Value Engineering Approach to increase Cost Efficiency

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Abstract

Nobody would argue that investment and operation costs are a key element for any industrial plant project nowadays. However, has this fact properly considered during the initial design phase of a project? Are the identified solutions selected and optimized accordingly? This point is essential during the design phase in order to increase cost efficiency during the entire lifetime of the plant. Utilizing a structured engineering approach would guarantee to identify and classify all potential opportunities in order to select the most appropriate ones for the project.

From a general aspect the “Value” of a plant or system can be increased by either improving its adequate functionality or reducing the required capital expenditure (CAPEX) and operational expenditure (OPEX).

In order to optimize the “Value” of a plant its essential functionalities needs to be properly defined and analyzed. This needs to be done in a systematic structured approach. This practice identifies and removes unnecessary functions. Achieving these essential functions at the lowest life-cycle cost would clearly improve the “Value” of a system. The necessary steps for that approach are briefly explained and examples from various projects will be provided for this Value Engineering Approach. These are not limited on Greenfield projects only as this approach can be also applied to Brownfield or Revamp projects. OPEX savings of 40% and more are possible as identified within resent projects. Furthermore the Value Engineering Approach can be also utilized within pre-defined Engineering Technical Practices which can be used as company standards.

The general steps of the Value Engineering Approach will be explained and supported by various examples.

1. Introduction

The financing of large investments for industrial plants (like Pipeline Infrastructure or their dedicated storage and export facilities) is a critical element for the success of a project. A responsible allocation of the required resources is therefore essential and the cost efficiency needs to be optimized. The “Value” of a plant can be used to measure the cost efficiency already during the early design phase. The “Value” of a plant can be defined as the reliable performance of “functions” to meet customer needs at the lowest overall “costs”.

In mathematical terms the "Value" of a plant or system can be reflected within the following simple algorithm:

Value = Function / Cost

The "Value" is derived from the ratio between the provided "Functions" and "Cost". Within this respect a "Function" is the characteristic action performed by a plant or system and the "Cost" is the expenditure (CAPEX & OPEX) which is necessary to realize, construct and operate a plant or system.

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In order to optimize the "Value" of a plant its essential functionalities needs to be properly defined, analyzed and improved. This needs to be done in a systematic structured approach within an interdisciplinary and experienced team. This practice identifies and removes unnecessary functions. Achieving these essential functions at the lowest life-cycle cost would clearly improve the "Value" of a system which forms the basis of the Value Engineering approach.

2. Methodology

The Value Engineering methodology is based on a multi-stage job plan, sometimes also called as "value analysis job plan". The required stages depend on the application, but in general the following 6-step approach (*Figure 1*) is very typical and forms the basis.

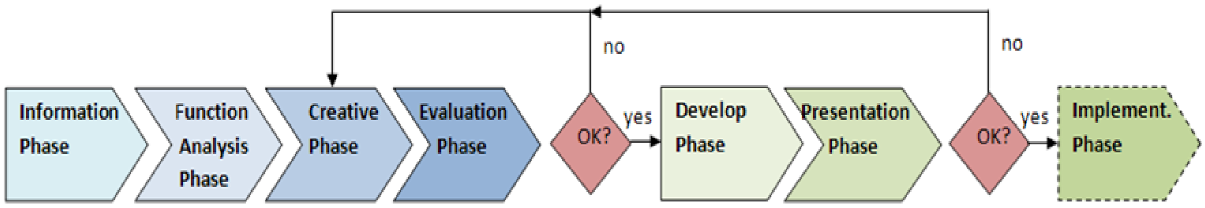

Figure 1: Value Engineering Workflow

The individual workflow steps do contain the following activities:

Information Phase

Within this initial task it is required to gather information about the proposed plant/system and its required main functions for a better understanding of the project.

Function Analysis Phase

During the Function Analysis Phase the project will be analyzed in order to clarify the required functions. It tries to identify what functions are important and which performance characteristics are required for these functions.

These function analysis activities are typically performed during a workshop exercise with an interdisciplinary experienced team. The individual experts will provide input from their areas of expertise as relevant for the project (e.g. system designer, senior engineers, plant manager, operation expert). This thought process is based exclusively on “function” (e.g. what something “does” and not what it “is”). Also initial alternative ideas might be already generated, registered and compared during that workshop for the next phase as shown within *Figure 2*. This exercise is an open discussion of further improvements rather than a quality evaluation of the design.

