

Review on Value Engineering and Value Analysis

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Abstract

Value engineering and its various stages are a fundamental concept used in industry to increase company productivity and eliminate unnecessary processes so that profit can be maximised and the cost of the product minimised. In the last decade, competition in the industrial sector has increased day by day, where manufacturing companies continually need to improve the production lines and product design. Nowadays, production is increased due to an increase in the need for goods, so reducing the total manufacturing cost of products and reducing wastage like part scrap, quality issues, and other product rejection is necessary. The international market leads to competition, and the organisation required by the market provides the consumer with the best value. Product standardisation is important for international trade in goods and services throughout the world.

Keywords: - Value Engineering, Value Analysis, VE Job Plan, Different Phases, Cost reduction

INTRODUCTION

Value Engineering is the systematic application by a multi-disciplinary team(s) of the statistically significant function of a product or service; creates a value for that function, generates alternatives through creative thinking, and provides the necessary functions reliably at the lowest overall cost.[1] Value Engineering is a systematic approach to achieving the desired product, process, system, or service functions at a minimum overall cost and maximum consistent performance without affecting the quality, reliability, performance, and safety of the product, process, system, or service in any way. [2] Value engineering is an intensive,

interdisciplinary activity to solve problems that focuses on improving the functions needed to achieve the objective or goal of any product, process, service, or organisation [3]. Value engineering is one of the major cost reduction and cost prevention techniques. It is a disciplined approach that ensures the required functions without sacrificing quality, reliability, performance, and appearance at the minimum cost. It is a systematic application that defines a product or services function. It sets a monetary value and reliably provides the required function at the lowest overall cost. [4] Value engineering is an intensive, interdisciplinary activity to solve

problems that focuses on improving the functions needed to achieve the objective or goal of any product, process, service, or organisation. Value engineering is also called "value management" or "value methodology" (VM) and "value analysis" (VA).

Value engineering in manufacturing industries

Nowadays, Value Engineering plays an important role in controlling the different factors such as cost, performance, and quality of the various products in the industries. Value engineering is concerned with cost reduction, improvement of quality, and installation for the benefit of industries of an integrated system of men,

material, and machine. It offers specialised knowledge and skills in engineering analysis methods and predicts and analyses the outcomes obtained from such a system. The additional costs associated with the production time must be reduced for each industry, and the quality of the product must be maintained to a certain level according to the customer's demand.

VE METHODOLOGY

The VE methodology (job plan) can be applied to any product or problem. The job plan for the VE divides tasks under study into functions. A value team leader usually organises the job plan in the eight sequential phases shown below. [6]

