



ISSN NO. 2320-5407

Journal homepage: <http://www.journalijar.com>

INTERNATIONAL JOURNAL
OF ADVANCED RESEARCH

RESEARCH ARTICLE

Prospect of Unleashing Value Engineering for Industrial Growth

Anshuman Patra

Hindalco Industries Limited, Belur Works, Howrah-711202

Manuscript Info

Manuscript History:

Received: 15 September 2014

Final Accepted: 22 October 2014

Published Online: November 2014

Key words:

Value Engineering, Foil stock, FAST Diagram, Paired Matrix, Decision Matrix

Abstract

Value Engineering is a systematic approach aimed to achieve the desired functions of a product, process, system or service at a minimum overall cost, and having maximum performance with consistency **without in any way affecting the quality, reliability, performance and safety** of the product, process, system or service. This paper aims how systematic approach through Value Engineering could identify the unwanted functions during manufacturing and some improvement aspects for better cost and quality in a foil stock rolling mill through a case study.

*Corresponding Author

Anshuman Patra

Copy Right, IJAR, 2014.. All rights reserved

Introduction

Value Engineering is systematic application of recognized technique by multidiscipline team establishes a worth for the function, generates alternatives through creative thinking and provides the needed function, reliably at lowest overall cost. It was developed during World War II, as a result of material shortage, by Lawrence D. Miles, Purchase Executive in the General Electric Company (GEC), USA. It took Lawrence considerable time to develop the technique and in the year 1947 he perfected this technique, and called it Value Analysis. It is one of the proven initiatives founded and successfully used in the last 5 decades by various industries all over the world. Irrespective of type of Industry, the wide range of application of VE include

- Reducing the Packing/freight /Transportation/shipment costs of the products (reduction of demurrages).
- Reduction of material waste by functional-creative approach.
- Life enhancement of parts like motors, Belts, Bearings etc.
- Functionality improvement of Machines/Parts/Products.
- Reducing the cost of Consumables like Grease, Lubricants, Oils, Fuels etc.
- Reducing the power consumption by adopting Functional approach and alternative devices.
- Creative application and best use of scarce resources.
- Enhancing the 3R concept –Reduce-Reuse –Recycle.

One of the major thrust of Value Engineering is to develop Value attitudes among people to compete more successfully in marketplace. According to the reports of Society of American Value Engineering, Value Engineering is a full-fledged initiative which can save the cost in metal industries ranging from 5 to 6% of cost of the metal [1-3]. Value is defined as a fair return or equivalent in goods, services, or money for something exchanged. There are lots of reasons for poor value or unnecessary cost in an industry such as:

1. **Lack of Information:** It is caused by unknown requirement and misunderstanding the requirement of the job.
2. **Decision based on honest wrong belief:** It happens when a designer without having experience made decisions based on assumption.
3. **Habitual thinking:** Reusing things in a traditional way that worked last time to minimize the risk of failure. These concepts are promoted by management through rigid use of standard designs, codecs and procedure customs.
4. **Negative attitudes:** This attitude comes from the mindset that there is no scope for improvement or people are more prone towards change regardless of the merit of the project work.
5. **Shortage of Time:** This arises due to stiff deadline for project completion. Designer try to complete design at the earliest, the construction person bogged down by routine operational problem leads to a situation where people doesn't venture for cost effective solution.
6. **Change in technology:** Avoiding usage or lack of knowledge regarding more efficient and economical product and process design in the hi-tech world where technology is changing rapidly leads towards sub-optimal performance.
7. **Old Specification:** Using old specification (guide, testing, codecs, material specification) which are more than 10 years are challenged all the way in this competitive market.

