Integrating Risk Management and Value Engineering in the Development of Renewable Energy Project

Hamid Reza Feili[1], Sina Nasiri[2], Navid Akar[3]

[1]Assistant Professor, Faculty of Industrial Engineering, Alzahra University, Tehran, Iran; [2,3]Undergraduate Student, Faculty of Industrial Engineering, Islamic Azad University of Karaj, Karaj, Iran,

hrfeili@gmail.com,cnanasiri@yahoo.com,navidakar@aol.com

Paper Reference Number: 6-1-11-6480
Name of the Presenter: Hamid Reza Feili

Abstract

The world's dependence on fossil fuels in the range of human activities is causing adverse consequence on the environment. On the other hand by ending these resources, countries will face problems such as adverse effects on economic and industrial activities. Use of renewable energy is a solution that many countries have begun to use it in the project life cycle. Sensitivity of the optimal implementation of projects, combined with reduced errors, waste of resources and costs are considerable for employers and investors. On the other hand development of risk management and value engineering industry, make experts to use this technology and its development as a new tool in the world to do so in all cases, especially in the field of renewable energy. This article has tried to use the knowledge of integrating risk management and value engineering for reaching to optimal approach in the development of alternative energy and reducing costs and environmental pollution.

Key words: Risk management, Value engineering, Renewable energy

---

Introduction

With increasing global demand for energy, reducing fossil fuels and concerns over environmental pollution, various countries towards the development of standards and renewable energy projects has led. The development of renewable energy as an opportunity to make investments in energy interests in each country will be remembered. Although in recent years significant growth in the attitudes of investors and developers and stakeholders of the risks and making decisions about how to respond it, but all the potential development of renewable energy is not used.

Renewable energy projects, often in a long period of investment are at risk. And at first it's possible that only investment risk will be considered. But the reality is that renewable energy projects not only financial risks but also risks of social, political and the technical concept.

Knowledge of risk management as a technique that is now in every step of the planning principles, as well as all the risks that exist in all stages of project life, qualitative and quantitative methods to identify and respond. Knowledge of risk management has been many changes and now from the beginning until now.

Value engineering as a means to reduce costs significantly, with the highest level of performance may change as risk management has extensive experience so that the value of the Lawrence Miles has developed it under pressure from lack of resources, has changed dramatically.

Risk management and value engineering for many years have been used separately in each project, and the dependence of the target, it is better to use a combination of them. The use of risk management and value engineering projects in each of the key tools for reducing risk and cost, to increase performance.

On this paper, we have tried to integrating of risk management and value engineering model for the use of these techniques in the development of renewable energy project.

Value Engineering

First, value analysis as a technical approach in the design and development in the years following World War II that was established by Henry Erlicker as technical assistant General Electric's Purchasing Department.
Henry Erlicker believed that some of materials and designs that were used to replace during world war had better performance and low cost, so he ordered to perform an all-out effort to replace the economical materials. And finally he assigned Lawrence D. Miles, a staff engineer, the task of finding a more effective way to improve a product's value.
Value engineering (VE) is a systematic method to improve the "value" of goods or products and services by using an examination of function.
Value Engineering may be defined in other ways, as long as the definition contains the following three basic precepts:
1. Value Engineering is the systematic application of recognized techniques by multidiscipline team(s) that identifies the function of a product or service.
2. Creative thinking using recognized techniques to explore alternative ways of performing the functions at a lower cost, or to otherwise improve the design.

$$Value = \frac{Performance}{Cost}$$

Implementation Phases of Value Engineering

The key features that separate the VE Job Plan from other methods used to solve routine engineering problems are:

(1) Analysis of function, (2) Specific creative effort to develop many design alternatives, (3) The principle of not degrading the required performance, (4) Assigning costs to perform each function
An effective Value Engineering effort must consider all phases of the JP (Job Plan). Omissions of any one of the phases will hamper accomplishment of the objectives. The amount of attention given to each phase, however, may differ from one project to another.
In this paper, we refer to 9 phases that are used in value engineering workshops:
(1) Selection, (2) Investigation, (3) Speculation (Creative), (4) Evaluation (Judgment), (5) Development, (6) Presentation, (7) Approval, (8) Approval, (9) Audit