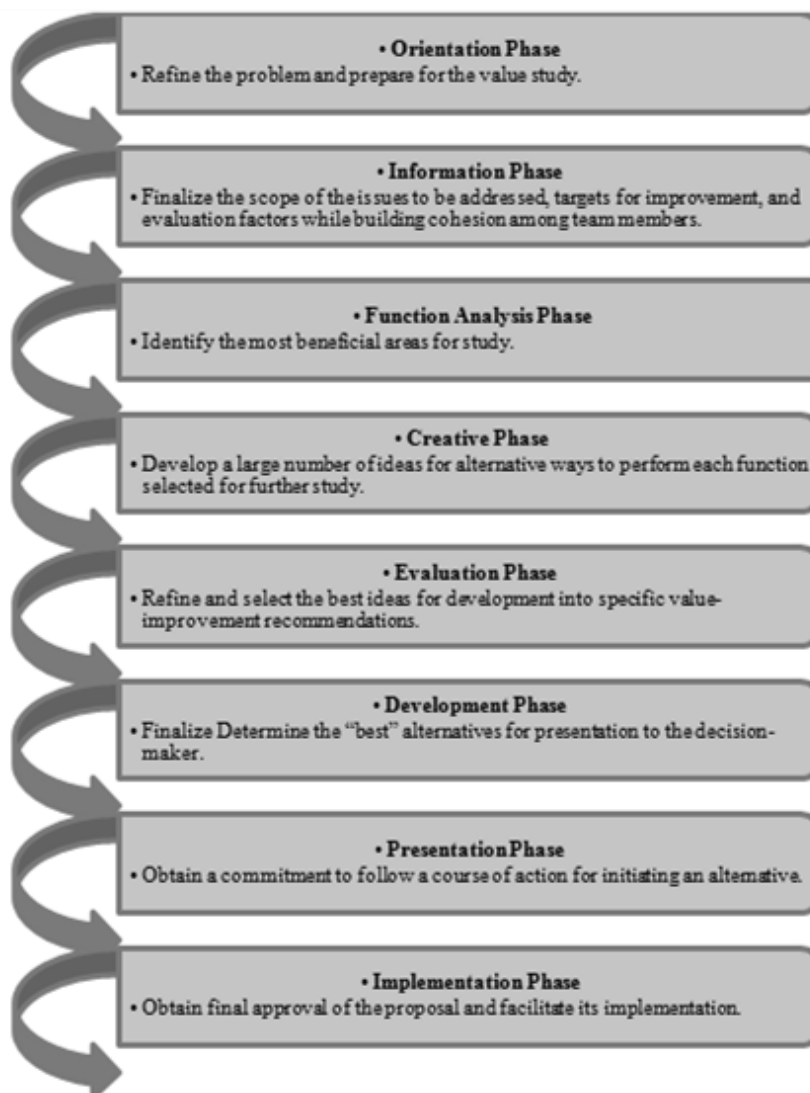


Figure 1 Phases of Value Engineering

LITERATURE REVIEW

Pratik Mahajan et al. [1] applied a case study on the basic fundamental of value engineering and its various phases that can be implemented in bath fitting product (CONC) to optimise its value. Using value engineering and applying Decision Matrix, the authors suggested changing the material and using ZAMAK instead of brass. Due to the above change, the cost was decreased, and it saved Rs. 35 per product. Annual saving was Rs. 2,80,000.

Amit Narwal et al. [2] presented a case study on the principle of value analysis in sheet metal. The author faced challenges in hole tapering and cutting into parts. A team was assembled from related departments to research the possible cause—the why analysis was taken to eliminate the problem. The punch is constructed in such a way that punching and embossing are carried out in one stage. Because of this, product rejection is reduced, and the rework time is saved, resulting in an overall saving of Rs. 234600.

Amit Narwal et al. [3] discussed a case study on the concept of Value Engineering, its job plan and the effective implementation of value engineering for Focus Adjustment Knob for Slit Lamp in a microscope. The best alternatives, which were nylon knobs, were selected from the feasibility ranking table. The total saving was 11.59 per product from the cost evaluation table. By applying the above changes, costs were reduced, overall production increased, scrap was reduced, and the product's value was also increased.

R. Vijayan et al. [4] conducted a value engineering and value analysis of the part in the air suspension system without affecting the product's performance and quality. Cost and weight are high

in the current rear air spring bracket model, so a new design was proposed in which the unwanted material such as the pivot bracket is removed and redesigned. The new design, proven through solid works software, could withstand more stress, and displacement of 4 kg of weight was reduced. The cost per piece reduction was Rs. 78, and cost savings per year were Rs. 10,10,880.

Rushil Kadu et al. [5] analysed the possibility of cost reduction through the value analysis technique. To reduce costs, a conservative wooden bed production process was studied to apply a value analysis technique. Function Cost worth Analysis (FCEA) was implemented to propose ideas, 1 make slots in the top slat, 2 optimise wood thickness by strength analysis. The cost saved per product was Rs. 415, 18.14% of the total cost by implementing the proposed ideas.

Parish M. Naoghare et al. [6] conducted a case study on process optimisation for rubber house moulding and assembly lines through value analysis. The author has created a new line balancing chart, combining the moulding of the rubber house on a single injection moulding machine and change the internal design of the post-curing oven. As a result of the above suggestion, the throughput time ratio decreased from 22 to 2.76, 87.4%. The space utilisation ratio decreased by 50.89%, the material handling ratio decreased by 51.8%, and each operator's productivity increased from 100 to 350 units.

P. Pimpanont et al. [7] adopted a value engineering methodology for product cost reduction in the manufacturing process of hard disk components. This study applies the principle of VE to the development of head stack assembly, focusing on the tail fixing process. The VE technique has

introduced seven phases to conduct cost and functional analysis of the specific technical process. To find out which solution gives the best outcome, statistical analysis and hypothesis testing have been tested. The result shows that the indirect cost of the material for the product can reduce the price of the adhesive used in the tail fixing process by 30%.

Sri Indrawati et al. [8] applied a case study to innovate the ceramic display table according to user needs. Value engineering techniques were used to develop the ceramic display table's best alternative product design. The issue that often included was a heavy table, a less flexible and a large display table. It showed that the user for ceramic display tables required three attributes. Design alternative scores were calculated based on the user's preferences of the ceramic display table. The best alternative design for the ceramic display table was made of a Dutch teak wood material that can also be converted into a suitcase.

