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A SYSTEMATIC APPROACH OF REDUCING COST IN 1.0 HP CENTRIFUGAL PUMP USING VALUE ENGINEERING TECHNIQUES

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ABSTRACT

This paper endeavours the detailed work of Value Engineering (VE) which can be implemented to any kind of product(s) in order to optimize the value of particular product. A Case study has been chosen from a pump industry for the product of 1.0HP centrifugal pump. During the observation period the product's mandatory point was observed that the cost of pump is high due o the usage of expensive material, and more material usage in the product. In order reduce the cost without sacrificing the quality of the product we have selected few components which is having great scope to achieve the good customer feedback in performance wise. The components are impeller, main and auxiliary winding, adaptor, end cover. The value engineering technique has been applied on the components to reduce the cost. Material modification for Impeller has been suggested, design changes are suggested for adaptor, end cover and coil winding turns reduction modification is suggested for Main and Auxiliary Winding and thereby the cost reduction of the product has been achieved through Value Engineering technique.

KEYWORDS

Value Engineering (VE), Job plan, Fast, Design, Materials and Centrifugal pump.

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INTRODUCTION

Value Engineering is a vibrant tool which can be practical not only in engineering but also any kind of products and these industries. Which helps to find out the alternative source, equipments, and methodology etc., in order to achieve the cost without sacrificing the quality of the product/service in a systematic way. Also it helps to improve the performance of the product / service. This paper provides the basic outlines of value engineering and presents a case study clearly showing the cost

reduction involved in a 1.0 HP centrifugal pump in a pump manufacturing company.

The Society of American value engineers International, or save, uses the broad term- value methodology, defined as the systematic presentation of familiar techniques which recognize the functions of the product or service, establish the worth of those functions, and provide the necessary functions to meet the required performance at the lowest overall cost.

The paper is structured in numerous stages. The first stage describes the idea of value engineering. Several definition are given making the concept more cohesive and explaining the need of value engineering in the present scenario where cost optimization has become a critical need for every industry to survive in this competitive environment. Second stage defines the value engineering job plan which should be followed for analyzing any product. In the third stage a case study has been discussed which helps us reach to a solid explanation of the problem deliberated here and in the latter stage the conclusion and upcoming scope of Value engineering have been delivered.

Definition

Value Engineering is the methodical presentation of known techniques by multi-disciplined team (s) that recognizes the function of a product or service; establishes a worth for that function; generates alternatives through the use of imaginative thinking; and delivers the needed functions, reliably, at the bottom overall cost. Value engineering may be described in other ways, as long as the meaning holds the following three essential guidelines:

An organized review to improve value by using multi-disciplined teams of specialists knows in various aspects of the problem being studied.

A function oriented method to recognize the vital functions of the system, product, or service being studied, and the cost associated with those functions.

Creative thinking by means of recognized techniques to discover alternative ways of execution the functions at a lower cost, or to otherwise develop the design.

It involves an objective appraisal of functions performed by parts, components, products, equipment, procedures and services; and so on anything that costs money[1]. Value Engineering is the systematic application of recognized techniques which identify the function of the product or service, establish a monitory value for that function and provide the necessary function reliability at the lowest overall cost. The purpose of the Value Engineering Systematic Approach is to deliver each individual with a means of skill fully, deliberately and methodically examining and guiding the total cost of product. This total cost control is talented, in the key, by the systematic study and growth of another means of achieving the functions that are desired and required. The purpose of VESA is well served when the user is able to define and segregate the necessary from the unnecessary and there by develop alternate means of accomplishing the necessary at a lower cost. Hence value engineering may be well-defined as, "an organized procedure for efficient identification of needless cost"[2].

Value Engineering (VE) Job Plan

VE process consists of three main phases that are: pre-study, value study and post-study. The VE job plan is a systematic plan to make sure that the VE analyzing team understands customer requirements and develops a cost-effective solution[3]. Park[4] has said: -No matter how many stages there are, the procedure is continuously the same, analysis, creativity, evaluation and development. A key point in organizing the value engineering effort is the usage of the job plan or value study. The information stage is a fact-finding point. There solution is to accrue all the factual information existing in respect to the proposed area of study. The function examination stage is the core of the value methodology. Mudge[5] has expressed that function analysis is created on two main parts: describe a function and evaluate the function relationships. The value engineering team evaluates the ideas made in the creativity phase using one of a number of techniques, many of which depend upon some form of weighted vote. This stage forms a crude filter for reducing the ideas produced to a manageable number for further study[6]. The determination of the post-study is to promise the implementation of the accepted value study change references the.