Risk Management

Risk management is the identification, assessment, and prioritization of risks followed by coordinated and economical application of resources to minimize, monitor, and control the probability and/or impact of unfortunate events or to maximize the realization of opportunities. Risks can come from uncertainty in financial markets, project failures (at any phase in design, development, production, or sustainment life-cycles), legal liabilities, credit risk, accidents, natural causes and disasters as well as deliberate attack from an adversary, or events of uncertain or unpredictable root-cause. Several risk management standards have been developed including the Project Management Institute, the National Institute of Science and Technology, actuarial societies, and ISO standards. Methods, definitions and goals vary widely according to whether the risk management method is in the context of project management, security, engineering, industrial processes, financial portfolios, actuarial assessments, or public health and safety.

Risk management in project involves:

-Identifying and assessing the risks in terms of impact and probability.
-Establishing and maintaining a joint risk register, agreed by the integrated project team.
-Establishing procedures for actively managing and monitoring risks throughout the project and during occupation on completion.
-Ensuring that members of the team have the opportunity to engage in a dialogue that will promote agreement of an appropriate allocation of risk.
-Updating risk information throughout the life of the project.
-Ensuring control of risks by planning how risks are to be managed through the life of the project to contain them within acceptable limits.
-Allocating responsibility for managing each risk with the party best able to do so.

Stage	Description
1. Plan Risk Management	The process of defining how to conduct risk management activities for a project
2. Identify Risks	The process of determining which risks may affect the project and documenting their characteristics
3. Perform Quantitative Risk Analysis	The process of prioritizing risks for further analysis or action by assessing and combining their probability of occurrence and impact
4. Perform Quantitative Risk Analysis	The process of numerically analyzing the effect of identified risks on overall project objectives

5. Plan Risk Response	The process of developing options and actions to enhance opportunities and to reduce threats to project objectives
6. Monitor and Control Risks	The process of implementing risk response plans, tracking identified risks, monitoring residual risks, and evaluating risk process effectiveness throughout the project

Table 1. Project Risk Management Overview

Renewable Energy

In contrast to the fossil fuels, renewable energy, as the name suggests, exists perpetually and in abundant quantity in the environment. Renewable energy is ready to be harnessed, inexhaustible, and more importantly, it is a clean alternative to fossil fuels.

The term “Renewable energy” has no official or commonly accepted definition. As an example, the Renewable Energy Working Party of the International Energy Agency defines renewable energy as “energy that is derived from natural processes that are replenished constantly”

Typical renewable energy sources are:

(1) Wind, (2) Heat & Light from the Sun, (3) Ocean Wave, (4) Purposely-Growth Energy Crops, (5) Potential Energy of Running Water, (6) Geothermal Energy

Energy generated from waste is termed as one kind of renewable energy sources in some countries. Others regard it as a waste disposal process rather than a renewable source, since there are pollutants generated as by-products, although modern technology has significantly reduced the pollutant emission to a very low level.

Many countries are already switching to renewable energy. Apart from looking for clean energy sources as substitutes for fossils fuels is another reason providing such drive.

With a projected world population of 10 billion by the year 2050, the increasing global energy demands with propel a more rapid depletion of the world’s fossil fuel reverse. Such possible tightening of energy supplies in the future will inevitably result in an upsurge of fuel and electricity prices.

Renewable energy can reduce the reliance on exhaustible sources of fossil fuels. Developed countries are now making more and more investments on the development of renewable energy technologies. We would envisage that when those equipment and systems are mature enough to be produced on a large scale, the unit price of electricity so generated could be comparable to that of the conventional fossil fuel burning process.

For example the development and operation of a wind farm can be subdivided into the following four phases:

Phase	Description
Initiation and feasibility	Study of technical feasibility, economic, and site.
Prebuilding	The basic design and pattern making and analysis were reviewed and the overall construction project leads.

Building	Compliance with all principles of design and construction of the exact model of the wind farm will be constructed.
Operation and maintenance	Considering the need to discuss maintenance and preventive maintenance service performed must be at least 2 times a year.