Chougule Mahadeo Annappa et al. [9] discussed a case study on the furniture industry in which the material size of the product is changed according to the value engineering methodology. This case study presents how theories and methods of value engineering can be applied in the industry. To reduce the cost, value engineering with its different phases can be implemented in any product. The material has been selected so that the cost is reduced without affecting the value and design of the product. The author used function analysis, function evaluation, and decision matrix tools to find the best possible alternative from the choices, giving the most relevant results. Value engineering was applied on a divan, on which functional analysis and cost analysis was carried

out. The authors decide the main four parameters during the evaluation phase, and based on two alternatives were decided, 1. Change the gauge of material, 2. Reduce the thickness of the board (where required). The total saving cost was 19.60% for alternative 1 and 14.61% for alternative 2 by implementing alternatives.

Chougule Mahadeo Annappa et al. [10] discussed a case study on furniture manufacturing small scale industry in which the material size of the product was changed according to the value engineering methodology. This paper presents how value engineering theories and methods can be applied in the industry. Value engineering is a powerful management technique that can make valuable contributions to the furniture manufacturing industry's value enhancement and cost reduction. The material was selected in such a way that the cost was reduced without affecting the product's value and its design. The author used tools such as Function Analysis, Functional evaluation and decision matrix to find the best possible alternative from the choices, giving the most relevant results. Functional analysis and cost analysis were carried out on the computer workstation, and value engineering was applied. The authors decide the main four parameters during the evaluation phase based on two alternatives, 1. change material, 2. make it in folding. By implementation, alternative weight was reduced, and the total saving cost was Rs. 3,00,000 per annum for alternative 2 and Rs. 1,20,000 per annum for alternative 1.

Chougule Mahadeo Annappa et al. [11] presented a case study. It observed that the unnecessary cost increase was due to the use of costly material, the increase in the variety of hardware items and the

increase in inventory. Some UTM components such as handwheel, range selector knob, top bearing bracket assembly, dial bracket and recorder gear were chosen by authors. Value engineering technique was applied for the cost reduction of these components of UTM. The modification of the top bearing bracket assembly and dial bracket was suggested, reducing the cost and weight and material requirements. To change material CI to nylon reduces cost and weight of handwheel, range selector knob and recorder gear. Total saving done was Rs. 3875, which was 20.84%.

Satish M. Silaskar et al. [12] concentrated on a case study on applying value engineering and value analysis of ball valves used in hydraulic systems. Value engineering principles have been mainly applied to weight optimisation of valves for cost-effectiveness and performance improvement. By applying value engineering methodology suggested to modification in the valve design, valve wall thickness reduced from 36 mm to 26 mm, create slot at the place ball rest, and reduce hole at seat retainer from 24 to 16 no which reduce drilling time also effect on torque. Effort applied results in a weight reduction of around 60kg, 12-13% of total weight. Due to the above change, cost and cycle time was also reduced.

Sri Lakshmana Kumar et al. [13] conducted a case study on developing a cost-effective design in a monoblock pump. During value engineering, there were few mandatory points observed to reduce the cost. The material for the impeller was changed from gunmetal grade LTB-4 to stainless steel grade 410, resulting in a net saving of 42.6%, the design for the adaptor and end cover was changed, resulting in a net saving of 21.69% for the adaptor

and 28.84% for the end cover and it also reduced weight. The reduction of turns from 130 to 95 for main and auxiliary windings resulted in a net saving of 11.79%. The result of the above changes in net saving was 24.84%.

Himanshu Kumaraswamy et al. [14] concentrated on a case study on value engineering and analysis of roof exhausters used for air circulation in most industries. A modification was done in design by applying value engineering methodology and eliminating the unnecessary parts. Instead of stainless steel, the new proposed product is made of mild steel. The net saving achieved from the above changes was Rs. 3180.

Vinay Kumar Sing et al. [15] presented a case study on cost analysis and optimisation for the automotive product life cycle through value engineering and value analysis techniques for the fuel tank neck locking mechanism. The design of the locking mechanism for the fuel tank neck was changed. The components have been reduced from 23 to 17 parts. The current filler neck length was reduced and projected inside the fuel tank. The author also recommended a single key for fuel tank cap locking, engine ignition, and door locking. The total cost reduction achieved was 6%.