Implementation tasks are made by the VE team, the organization's own personnel or together[7].

The value methodology is a systematic process that tails. The team decribes the project functions using a two-word active verb/ measurable noun framework. The team reviews and analyzes these functions to decide which necessity improvement, elimination, or creation to meet the project's goals.

Creative Phase

The team employs creative techniques to identify other ways to perform the project's function(s).

Evaluation Phase

The team monitors a structure devaluation process to choice those ideas that offer the potential for value improvement while delivering the project's function (s) and con x sidering performance requirements and resource limits.

Development Phase

The team progresses the selected ideas into alternatives (or proposals) with a adeqaute level of documentation to allow decision makers to conclude if the alternative should be implemented.

Presentation Phase

The team leader improves are port and/or presentation that documents and conveys the adequacy of the alternative (s) developed by the team and the related value improvement opportunity.

Implementation Phase

During the application and follow-up phase, management must assure that approved recommendations are renewed into actions. Until this is done, savings to offset the cost of the study will not be realized.

Case Study

In this paper we have considered a pump manufacturing company, located in Coimbatore. This firm is producing different types of centrifugal pump which they export to various countries around the globe. All of the products factory-made here are compatible to the international standards. It is an ISO certified company.

One of their models 1.0 HP centrifugal pump having few components namely impeller, main and auxiliary winding, adaptor and end cover. This model has found application in the domestic field.

In this paper we have discussed a case study of 1.0HP centrifugal pump which is manufactured in an ISO unit of manufacturing pumps located in Coimbatore. They are also manufacturing wide range of pumps i.e. Submersible and centrifugal pumps in different ranges like 0.5 HP, 1.0HP, 1.5Hp, etc.1.0 HP centrifugal pump is selected for case study as it the job plan. A value methodology is functional by a multidisciplinary team to develop the value of a project through the analysis of functions.

The job plan contains of the following sequential phases[7].

Information Phase

The team reviews and describes the present conditions of the project and classifies the goals of the study.

Function analysis phase

Is most popular and relatively fast moving product. We have selected following components from 1.0HP centrifugal pump and we have applied value engineering technique for cost reduction of following components of 1.0HP centrifugal pump.

The components are

Impeller

Main and auxiliary winding

Adaptor

End Cover

In the current case study it is observed that the unnecessary increase in cost is due to use of expensive material, mass of materials used in major components materials thereby increasing the inventory. So by value engineering technique, use of alternative fewer expensive material for impeller, weight reduction for main and auxiliary winding, adaptor and end cover, is advocated in this case study and thereby which cost lessening is attained.

Impeller

Data collection and analysis

An impeller is a rotating component of a centrifugal pump, that transfers energy from the motor that energies the pump to the fluid being pumped by quickening the fluid outwards from the center of rotation. By keeping same function the material of Impeller can be changed from gun metal grade LTB-4 to stainless steel grade 410.

We are looking for the minimum amount which must be spent to attain the appropriate use and esteem factors.

Selling

What do we necessity to vend our ideas and forestall road-blocks?

Model

Sketches

Full drawing

Product cost comparison

Capital cost of change

Revenue costs of change

Achievement

With the same function the material of Impeller can be replaced by stainless steel (Grade 410)

Result of VE Job plan

Die Development Charges/piece = Die Development cost/ (No. of considered Yrs. X No.of pieces per year) = 25000/ (5x2000) = Rs. 15.00

Total cost per piece = Die development cost+ Cost of Material

=15.00 +210 = Rs.235

So Net Saving = 434-235

= Rs.199/-

Percentage saving in cost= 45.85 %

Main and auxiliary winding data collection and analysis

Main and auxiliary winding will generate the force thereby provides the rotational movement to the rotor shaft and to the accompanying parts of the centrifugal pump of a centrifugal pump. By keeping same the No.of turns of main and auxiliary winding has been reduced from 130 to 94.

We are looking for the least amount which must be consumed to achieve the appropriate use and esteem factors.

Selling

What do we essential to sell our thoughts and forestall road-blocks?

Model

Sketches

Full drawing

Product cost comparison

Capital cost of change

Revenue costs of change

Achievement

With the same function, the No. of turns of Main and Auxiliary winding has been reduced from 130 to 94.

