An Analytical Way to Reduce Cost of a Product Through Value Engineering Employment (Case Study: Walton)

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Abstract: Value engineering is considered as an important and powerful approach for cost cutting and quality management for organizations. Value engineering not only reduces cost or increase economic efficiency, but also provides environmental positivity. Value engineering is a systematic approach to find out the cost reduction opportunity without compromising the quality. However, this paper represents a case study with the implementation of value engineering through completing some certain analysis in a product component. The goal of this paper is to analyze the reality of value engineering in a case organization. The results of the analysis and calculation then be compared to select the best option and result will define the best solution amongst all solution. The result will largely depend on the cost savings that is calculated in Bangladeshi Taka (BDT). This paper aims to utilize the uses and application of value engineering and implement VE in products and projects.

Keywords: value engineering, cost cutting, value analysis, value management.

1. INTRODUCTION

Value Engineering is simply a method that simultaneously reduces the cost with adding value and improve the quality of the product or services. Today's market is a competitive market and the way to have success in this market is to provide the best value price to the customer. This is possible by the cost calculation. Value Engineering is a systematic approach to an improved and value product for every single resource that is used during the production or in a system (Ibusuki and Kaminski 2007; Kwong et al. 2007). The results of value engineering are proved in so many countries and it is used largely to some sectors. Value analysis is developed through teamwork and diagnosis and the techniques of value engineering gives a solution to reduce the price in an innovative way (Kalani and Kamrani 2017, p. 57). VE is defined as an organized effort that analyses the system, facilities, services and supplies to sort out the most essential functions at the lowest life cycle cost(LCC) without decreasing the required quality, durability performance and sustainability (Elayache 2010).

The value engineering methodology is taught mostly in industrial engineering programs and in project management for Total Quality Management and Business Process Reengineering. The concept of value engineering calls for several steps of project planning. But the key steps are accomplished through the development of performance criteria measures and ranking performance according to the current established measures and project costs. Value is then determined according to the ratio of performance over the cost (Pearsall 2006). The mathematical term is given below:

Value = Performance / Cost

To improve the value of a project or product, there must be a way to measure these values. Ilayaraja stated in his article that, value is based on three elements. These elements are cost, quality and functionality. But in some cases, time and efficiency can also be determined as the variables to measure VE (Ilayaraja and Eqyaabal 2015).

The aim of this article is to conduct a study on value engineering and its applications through literature review and an empirical study to understand the value engineering cost saving method and generate some thoughts for further research to improve the conventional one. During this report, there are some research questions that will be answered. The questions are:

1. What are the important parameters that is considered during value engineering?
2. What are the phases or steps of value engineering?
3. How to choose the best option from the alternatives after the value analysis is done?

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In this article, a broad literature review was done to overview the current status of the value engineering. In section 3, the methodology was discussed. Section 4 and its subsection determines the case company, current status of the product to work with, value analysis of the product and in section 5 we discussed about the result of the analysis to choose the best option. In section 6, we came into a conclusion and discussed about the further scope of work.

2. LITERATURE REVIEW

Value analysis, value engineering and value management is a concept of finding solutions to reduce the cost without changing the value. Value analysis is applied on project completion or products currently using to get rid of extra costs. Whereas engineering value is used to improve the quality and reduce the cost of projects. And this work is done during idea generation or after completion. Management value is another concept to manage programs and setup value studies (Ilayaraja and Eqyaabal 2015).

2.1 Value Engineering

Haskins stated in his article that VE is a systematic approach and works for the lowest lifecycle cost with required performance, reliability, availability and quality (Haskins 2010). Whereas Formentini discussed in his paper that VE not only improve the value, it also adds other benefits such as risk reduction and quality improvement (Formentini and Romano 2011, p. 545-560).

Value Engineering is a process which balances the functions between cost, reliability and function of the product. It does not have to be products only; project or services can also be balanced by VE (Ilayaraja and Eqyaabal 2015). Successful VE is possible when it is possible to identify the unnecessary cost and remove them without changing the quality, reliability and performance or any other factors that is needed by the end customer (Harish and Menezes 2011, p. 223). There are many tools and techniques in VE to improve the value. Some of those are FAST diagram, creative thinking technique, weighted scoring technique and so on (Saeed and Hassan 2012). It is always a good choice to start the study before the proposals are accepted or the operation has started. This will reduce the high cost of applications and increase the acceptance rate (Tanaka et al. 2012, p. 1801-1811).

Ilayaraja (2015) discussed in his article about 2 phases of applying value engineering. The first phase is the preparation of study where there will be five to nine members including certified value specialists and the members will be of multi-disciplinary expertise. This team will review and study the project, find out the cost of the project, determine the completion time of each study and compile the end time of the project. In the second phase, he discussed about 7 sequential and logical steps which starts from collecting data followed by job analysis, innovation, brainstorming, evaluation, R&D and ended in presentation of recommendation.