Aprender Singh Sandhu et al. [16] discussed a case study on the Value Engineering Job Plan (VEJP) to reduce the cost and to improve the value of the Auto rickshaw steering bar. The author created four different ideas during the creative phase. The upper cone's major changes were made by changing the shape as it fits properly into dust cover, and two plain check nuts were used to avoid steering play. In the upper cup, grooving and radius chamfering were done, and the lower cup can improve fitting techniques that reduced the

chances of breakage. Because of the above suggestion, the efficiency of the grinding wheel was increased, and it would be changed after 4500 assembly parts instead of 3000 assemblies. By use of dust cover, the life of the auto-rickshaw steering bar increases. Total cost reduction was 1.54%, and the average annual saving was Rs. 240000.

Amit Sharma et al. [17] conducted a value engineering case study on the flush valve for cost optimisation. By applying value engineering, the author suggested changing the material and using ZAMAK instead of brass which was lower cost and equal value and no design changes required Rs. 16 per part was saved, and expecting annual saving was Rs. 192000.

Amit Sharma et al. [18] presented a case study of value engineering on slit housing which increased value and optimised product cost. The production process was changed by applying value engineering, and it was made from casting instead of CNC turning and CNC milling. Rs. 57.32 was saved per product due to the changing process, and annual savings were Rs. 5, 73,200. This increased the value by 58.20%.

Bhaskar B. Gardas et al. [19] applied case study value engineering and its methodology was to handle assembly of the Mumbai local train to reduce its cost and weight optimisation. Using the evaluation matrix, the author suggests an idea to "eliminate assembly of handles and lower the road on which handles were mounted." Due to the above suggestion, weight was reduced; material and cost saved, and less pollution and the dropping ratio of passengers were reduced.

Celestine Aguwa et al. [20] applied case study value analysis and different phases for tree

climbing devices to improve product development and increase customer satisfaction. A new design was created by value analysed and evaluated by the author. It was a safer, better product and satisfying customer expectations. Safety hooks have been used to ensure users safety. For the customers, footrest and height adjustment features were used because of the above changes that fulfilled the clients' function and increased the value of tree climbing devices.

Find John et al. [21] conducted case studies on value engineering principles in a residential building construction project to save time and reduce cost. At the initial stage of construction beginning, authors created new plan designs for cost reduction and also created fast diagrams. Some designs were also taken, such as cement plastering replaced by gypsum plastering, wooden windows and doors replaced by UPVC and for easier cleaning, tilling the windowsills. For the success of the project, information phases were more important for finding and solving the problem.

UgoIbusuki et al. [22] focused a case study on the engine starter system and applied value engineering methodology and target costing in cost management. Improve the current design through detailed research with local suppliers and change the material, production process and simplify the design for customers. By value analysis, the author suggests a pneumatic starter instead of an electrical engine starter, which provides a longer useful life, low maintenance cost, more force, and less weight and safe operation. Due to the above change Rs. 9.97 saved per starter, and the annual saving per year was Rs. 59,820.

Ali Mostafaeipour [23] applied value engineering techniques on humidifiers to necessary changes in the design to reduce unnecessary costs, increase the quality of the product, and optimise the life cycle cost. The best idea was selected from the decision matrix, and the author suggested that the fan cover material be changed from galvanised iron to hard plastic or fibre plastic. Weight was reduced, and due to this change, maximum cost savings were achieved, and part quality was increased.

FINDINGS FROM LITERATURE REVIEW

1. Value engineering is a powerful problem-solving tool that can be reduced costs while maintaining or improving performance and quality requirements.
2. Value engineering is executed by implementing design modifications and material changes in components for cost reduction.
3. During the concept and design stage of new product phases, value engineering techniques required the overall lifecycle time, reduced product cost, wastage, increased product reliability, and high customer satisfaction.
4. Value engineering helped reduce space utilisation, material handling, and throughput time, eliminates unnecessary parts, weight reduction, increased stress capacity, and increased productivity.
5. Value engineering also increased the life of the product.

CONCLUSIONS

Value engineering is a powerful tool and uses better results after implementation in any product, process, and system. This gives better replacement/change along with more improvement

of product or service quality and increases productivity. It eliminates the additional components and processes that increase the manufacturing cost of products in the industry and increase the performance and profit of the company. By applying Value Engineering ideas, the cost is effectively reduced with respect to various products. Hence, this research shows that implementing value analysis in a production line led to a reduction in labour, resulting in reduced investments, which improves space utilisation, material handling throughput time, and increased production.

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