Result of VE job plan

Adaptor

Data collection and analysis

An Adaptor is a component of a centrifugal pump, which accommodate the stator body and end cover. By keeping same function the weight of the adaptor has been reduced from 4.5kgto3.8kg.

End cover

Data collection and analysis

An end cover is a component of a centrifugal pump, which maintains the centrifugal force of the rotor shaft also ensures the smooth running of the shaft. By keeping same function the weight of the end cover has been reduced from1.5Kg to 1Kg.

Achievement

With the same function, the weight of the end cover has been reduced from1.5Kg to 1.0Kg.

Achievement

With the same function, the weight of the adaptor has been reduced from 4.5kg to 3.8kg.

Result of VE job plan

Achievement

With the same function, the weight of the end cover has been reduced from1.5Kg to 1.0Kg.

Table No.1: Impeller value engineering Job Plan

S.No	Information	
1	What is it?	Impeller Gun Metal LTB-4
2	What does it cost?	Rs.434
3	How many parts?	One
4	What does it do?	To Pressurize the liquid
5	How many required? Current usage Quantity?	2000per month

	Speculation and Evaluations	
6	Which is the primary function?	Pressurize Liquid
7	What else will do?	Replace Gun Metal– LTB-4 impeller by stainless steel grade 410
8	What will that cost?	Rs.210
Plan		
9	Which alternative way of doing the job show the greatest difference between cost and use value?	Stainless Steel Grade 410 Impeller
10	Which ideas are to be developed?	Stainless steel grade 410 impeller
11	What other functions (work or sell) and specification features must be incorporated?	
Factor		Stainless steel grade 410 impeller
Function		Same as existing
No.of parts		No Change
Space Required		Same as Existing
Durability		Certainty
Aesthetic		Very Good

Table No.2: Main and auxiliary winding value engineering job plan

S.No	**Information**	
1	What is it?	Main and Auxiliary Winding
2	What does it cost?	Rs. 553
3	How many parts?	One
4	What does it do?	To Generate Force
5	How many required? Current usage Quantity?	2000 per month
	Speculation and Evaluations	
6	Which is the primary function?	To Generate Force
7	What else will do?	Reduce no. of turnsin order to reduce weight of the winding
8	What will that cost?	Rs. 492
Plan		
9	Which alternative way of doing the job show the greatest difference between cost and use value?	Reduce no. of turns inorder to reduce weight of the winding
10	Which ideas are to bedeveloped?	Reduce no. of turns inorder to reduce weight of the winding
11	What other functions (work or sell) and specification features must be in corporated?	
Factor		Reduce no. of turns in order to reduce weightof the winding
Function		Same as Existing
No. of parts		No Change
Space Required		Same as Existing
Conductance		Certainty

Table No.3: Cost calculation

S.No	Existing Cost (Rs)	Proposed Cost (Rs.)	Cost Saving (Rs.)
1	Main (380*)+ Aux (174*) = 554 /Quantity	Main (329*)+Aux (163*) = 492/ Quantity	62/Quantity

*-Including Labour Cost-Winding = Rs.27 and Testing=Rs.1.40

So Net Saving = 554-492= Rs.62/-Percentage saving in cost=11.19 %

Table No.4: Adaptor value engineering job plan

S.No	Information	
1	What is it?	Adaptor
2	What does it cost?	Rs.344
3	How many parts?	One
4	What does it do?	To accommodate the stator body and end cover

So Net Saving = 295-243= Rs.52/-Percentage saving in cost = 17.62%

Table No.5: End cover value engineering job plan

S.No	Information	
1	What is it?	End cover
2	What does it cost?	Rs.103
3	How many parts?	One
4	What does it do?	To maintain the centrifugal force
5	How many required? Current usage quantity?	2000per month
	Speculation and Evaluations	
6	Which is the primary function?	To maintain the Centrifugal force
7	What else will do?	Reduce the weight of the end cover
8	What will that cost?	Rs.74
	Plan	
9	Which alternative way of doing the job show the greatest difference between cost and use value?	Reduce the weight of the end cover
10	Which ideas are to be developed?	Reduce the weight of the end cover
11	What other functions (work or sell) and specification features must be incorporated?	
Factor		Reduce no. of turns in order to reduce weight of the winding
Function		Same as existing
No.of parts		No change
Space required		Same as existing
Design		Compact