VE is a process that can be used both in technical and business management applications. VE roles vary in product lifecycle but the main structure remains the same with some little variations. In Kalani's article, he pointed that there are typically 6 different phases in VE which can be summarized into 3 main phases and those are: value discovery, value implementation (Going on-line) and value optimization and future support. The values might be relevant to the project or inspired by the project (Ibusuki and Kaminski 2007, p. 459-474). Value discovery identifies the optimization and innovation opportunities. According to Flanagan and Frey, various workshops, tools, community educations and open discussion are some ways to accomplish this task. The main objective of VD is to make a list of values and bring into attention what are latent in a design project (Flanagan et al. 2008; Frey and Cruz 2013).

Value Implementation means the creation of the value, validation and execution of the values and rendering of those values on the ongoing process. In this regard, value implementation in IT sector became one of the major thing for competitive advantage as most of the improvement in company starts with improving the IT infrastructure (Bakhrun and Ramadani 2014, p. 219-223). Value translation is the action of expressing the values into system. This includes defining the values, implementing them (Flanagan et al. 2008, p. 322-353).

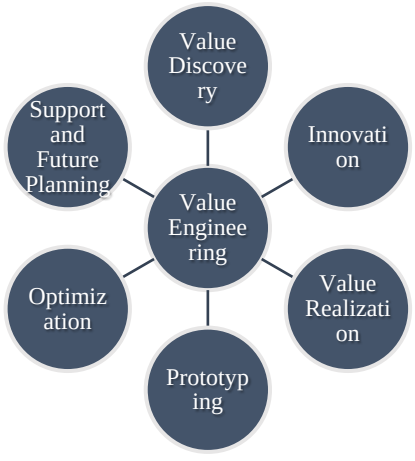

Fig. 1. Importance of VE (retell from Kalani et al. 2017, p. 59)

From the fig 1, it is seen that after VI, there comes Value optimization (VO). VI needs to be continuously accessed to improve the business condition of a company (Bakhrun and Ramadani 2014, p. 219-223). VO ensures the delivery time and budgeting. VO is responsible for delivering the results of the upper stages to make sure the outcome of the value. VO focuses on the leverage of the whole organization. For this reason, it is considered as the most critical element. The VO is critical for future success and therefore needs to be a focus and a priority. A strategy should be defined to drive this value optimization. Some of the strategies are internal testing amongst the design team, user testing, interviews, using prototypes etc. (Flanagan et al. 2008; Frey and Cruz 2013).

For the improvement of project, it is needed to apply VE to multidisciplinary team. According to SAVE International, there are 6 sequential phases which leads to a successful VE study which are distributed into 3 stages. These stages are pre-workshop study, workshop study and post workshop study. The stages are shown in Fig 2.

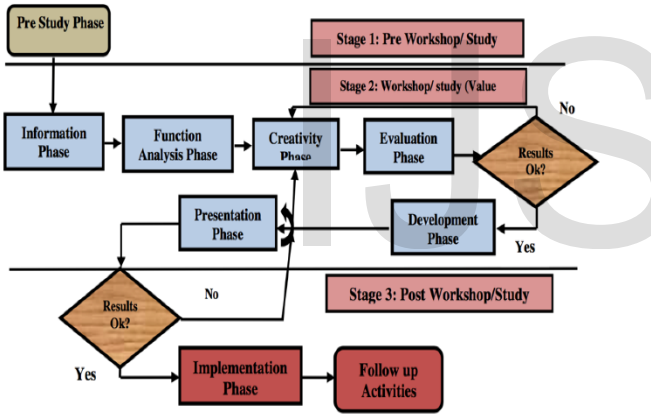

Fig. 2. Stages of value study (retell from Mahdi et al. 2015, p. 2744)

From the figure 2, we can see that stage two is the most technical stage during the VE study. The phases in stage 2 are:

1. Information phase
2. Function analysis phase
3. Creativity phase
4. Evaluation phase
5. Development phase
6. Presentation phase

2.2 Value Engineering and Cost Cutting

Some get confused between value engineering method with cost reduction method. But there is some tangible difference between this two. Cost reduction is a process of reducing cost based on segmentation and elimination of the parts whereas value engineering is an analytical method of project posts and subtracting the alternatives by using less expensive alternatives. This process won't change the design of the project. Suppose there is a plan of making 8 stories building but budget of 6 stories building. Cost cutting method will reduce the size of the building or remove some parts from the plan. VE method will look for some cheaper alternatives such as electricity system, air conditioning etc. but the plan will be constant (Ilayaraja and Eqyaabal 2015).