There are several ways and means to improve value. Value (V) is a function of performance (P), Cost (C).

$$\text{Value (V)} = \frac{P}{C}$$

$$\begin{array}{cccc}
 1. \frac{P \uparrow}{C \downarrow} & 2. \frac{P \Rightarrow}{C \downarrow} & 3. \frac{P \uparrow}{C \Rightarrow} & 4. \frac{P \uparrow}{C \uparrow} \quad P > C \\
 5. \frac{P \downarrow}{C \downarrow} \quad P < C & & &
 \end{array}$$

The above steps show how to improve value by changing the performance and cost. By adding a third dimension i.e time (T) proves to be more effective in terms of improving value in industry as due to more stringent timeline set by customers (Fig.1). Value of a product or process will be much more effective if it is completed within the given time period by reducing the downtime losses in an industry [4].

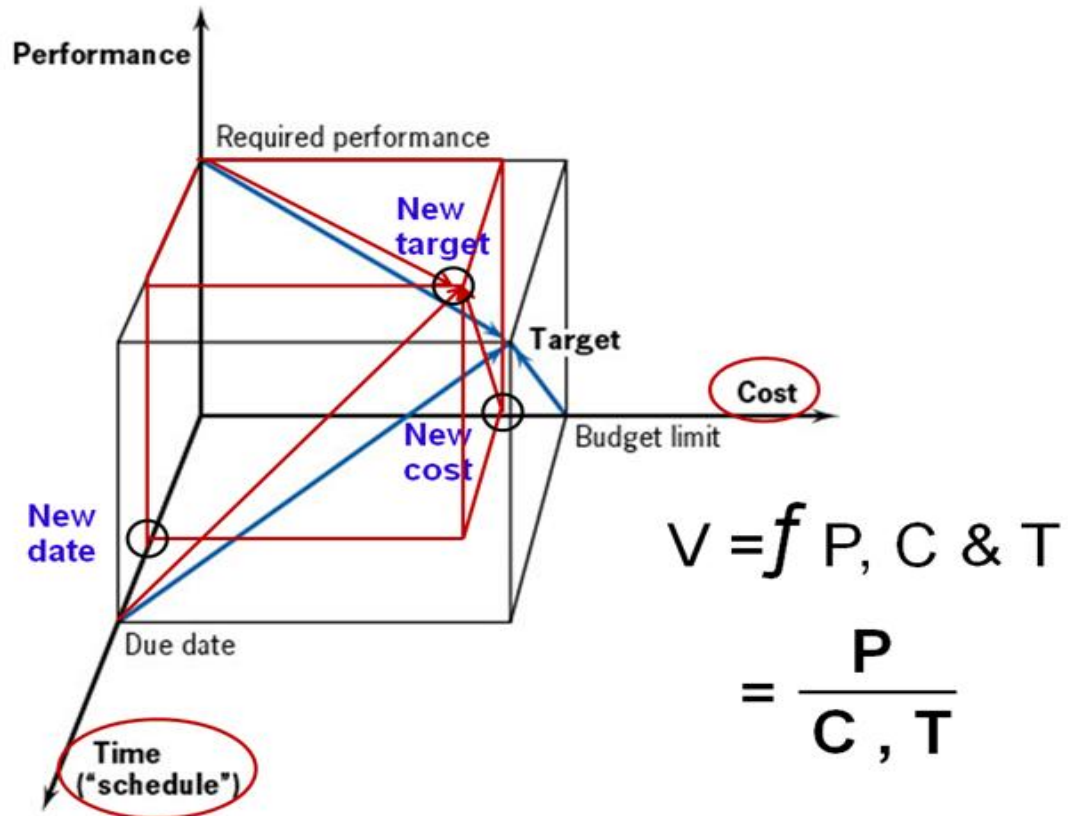


Fig .1. Relationship between Value, Performance, Cost and Time.

In a gross prospective of an Industry value engineering is for the improvement on productivity, Quality, Cost, Delivery, Safety and Environment and Morale. Value engineering projects are selected on the basis of these attributes. The effects of these attributes are provided in the table below:

Table 1: Effects of attributes on Industrial process

Attributes	Effects
Production	Meeting the target with at least resources.
Quality	Reduction in rework, Reduction in waste
Cost	Increase in cash inflow, Reduction in cash outflow
Delivery	Reduction in time
Environment	Less incident/accident, Lower carbon footprint, More sustainability
Morale	Increase in Value engineering projects

Foil stock manufacturing needs special attention due to surface sensitivity of foil during downgauging. Unsystematic approach could leads to higher customer complaints and rejections which increase the overall cost of the unit. Present study deals with identifying problems in a foil stock manufacturing company which supplies foil stock to its customers for further downgauging upto 7, 9, 12 μm and enhancement of value in terms of process and product by providing suitable alternatives through Value Engineering methodology.