	Item	Function (verb)	(noun)	Function is provided?	Alternative 1	Does it fulfill function?	Does it reduce cost?	Alternative 2	Does it fulfill function?	Does it reduce cost?
1	Cooler in station recycle line	allow	performance test	y	Locate cooler in main stream (potentially with by-pass)	y	n (n)	No cooler	n	y
		allow	high compression rates	n		y			n	
		allow	steady state unit recycle	n		y			n	
		avoid	pressure drop (in main line)	y		n (y)			y	

Figure 2: Example for the Function Analysis

Creative Phase

Within the Creative Phase it is required to generate ideas on all possible ways to achieve the required functions. It is looking for various alternative solutions to achieve the identified requirements. Ideally this would be a process without any restrictions or limitations in order to pick-up also the possibilities of new technologies or unconventional solutions.

Evaluation Phase

The Evaluation Phase is assessing the ideas and concepts derived from the Creative Phase. It will cross-check and verify if these alternatives do meet the required functions. During that Phase the feasible and most promising ones are selected for further steps.

Development Phase

The identified best ideas / alternatives from the Evaluation Phase are selected and further developed during that phase. In order to improve the value of the plant a special focus would be on their impact, what are the costs and what performance can be expected?

Presentation Phase

The identified and developed alternative solutions are presented to the project stakeholders. The presentation shall provide all pros and cons of the alternative solutions and convince the stakeholder to follow the recommendations to improve the value of their project or plant. With the approval of the stakeholders the alternative solutions will be granted a form part of the project implementation phase.

3. Examples

The Value Engineering Approach is possible within various types of projects and not limited to Greenfield project plants only. It can be used also for Brownfield / Revamp projects and it’s getting more and more popular within this area. Furthermore the Value Engineering Approach is also not limited to (re-)construction of real industrial plants only as it is also possible to utilize it for the update of company standards. The following examples are derived from recent projects within ILF and shall provide a flavour of the variety and it’s possibilities to utilize the Value Engineering Approach.

Greenfield Projects

Within the Burgas – Alexandroupolis Crude Oil Pipeline project (in Bulgaria and Greece) an Oil Transportation Model has been developed to reflect all required functions and boundary conditions. It defines the amount of oil supply at Novorossiysk and Sheskharis Terminals, the required black see shuttle traffic via vessels to reach Burgas, the pipeline transport capacity and it provides the required figures to optimizes the tank farm storage capacity as well as the marine facilities (see also *Figure 3*). The derived key parameters have been further used to determine the optimum pipeline diameter and the required number of pump stations.

The approach is based on a simulation model which equips organizations with the ability to ask “what-if?” when making strategic decisions. Simulation’s unique time based approach, in conjunction with the ability to reflect the factors that vary, enables models to accurately mimic the complexities of real life systems. As a result, decision-makers can be sure that they have found the solution that strikes the right balance between capital costs and service levels.

Figure 3: Oil Transportation Modelling

Brownfield Projects / Revamp Projects

In 2011 ILF has been involved as an Engineering Contractor responsible for Re-Engineering and Infrastructure Optimization Study of the Samotlor field which is the biggest oil field in the history of the Former Soviet Union and one of the biggest in the world. The Samotlor field is in operation since 1969 and has produced some 2.3 billion tons of crude oil until now.

The Purpose of the Re-Engineering and Infrastructure Optimization Study was:

- to ascertain options for infrastructure development of the Samotlor field in its mature stage of production, allowing for improvement of economic indicators of field operation;
- to optimize expenses for infrastructure maintenance in safe mode and without loss of production throughout the remaining period of operation (estimated till 2030)

Within this respect the Value Engineering Approach has been utilized in this project and the required steps performed accordingly (see also *Figure 4*):