Table 2. Phases of Development and Operation of a Wind Farm

Integrating value engineering and risk management

Using of risk management and value engineering as important tools for achieving higher quality and quantity of renewable energy development projects are. Value engineering helps employers with a way to find the minimum cost function, and risk management as the best solution for a variety of routes and assist in identifying how to respond to risks. In fact, risk management was considered not only as an obstacle in the implementation of the project, but experience has shown the best implementation of the project, fully and accurately identified and assessed to be taken. Obviously, the uncertainty in risk management can achieve its aims to completely eliminate, the methods for determining the elements that are causing this uncertainty provides to be managed rather than being caught (Reactive Management), Identify and manage them efficiently (Pro-Active Management).

There are same goal for risk management and value engineering, that two techniques both increase the value and performance of project and decrease the cost of project.
Those techniques have been used separately on many projects for many years. There's an ideal approach to integrating those techniques to be an efficient method to development of renewable energy projects.
The application of integrated risk management and value engineering makes the final cost of quality issues that are difficult to quantify, also calculated and it is more accurate analysis.
Risk analysis, comparing the exact mechanism for the initial design and design options in a value engineering process.

The benefits that can be achieved through this approach include:

1. A better understanding of the business needs, including the flexibility required to meet future needs

2. Simple, clear definition of specific stakeholder needs

3. Consideration of all options, alternatives and innovative ideas

4. Achievement of optimum value for money while satisfying the range of user requirements

5. Prevention of unnecessary expenditure through reducing waste and inefficiency

6. Improved team working with joint ownership of solutions.

Integrating risk management and value engineering in the model

As a key tool in identifying both the risks and alternative solutions with the lowest cost and highest function, we use integration of risk management and value engineering for the strategy of development