Methods

The value methodology is a structured, disciplined procedure aimed to improve value. That procedure is called the Job Plan. The Job Plan outlines sequential phases to be followed which support team synergy within a structured process, as opposed to a collection of individual opinions. The activities conducted during each phase of the Job

Plan will stimulate the team to identify ideas and develop them into alternatives to the original concept or design. The job plan is based on six pillars [1, 4-5] such as

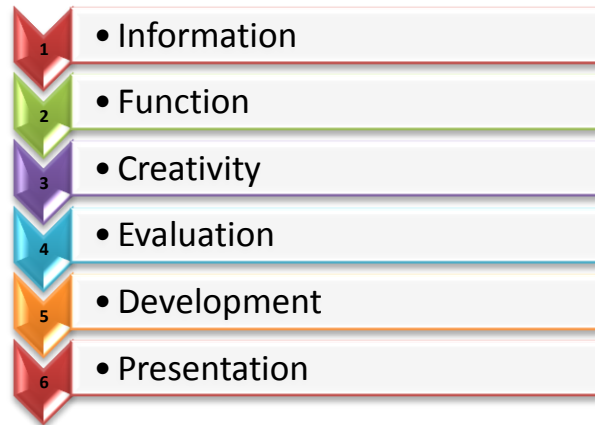


Fig 2. Different Phases of Value Engineering

1. Information phase :

The purpose of the information phase is to understand the current state of the project and constraints that influence project decisions. The benefits from VE will depend, to a great extent, on the correctness of information gathered. The whole efforts must be directed towards those areas containing the greatest return, low investment, completed and accurate costs.

The production steps of foil stock are provided below:

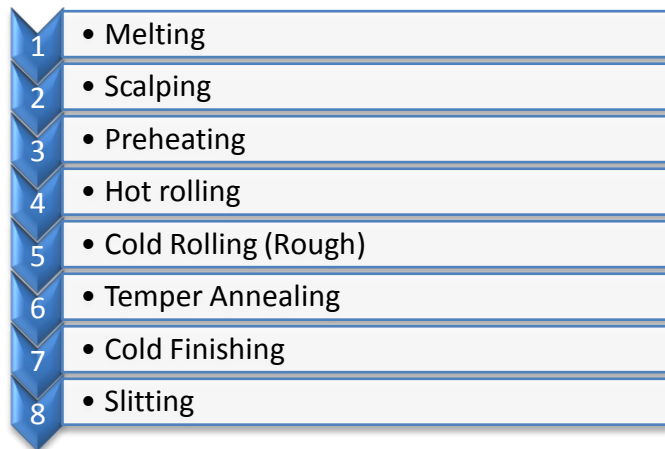


Fig 3. Steps of foil stock production

There are certain areas where unwanted process and product related anomalies arises which are as follows:

Table 2. Problematic areas for foil stock manufacturing

Areas	Problems
Casting	Drossing, Degassing, Uneven Ingot
Scalping	Edge burr, Surface scratch, dents
Hot Rolling	Rolled in dirt, edge notch/extra metal

All the above mentioned problems could lead to customer complaints and even sales return to the mother plant which increases the overall fabrication cost of the industry as all the sales return materials need to be refabricated.