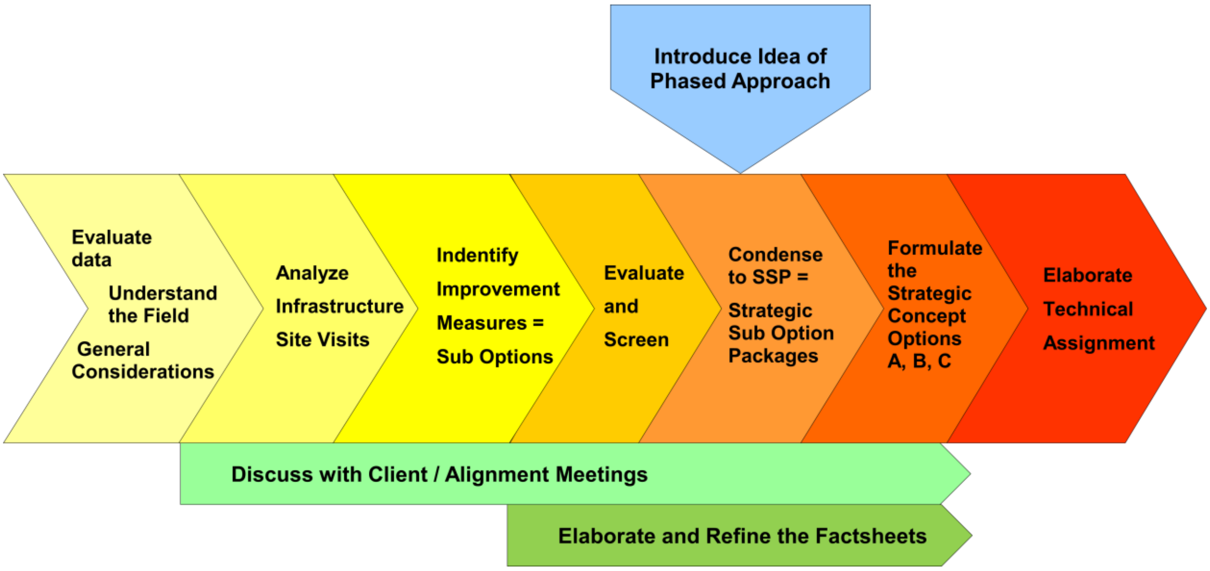

Figure 4: Value Engineering Workflow within Re-Engineering Project

Due to the magnitude of the Re-Engineering Project in total 143 sub-options could be identified during the Creation Phase of Value Engineering Approach. In order to better structure and handle this big amount an additional Screening & Condensing Phase (see also *Figure 5*) has been introduced which reduced it to 10 strategic sub-option packages and finally identified 3 strategic options, which are based on each other. The Base Case was further developed and investigated in detail.

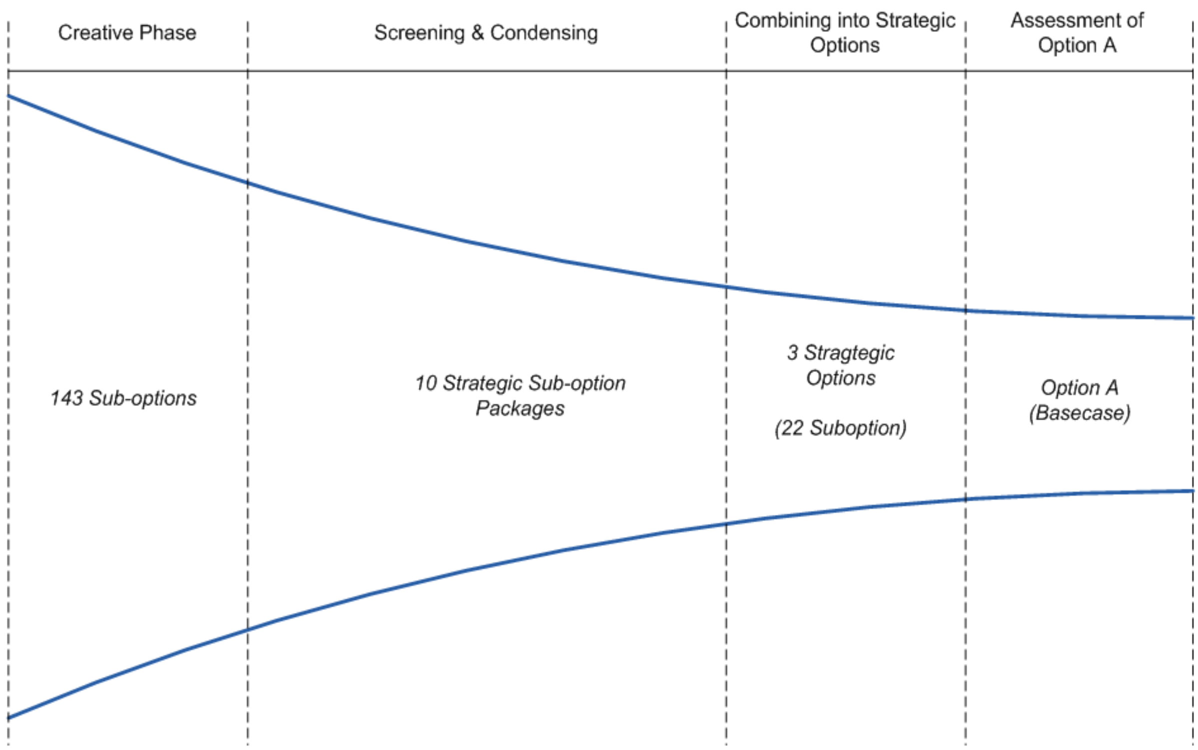

Figure 5: Screening & Condensing Phase

Due to the identified Base Case it was possible to identify about 40% of OPEX savings and to increase the revenue gains (see also *Figure 6*).

