of the team, but no evaluation is allowed at this point. Off-the-wall, out-of-the-box ideas are encouraged, as they often lead to innovative, workable solutions. The team lists all of the brainstorm ideas, even the most improbable.

While the VE team is brainstorming ways to improve the project, different ideas start to emerge on how to reduce or eliminate the risks that were identified during the Risk Solicitation.

Towards the end of the Speculation Phase, the risk register is revisited to make sure that the team has had a chance to speculate on each risk.

Evaluation Phase

The Evaluation Phase begins by going back through the ideas brainstormed during speculation to determine those that have fatal flaws. Ideas that are not viable will be dropped.

The team lists the advantages and disadvantages of each idea that warrants further consideration. If the disadvantages of an idea outweigh the advantages, in number or importance, that idea will not be considered further.

When all of the ideas have been evaluated, and the team still has competing ideas, the most promising may be put through an Evaluation Matrix. The evaluation matrix is used to determine which idea ranks best against selected criteria. Risk is generally used in the evaluation matrix as one of the criteria. This allows the opportunity to select the idea that results in the most significant reduction of risks.

Development Phase

During the Development Phase the team leader will typically assign a subgroup for each recommendation, to develop the appropriate documentation and descriptions.

Cost estimates are included when developing recommendations. Although the goal of the WSDOT VE program is to add value, due to the nature of highway projects and funding, we must also consider, and document, cost savings and cost added.

Revisit Risk Elicitation and Risk Analysis on Recommendations

The final step prior to developing the presentation is to identify the proposed project if all or some of the recommendations are implemented. The team then revisits the risk elicitation and risk analysis phases to develop a new cost and schedule estimate and risk register on the proposed project.

Presentation Phase

The team develops a presentation to be given on the final day of the study to the project office and other project stakeholders, such as Region Administrators and Managers, FHWA, local agencies, and others.

The presentation includes a short summary of the recommendations along with what the estimate for both the original design with risks and also the recommended design with risks.

Documentation

With the addition of the CRA additional materials are added to the typical documentation for a VE Study Report. The Risk Register along with a "One-Pager" is included in the report. **Please see the attachments to this document for examples.**

Benefits of the CRA/VE process

Some of the benefits of combining a CRA and VE includes:

- Better understanding of the project's challenges
- Better understanding and evaluation of the VE recommendations
- Crafts the project risk management plan with clear target of how to enhance the project value
- Helps maximize the project's opportunities and reduce or eliminate the project's threats
- Gives the project team a validated estimate and schedule
- Assists with the communication of the project risks and opportunities
- Combining these two processes creates a new, enhanced VE study with the added benefit of a comprehensive analysis of major factors that would or could have an effect on the project value
- Time and cost savings by using the same team for both

Criteria used in selecting projects for the CRA/VE process at WSDOT

For a combined CRA/VE Study the project should have the following:

- A current estimate
- A defined scope of work
- It can't be to complex
- Justification if over $25 million
- Has minimal risk

< $25 million	OK
$25 - $100 million	with justification
> $100 million	No

Conclusions

The information provided by this style of VE/CRA study gives valuable tools to project managers to help them deliver a successful project on time and within budget.

When a multi-disciplined team of experts is assembled in a workshop environment, maximum benefit can be achieved by using this combined process.

The process of combining a CRA with a VE continues to improve and the requests are increasing with each study we complete.