2. Function Phase

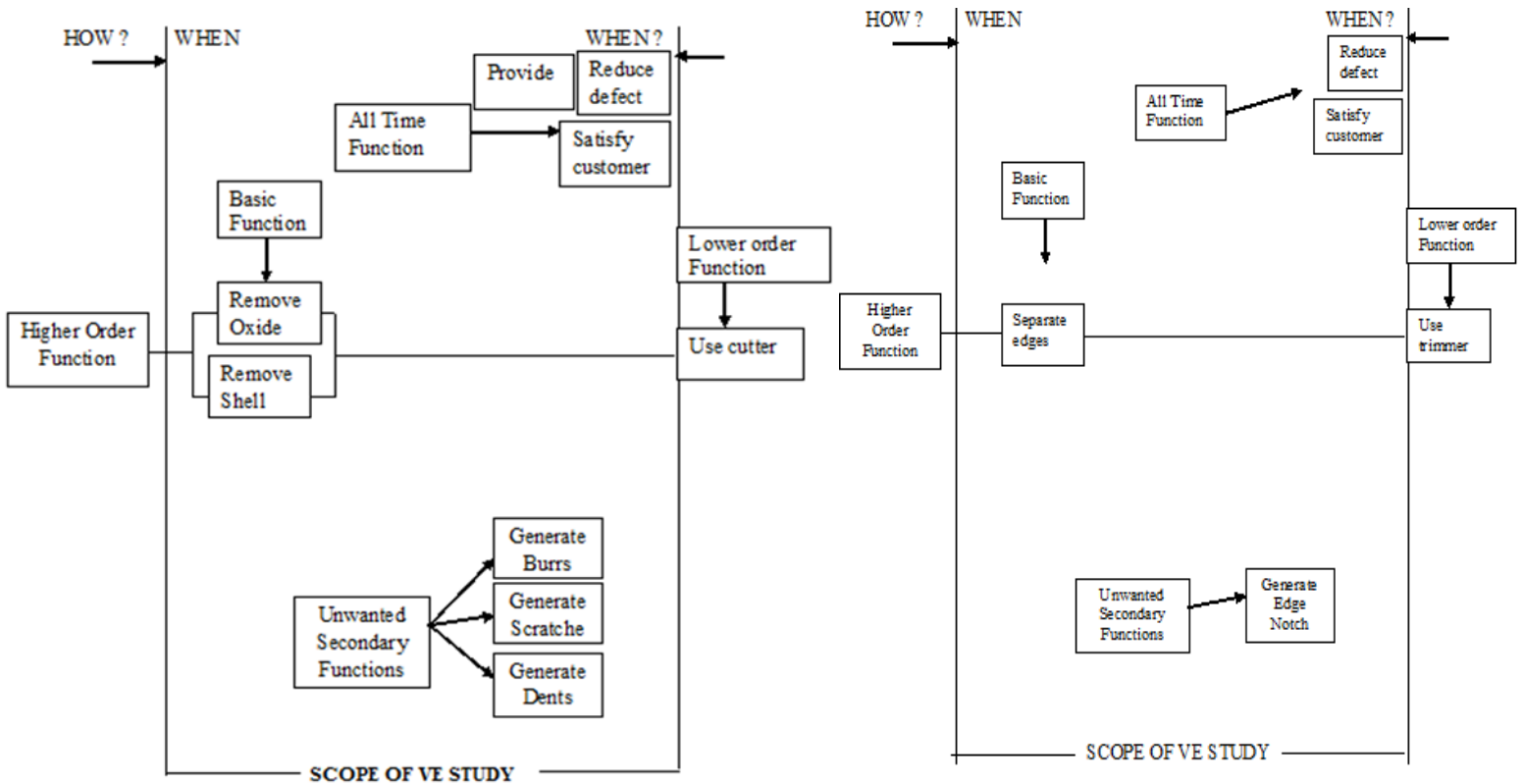
This phase is the heart of a Value engineering Job plan. Function is what makes an Item work (use value) or Sell (Esteem Value). It is defined in two words an active verb and a measurable noun. Functions are of two types such as Basic (B) and secondary (S) function. Basic Function is the specific work which a product or services is designed to perform. The Secondary Functions are those which support or arise during the performance of the Basic Function. Using FAST (**F**unction – **A**nalysis – **S**ystem – **T**echniques) diagram (Fig. 4) helps the team to study the **know-why** of the entire process. It is difficult to fully alleviate the problem posed by human factors so system generated problems are the major considerations.