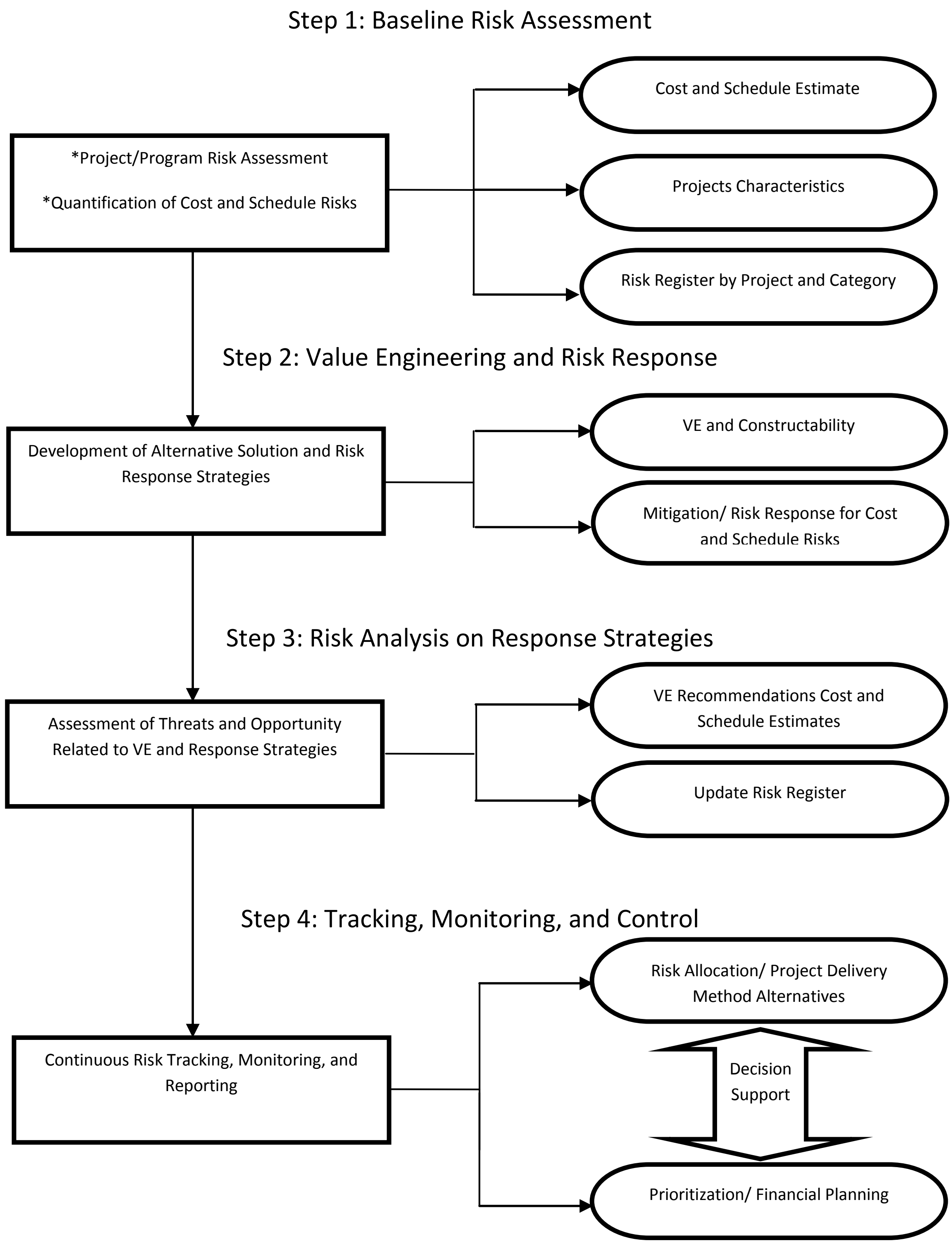

Fig 1: Integration Process of Value Engineering and Risk Management

Step 1: Baseline Risk Assessment

The risk register is the repository for all identified risks (as document or database). It can be developed to provide views on the range of the risk and the parameter(s) affected. It provides as common, uniform format for the presentation of risk-related information which is updated and maintained as a live document during the project.
The fields that could appear in the risk register include the information which shows bellow:

Step	Information
Identification	Risk name and number
	Category
	Owner
	Risk description (risk causes and consequences)
Evaluation	Probability of risk occurrence
	Consequences of risk occurrence on Project objectives
Control	Management strategy (action, responsible, planned dates, and actual completion dates).

Table 3. Information of Risk Register

Suppliers	Delay of production because of unavailable or missing construction vessels
	Delay and higher cost due to bad weather condition during installing
	Potential bottlenecks in the supply chain
	Impact of the cost of raw materials
Operation and	High O&M cost (due to complexity of maintenance)
	Failure of grid connection (single point failure)
	Limited knowledge of maintenance issues
	Downtime due to delayed repair/maintenance

Maintenance	Corrosion issues (complexity of add-on systems)
	Transport and logistics complexity of blades
Project	Changing in policy
	Exceeding construction cost due to delay

Table 4. Generally Three Categories of Risks in Wind Energy Development

Generally, in the first step, on the one hand we define the project characteristics and identify the project risks, and on the other hand we estimate cost and time and quantitative risk assessment.

Step 2: Value Engineering and Risk Response

At this stage, the main purpose is to explain the approaches that are used to analysis and risk assessment records at the first stage. In this regard, it is important that eliminate any risk without analysis, led to the devaluation; so the only costs should be removed from the processes that are unnecessary or increasing. The other hand with using the categories of value engineering knowledge in order to develop a strategic response can be process and evaluate risk cases in development of wind energy by identifying areas of risk that have high cost And processing and presentation of ideas that to be discussed as quantitative. It should be noted in the table to define the phases of value engineering workshop to perform a variety of strategic projects (including the model). But another technique that used in this step, together with value engineering, is Risk Mitigation that its task is reduce the likelihood of negative risks and threats and also increase the profits of the positive risks and opportunities. This technique is one of Risk Management Strategies that in directly communication with the technology development and also can be used as base project plans. Among other applications of Risk Mitigation techniques can be used to further ensure to feasibility installing wind power turbines and the benefits from energy saving as compared to the known costs.

Step 3: Risk Analysis on Response Strategies

Risk response: A risk response should only be decided after a risk's possible causes and effects have been considered and fully understood. It will take the form of one or more of the following management actions:

Avoidance – where risks have such serious consequences on the renewable energy project outcome that make them totally unacceptable, measures might include a review of the project objectives and a re-appraisal of the project, perhaps leading to the replacement of the project, or its cancellation

Reduction (including elimination) – typical action to reduce risk can take the form of:

- Re-design: including that arising out of value engineering studies.
- More detailed design or further site investigation: to improve the information on which estimates and programs are based.
- Different methods of construction: to avoid inherently risky construction techniques.

- Changing the procurement route: to allocate risk between the project participants in a different way.

Risk reduction measures lead to a more certain project outturn, they usually result in a direct increase in the base estimate and a corresponding reduction in risk allowance

Transfer – to another party in the integrated project team, who would be responsible for the consequences should the risk occur. Risks should not be transferred until they are clearly understood. The object of transferring risk is to pass the responsibility to another party better able to manage it.