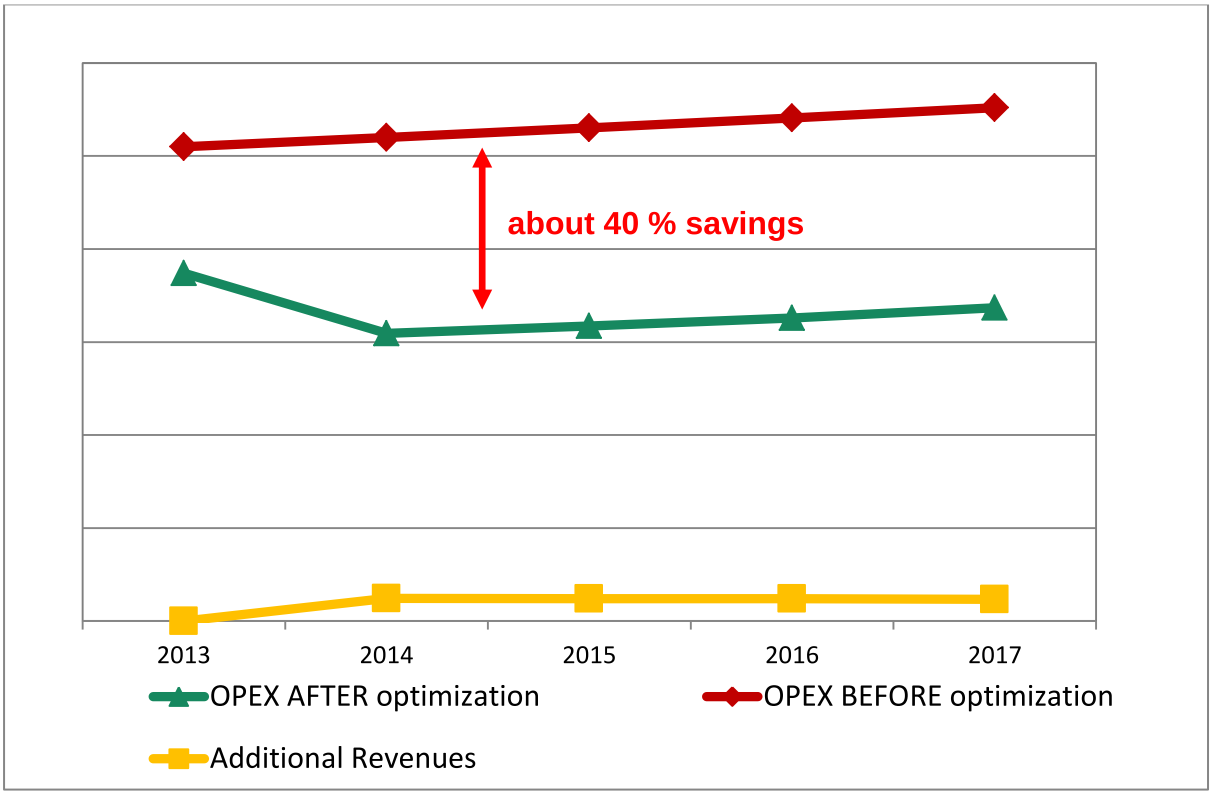

Figure 6: OPEX savings and Revenue Gains

4. Conclusion

Utilizing a structured engineering approach would guarantee to identify and classify all potential opportunities in order to select the most appropriate ones for the project. The Value Engineering Approach can be utilized within various project types to increase significantly the cost efficiency of a plant. Therefore it is an essential methodology to increase the value of a plant or system at an early stage of a project. The approach is not limited to Greenfield projects and can be adapted also for Brownfield revamp projects or the development of company standards.

Literature

1. Value Methodology Standard, June 2007 edition, SAVE International, www.value-eng.org.

2. Techniques of value Analysis and Engineering, Lawrence D. Miles.