The functions arise from scalping operation and hot rolling emulsion filtration (for reusing) are described in Table 3:

Table 3. Functions of different process in foil stock manufacturing operation.

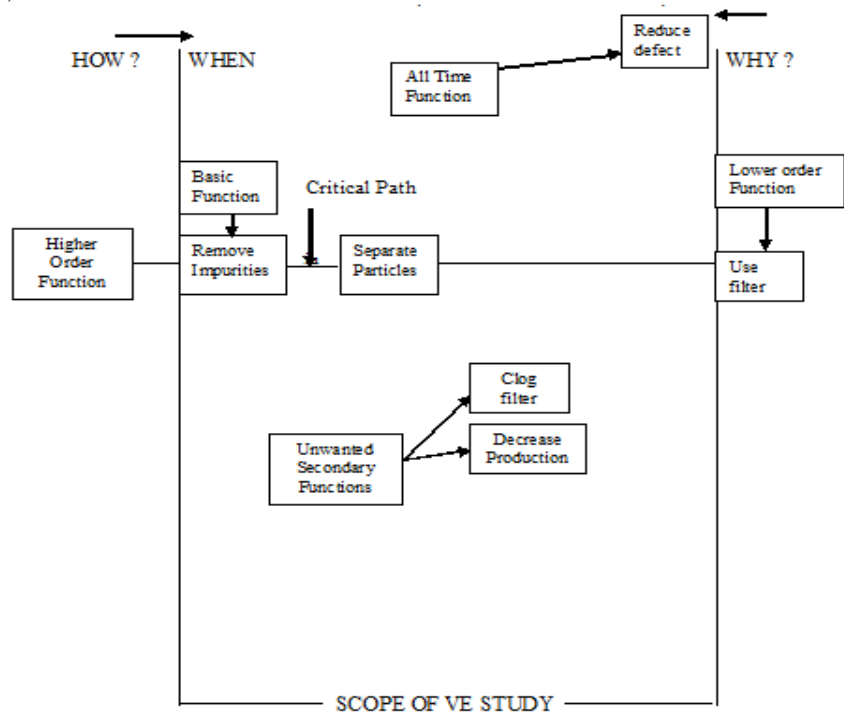
Process	Function		Type
	Verb	Noun	
Scalping operation	Remove	Oxide	B
	Remove	Shell	B
	Provide	Flatness	S
	Reduce	Defect	S
	Satisfy	Customer	S
	Generate	Burr	S (U*)
	Generate	Scratch	S (U)
	Generate	Dents	S (U)
Emulsion Filtration	Remove	Impurities	B
	Separate	Particles	S
	Reduce	Defect	S
	Clog	Filter	S (U)

*U refers to Unwanted functions.



(a)

(b)



(c)

Fig.4: FAST diagram for (a) Scalping (b) Hot Rolling (c) Hot Rolling Emulsion Filtration

3. Creativity Phase

Creativity is doing the same thing differently by the art of imagination or brainstorming. The purpose of the creativity phase is to generate a quantity of ideas related to other ways to perform functions. Creativity urges to have answers of the following points

- ✓ What can be added to an object to improve it?
- ✓ What can be subtracted to improve it?
- ✓ Can re-arrange to improve it?
- ✓ Can the object be magnified?
- ✓ What is the opposite of the object?
- ✓ Does the object have other uses?
- ✓ Can the size be reduced?
- ✓ What are the alternative ways?