3 RESEARCH METHODOLOGY

Very practical and simple qualitative method is used for this case study. Employees working in the production line, R&D department of the company and sales department were interviewed for this analysis. They provided all necessary information. Of course, there were some data unrevealed to maintain the competitive advantage in the market. Some research on secondary data from books, articles and similar case studies and a common survey of customer was done. From the survey, some basic requirements of customers are assumed, and value analysis is made.

4 CASE STUDY

The case company we are working on is "Walton". Walton is one of the leading multinational electrical company in Bangladesh with well-equipped R&D facilities. Many world class machineries like thermoforming, channel Extrusion, ABS/HIPS sheet extrusion, magnetic strip extrusion, PP hollow sheet extrusion, VMC, 5 axis VMC, ultrasonic welding, injection molding, Styrofoam making, High speed power press, fin Press, corrugation, SMT pick and place, SPG printing machine, AOI machine, tamura wave solder machine, auto insertion machine are used in Walton to produce these world-class electronic products. Walton is targeted to produce 3 million refrigerators, 0.3 million air conditioners, 0.15 million motor bikes and 1.5 million televisions per annum which are also considered as their flagship product (Walton 2017).

For the variation of products and finding out an easier way for applying value engineering, we have taken a general type of case study by selecting refrigerator. It is a technical component having so many other technical components and it requires certain degree of engineering; as well as value engineering.

The steps used for the value engineering of Refrigerator are as follows:

1. Functional analysis
2. Functional evaluation
3. Creativity phase
4. Evaluation phase
5. Selection of alternatives

4.1 Functional Analysis

In Walton refrigerator, there are many parts that completes the refrigerator. For the analysis, we are working on the body stand, side cabinet, liner, compressor. These parts are considered to be the core parts of the refrigerator. The functional definition along with the verb and noun type definition, basic and secondary functions are given in table 1.

TABLE 1:
Functional analysis of refrigerator

Part Name	Quantity (kg)	Function		Part		Assembly	
		Verb	Noun	Basic	Secondary	Basic	Secondary
Body Stand	1.86	Hold	Material	X			
		Provide	Surface	X			
		Improve	Appearance		X		
Side Cabinet	10.2	Support	Frame		X		
		Improve	Strength	X			
Liner	6.22	Support	Frame	X			X
		Improve	Parts		X		
Compressor	1.53	Support	Parts		X	X	
		Convert	Energy	X			

Table 1 shows that every component has its own functions and these functions are divided into basic functions and secondary functions. The basic and secondary functions are divided for making the redesign easier in a way so that the secondary functions are either added with another function or being eliminated from the product.

4.1.1 Costing of the parts

The material costs of these refrigerator parts are given in Table 2. From the table 2, the total price of all the components is BDT 535.98. The quantities are also given in kilograms.

TABLE 2:
Cost of the components

Serial Number	Part	Quantity (kg)	Cost in BDT
A	Body Stand (ABS Resin)	1.86	140.00
B	Side Cabinet (PCM)	10.20	159.00
C	Liner (ABS Resin)	6.22	151.00
D	Compressor (Base Plate -Aluzinc)	1.53	85.98
		Total	535.98

Figure. 3 represents the price of the part's material in a bar diagram. From fig. 3 we can see that liner is the most expensive part of BDT 159.00 and compressor base plate is the cheapest, BDT 85.98.

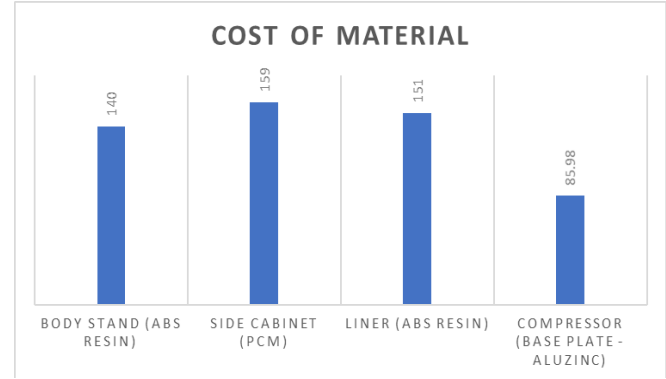

Fig. 3. Cost of material

4.2 Functional Evaluation

By using the interacting functions between the components, a matrix is formed to show the connection between every component with other components. According to the interactions with other components a grading is done as major performance=3, medium performance=2 and minor performance=1. A, B, C, D are the key letters from table 2 which only represents the components of the refrigerator, not the material.

	B	C	D
A	A3	A3	A3
B		B2	B1
C			C1
D			

By doing the above matrix, the weight of every component along with the percentage of cost of the material is given in table 3.