Table No.6: Cost calculation

S.No	Description	Existing	Proposed
1	Weight of the Material (Kg)	4.5	3.8

Table No.7: Cost calculation

S.No	Description	Existing	Proposed
1	Weight of the material (Kg)	1.5	1.0
2	Material cost (Rs.)	60	60
3	Labour cost (Rs.)	14	14
4	Total cost (Rs.)	(1.5*60+14) = Rs.103	(1.0*60+14) = Rs.74

So Net Saving = 103-74= Rs.29/-Percentage saving in cost = 28.15%

Table No.8: Combined result of suggested modification

S.No	Comp.name	Present cost (Rs.)	Modified Cost (Rs.)	Net Saving (Rs).	% of Cost Reduction
1	Impeller	434	235	199	45.85
2	Main andaux winding	554	492	62	11.19
3	Adaptor	295	243	52	17.62
4	End cover	103	74	29	28.15
		1386	1044	342	24.67

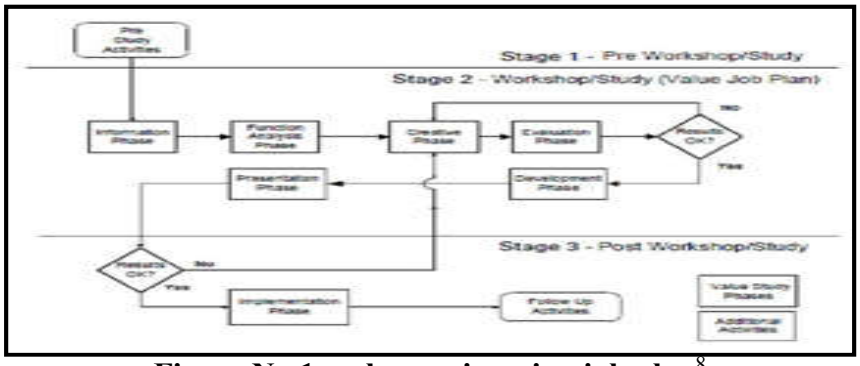

Figure No.1: value engineering job plan[8]

Figure No.2: 1.0HP Centrifugal pump

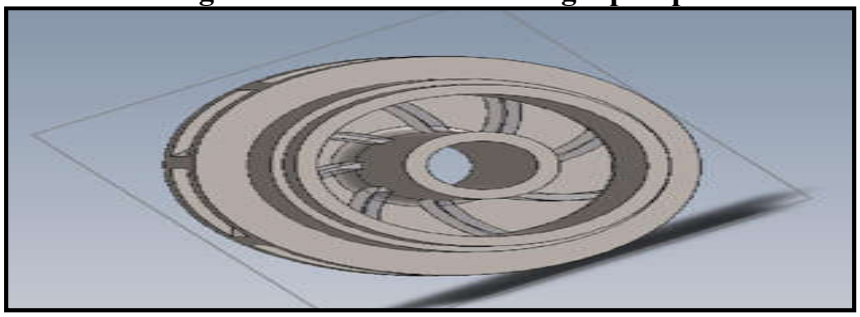

Figure No.3: Impeller (Stainless Steel-Grade 410)