Table 4: Idea Generation against process and Product attributes

ATTRIBUTES	IDEAS
Uneven ingot	i) Gauge checking at several points of ingot before subjected to operation. ii) Polishing records and mould surface quality records are to be documented for evaluation.
Improper Cutter	i) Provide automated cooling system at Cutter point. ✓ ii) Provide Standard operating practice (SOP) for periodic checking of cutter condition. (Edge Quality, Metal Sticking). iii) Bed alignment checking where the ingot moves towards cutter. ✓ iv) Proper fixing of ingot during scalping. ✓
Improper Emulsion Hygiene	i) Periodic check of filter Paper. ii) Daily checking of Oil Hygiene. iii) Cleaning duration has to be checked and changed if required.
Side Trimming	i) Proper check of cutter gap (at periodic frequency). ii) Checking cutter edge condition. iii) Check eccentricity of cutter. iv) Checking and cleaning of cutter and associate parts.

Brainstorming or creativity and product analysis from customer complaints reveals that improper scalping operation is the highly responsible for poor quality of foil stock. So ideas to cope up with improper scalping operation could be

- Provide automated cooling system at cutter point. (Majority cases application of coolant manually doesn't have best effect for the cutting tool and ingot)
- Bed alignment where ingot moves towards cutter.
- Proper fixing of ingot with base before subjected to scalping operation.
- Provide SOP for proper checking of cutter condition.

4. Evaluation Phase

In this phase, the evaluation of ideas generated during the creativity phase is carried out. Out of all the ideas listed during brainstorming, only those which seem to be performing the basic function with the least number of secondary functions will be taken up for further evaluation and development. Two powerful tools which are used for evaluating alternatives are:

- a) **Paired comparison matrix**
- b) **Decision matrix**

The selection criterion is identified through ranking (Table 5). Best fit idea is selected through comparison between different criteria by paired matrix (Fig. 6) and by decision matrix (Fig. 7) method.

Table 5: Identification of Criteria through selection [1].

IDENTITY	CRITERIA	SCORE	RANK
A	Cost	7	V
B	Maintainability	4	VII
C	Designability	8	IV
D	Reliability	10	II
E	Implementabilty	9	III
F	Manpower	6	VI
G	Safety	11	I
H	Time	2	VIII
I	Resource	1	IX

	B	C	D	E	F	G	H	I	SCORE	
A	A2	C2	D2	A2	A1	G2	H2	A2	7	
B		C1	D1	E2	F3	G2	B2	B2	4	
C			D1	E1	C1	G1	C2	C2	8	
D				D1	D1	D0	D2	D2	10	
E					E2	G1	E2	E2	9	
F						G1	F2	F2	6	
G							G2	G2	11	
H								H1	2	
I									I1	1

Comparison	Points
Major Difference	3
Medium Difference	2
Minor Difference	1
No Difference	0

Fig. 6. Paired matrix for evaluating alternatives

DECISION MATRIX

5 POINT SCALE		DESIRED CRITERIA	C	M	D	R	I	M	S	T	R		
EXCELLENT	5		O	A	E	E	P	A	A	I	S		
VERY GOOD	4		S	I	S	A	B	N	S	M	O		
GOOD	3		T	T	I	B	I	I	E	E	R		
FAIR	2		7	4	8	10	9	6	11	2	1		
POOR	1												
PROPOSAL	WEIGHTAGE FOR CRITERIA	A	B	C	D	E	F	G	H	I	J	TOTAL SCORE	
1. Automated cooling system at Scalper cutter.		2	4	3	4	3	3	2	4	3		172	
		14	16	24	40	27	18	22	8	3			
2. Bed Alignment		3	2	2	2	2	2	3	2	2		134	
		21	8	16	20	18	12	33	4	2			
3. Ingot Fixing during scalping		3	2	2	3	2	3	3	2	2		150	
		21	8	16	30	18	18	33	4	2			

Fig 7. Decision matrix for selection of alternatives [1].

It is evident from Fig. 7 that automated cooling system at scalper cutter having the highest score. So it can be concluded that automated cooling system is the best feasible option to improve product and process lifecycle considering all the technical constraints.

5. Development phase

During the development phase acceptability, cost reduction, strength, weakness and required resources for the process to be developed are analyzed. All strength and weakness are to be taken into consideration during real life implementation of the project.

Proposal	Strength	Weakness
Automated Ingot cutter cooling system	Better cutter Life and cutting efficiency	Manpower Involvement. Increase Breakdown. Increase Cost.