Retention/Acceptance – risks that are not transferred or avoided are retained by the client although they may have been reduced or shared. These risks must continue to be managed by the client to minimize their likelihood and potential impact. A 'do-nothing' approach is unacceptable. Even when risks have been transferred, the client still needs to track management of the risk to ensure the aims of the project continue to be delivered satisfactorily.

Step 4: Tracking, Monitoring, and Control

Once the project is commissioned and in service, some risks remain and require active risk monitoring, to ensure that the project is able to achieve its financial objectives over its cycle. Risk monitoring involves the systematic, continuous tracking and evaluation of the effectiveness and appropriateness of the risk management strategy, techniques, and actions established within the risk management plan. The risk monitoring process should provide both information to decision makers regarding the progress of the risks and risk management actions being tracked evaluated.

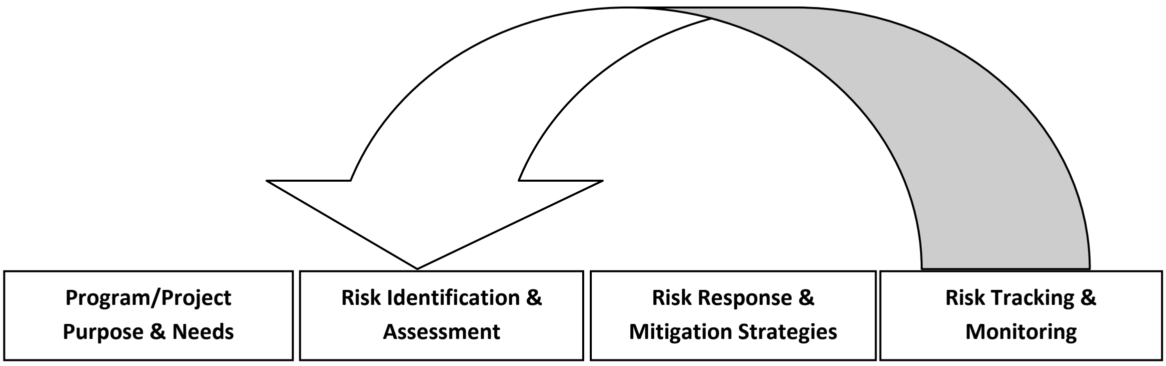

Fig 2: Process of Risk Management

Conclusion:

Risk management and value engineering are very useful techniques in identifying and assessing risks by considering the highest performance and lowest cost. These two tools were been used separately in each project for many years, and due to the dependence of the target it is better to use a combination of them. Renewable energy project, without exception, should contain integrated with those techniques to reach best approach.

Reference

Donald, W. A. (2011). Transitioning to a Renewable Energy Future. International Solar Energy Society.

Van De Wekken, Ton. (2007). Wind Farm Case Study. Power Quality Utilization Guide. KEMA, Nederland.

Technical Section (2004). Engineering Division. Division of Highways. West Virginia Department of Transportation

Covello, V.T. (1995). Risk Perception and Communication. *Can J Public Health*

Leiss, W., Chociolko, C. (1994). *Risk and Responsibility*. Montreal:McGill-Queen's University Press.

Presidential/Congressional Commission on Risk Assessment and Risk Management (1997). *Risk Assessment and Risk Management in Regulatory Decision-Making*. Washington DC.

CANMET. (1998/2007). Class 43.1 Technical Guide and Technical Guide to Canadian Renewable and Conservation Expenses (CRCE). Ottawa, Natural Resources Canada

Cleijne, H. and W. Ruijgrok. (2004): Modelling Risks of Renewable Energy Investments. Reporter of the Project "Deriving Optimal Promotion Strategies for Increasing the Share of RES-E in a Dynamic European Electricity Market, Green-X; KEMA, Netherlands

EWEA. (2005). Support Schemes for Renewable Energy. A Comparative Analysis of Payment Mechanisms in the EU. European Wind Energy Association (EWEA). Brussels.

Project Management Institute (PMI) (2004). Project Management Body of Knowledge (PMBOK). USA

Hartnell. (2000). Wind on the System-Grid Integration of Wind Power. *Renewable Energy World. London*