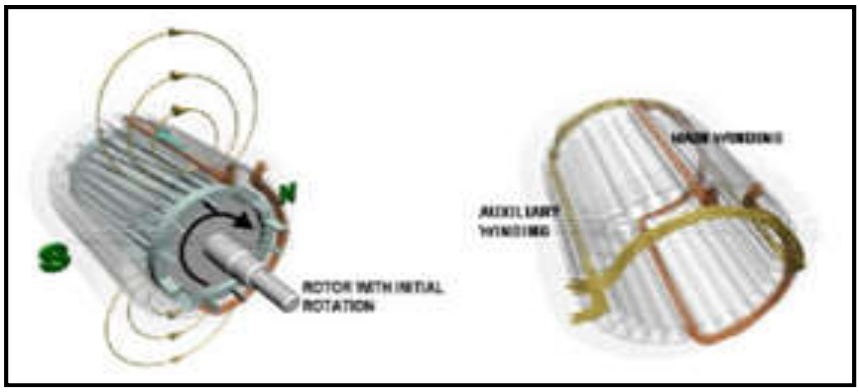

Figure No.4: Main and auxiliary winding

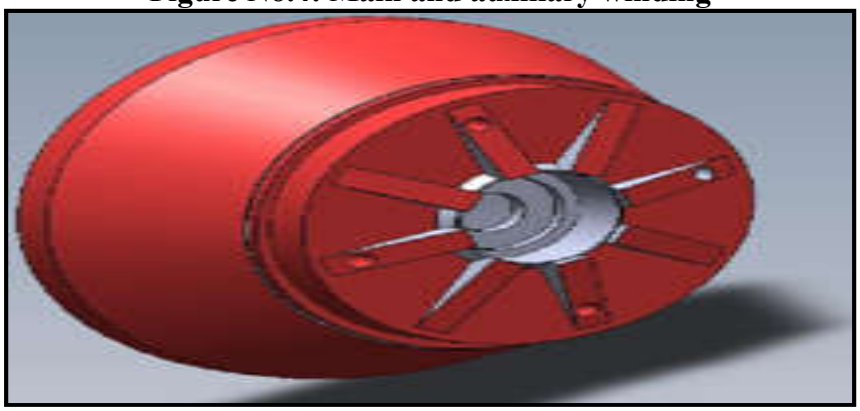

Figure No.5: Adaptor

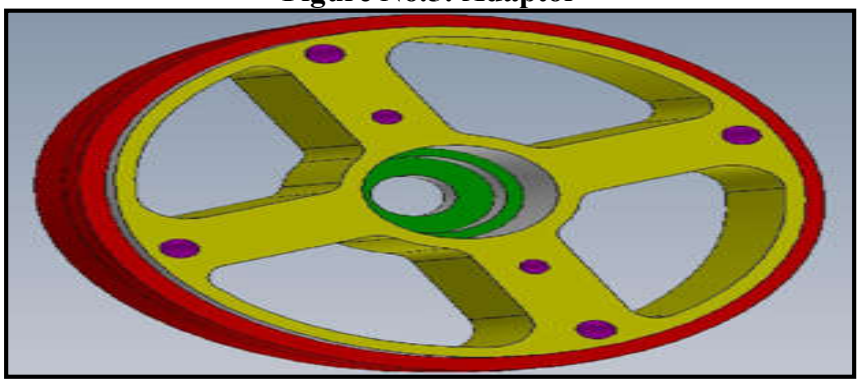

Figure No.6: End cover

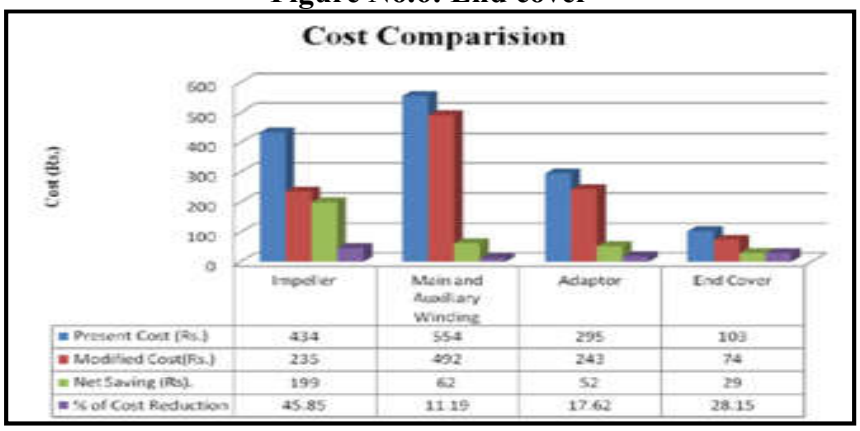

Figure No.7: Cost comparison

CONCLUSION AND FUTURE SCOPE

In the current case study it is experimental that the unnecessary growth in cost is due to use of expensive material, complicated design, increase in variety of hardware items and thereby increasing the inventory. Value Engineering is performed in this case study by applying design modifications and change in materials of components. From the results of the execution of value engineering to the selected components of 1.0HP Centrifugal Pump, we conclude as follows:

Material modification for impeller has been suggested, design changes are suggested for adaptor, end cover and coil winding turns reduction modification is suggested for main and auxiliary winding and thereby the cost reduction of the product have been achieved through value engineering technique.

From Table No.8 it is clear that execution of value engineering to selected four components only results in net saving of 24.67%.

The substantial cost reduction is achieved through value engineering technique ion 1.0 HP centrifugal pump. In the similar way secondary analysis can be made for remaining components and further cost reduction can be achieved. Also the Value Engineering results in the elimination of unnecessary cost by avoiding unwanted machining of components and minimizing variety of different hardware and also of the required tools of operation.

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CONFLICT OF INTEREST

We declare that we have no conflict of interest.

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