6. Presentation Phase

In this phase presentation has to be made to the management for management or owners approval. The approval is for resources, deadline of implementation and suggestions regarding cost and performance data from actual user. The cost is also divided into several parts such as:

- ✓ Total Initial cost (Design, purchase, construction, Installation/commissioning cost)
- ✓ Annual operation cost (Raw Material, Labour, Overheads)
- ✓ Total Maintenance cost (Mechanical, Electrical, Others)

R.O.I (Return on Investment) and payback period are two most valuable attributes in industrial terms. These major aspects are calculated as follows:

$$\text{R.O.I} = \frac{\text{Saving}}{\text{Initial Cost}} * 10 \quad , \quad \text{Payback period (in years)} = \frac{\text{Initial Cost}}{\text{Savings}}$$

Recommendation with Implementation plan is an important phase of the whole life cycle of the project. The full cycle from design to finalization of the project is as follows:

1. Drawing and Layout
2. Sending Enquiry to vendor
3. Technical and Commercial Negotiation
4. Receive material
5. Installation
6. Trail
7. Commissioning
8. Review
9. Audit

Gains through Value Engineering

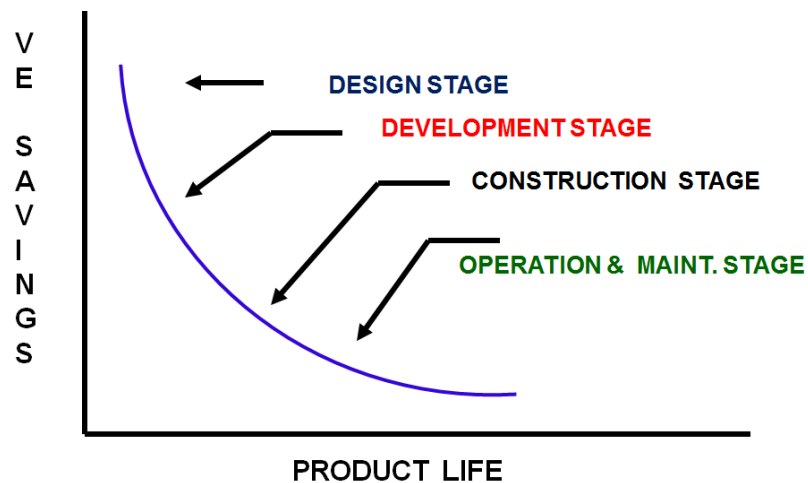


Fig: 8. Variation of Value Engineering gains with product life.

Fig 8 shows that saving through implementation of Value Engineering concepts shows decay with increase in product life cycle. Maximum benefit or savings are achieved in the design stage rather than development, construction and operation stages.

Conclusions

Value Engineering is a novel technique to counteract industrial problems. Foil stock is very surface sensitive product because it is subjected to downgauging upto micron level, so hygiene of the process and product plays a vital role of in its production route. Rigorous analysis from the nature of complains reveals that Casting, Scalping and Hot Mill are the major pain areas in the production of foil stock. Analysis through value engineering tools helps in depth analysis of the problem and also provide a suitable alternative such as automated cooling system to reduce customer complain, sales return and fabrication cost with overall improvement in product quality of the industry.

Reference

1. Muthiah Kasi, Thomas J. Snodgrass, An Introduction to value analysis and value engineering for Architects, Engineers, and Builders, *Civil and Environmental Engineering* C240-A362 1994.
2. Tobias Walk, Value Engineering Approach to Increase Cost Efficiency, *Engineering and construction*, 2 (2012) 1-4.
3. Mark S. Benstin, David P. Benston, Scott S. Haraburda, Using Value Engineering to Reduce Life Cycle Cost, (2011) 31-34.
4. N. Rich, M. Holweg, *Value Analysis and Value Engineering*, Lean Enterprise Research Centre Cardiff, United Kingdom, (2000) 1-32.
5. Value engineering Program, Connecticut department of transportation, (2009) 1-18.