TABLE 3:
Weight and % cost of the components

Key letter	Part	Weight	% Cost
A	Body Stand (ABS Resin)	9	26.12
B	Side Cabinet (PCM)	3	29.66
C	Liner (ABS Resin)	1	28.17
D	Compressor (Base Plate - Aluzinc)	1	16.05

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From table 3, we get that body stand has the maximum weight of 9 and whereas liner and compressor has the minimum weight of 1. Considering percentage of cost, side cabinet has the maximum cost of 29.66% and compressor has the minimum cost of 16.05%.

4.3 Creativity Phase

To make the refrigerator in a cheaper way, there are some techniques and options available to reduce the cost without compromising the quality and performance of the refrigerator. After brainstorming, some ideas are generated in the creative phase. These are: -

1. Using PP resin instead of ABS resin for body stand
2. Reduce the thickness of the side cabinet from 0.5mm to 0.45mm
3. Using HIPS resin instead of ABS resin for liner
4. Substituting wastage VCM sheet instead of Aluzinc in compressor base plate

In table 4, there is the estimated cost of the components after implementing the four factors and also the value gap between the existing cost and the new estimated cost. The ranking is done accordingly with the highest value gap having first rank and lowest value gap having last rank.

TABLE 4:
Function cost worth analysis of the refrigerator

Part	Existing cost in BDT	Worth		Value gap	Ranking
		Alternative	Estimated cost in BDT		
Body Stand	140.00	PP resin	103.4	36.6	1
Side Cabinet	159.00	Reduce thickness	134.00	25.00	3
Liner	151.00	HIPS resin	127.00	24.00	4
Compressor	85.98	VCM sheet	56.00	29.98	2
Total	535.98		420.4	115.58	

From table 4, we can say that by the modification of the product, we can target the new proposed value of BDT 420.40.

4.4 Evaluation Phase

In order to save money, there are some scope of redesigning the product without changing any performance of the product. In the section 4.3.1, we see that there are four alternatives of changing the design without compromising the product quality and parameters. The alternatives are:

Alternative 1: Using PP resin in body stand

Alternative 2: Reduce the thickness of the side cabinet to 0.45

Alternative 3: Using HIPS resin in liner

Alternative 4: Using VCM sheet in compressor base plate

The common parameters that the company follows for each of her products are:

A. Firmness
B. Aesthetic
C. Light weight
D. Durability

The weightage of the parameters are calculated in the below matrix:

	B	C	D	Score
A	A1	A2	A3	6
	B	B2	B1	3
		C	C3	3
			D	1

The score from the matrix are 6,3,3,1 for firmness, aesthetic, lightweight and durability respectively. The scores are then used in the evaluation matrix.

4.5 Selection of Alternatives

An evaluation matrix table is created in table 6. The purpose of this matrix table is to select the best alternative according to the total score. There are five alternatives in our current analysis. During the survey, the demand of the four parameters in a product were asked to random people for the existing and alternative products. Scoring 5 for excellent, 4 for very good, 3 for good, 2 for fair and 1 for poor. The scores are at the left of each cells and the total score of each parameter are at the right of each cell on the parameter's column. Total score of the parameter is the multiplication of the weighting factor and customer's score.

TABLE 5.
Transformation of Customer feedback to score

Excellent	Very good	Good	Fair	Poor
5	4	3	2	1

TABLE 6:
Evaluation matrix for all alternatives of the refrigerator

Alternatives	Firmness		Aesthetic		Light weight		Durability		Total
	6		3		3		1		
Existing	4	24	4	12	3	9	3	3	48
Alternative 1	4	24	5	15	4	12	4	4	55
Alternative 2	3	18	5	15	5	15	3	3	51
Alternative 3	4	24	4	12	4	12	3	3	51
Alternative 4	4	24	4	12	5	15	3	3	54

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From table 6, we see that alternative 1 has the maximum score of 55 points. The existing product got 48 points, alternative 2 and alternative 3 got 51 points, alternative 4 has 54 points. In customer's satisfaction point of view, alternative 1, alternative 2, alternative 3 and alternative 4 all satisfies the demand of the customer.

5 RESULTS

The above table 4 and table 6 shows that; by changing the material to body stand, liner and compressor; the product cost can be reduced without any sacrifice of the customer's demand. Also reducing the thickness of the side cabinet does not affect the customer demand and reduces the price. comparing all the alternatives in table 7, reducing the thickness is more profitable for the company than eliminating the leg strip.

TABLE 7:
Price comparison for all alternatives

Part	Existing (Prices are in BDT)	Alternative 1 (Prices are in BDT)	Alternative 2 (Prices are in BDT)	Alternative 3 (Prices are in BDT)	Alternative 4 (Prices are in BDT)
Body Stand	140.00	103.4	140.00	140.00	140.00
Side Cabinet	159.00	159.00	134.00	159.00	159.00
Liner	151.00	151.00	151.00	127.00	151.00
Compressor	85.98	85.98	85.98	85.98	56.00
Total	535.98	499.38	510.98	511.98	506

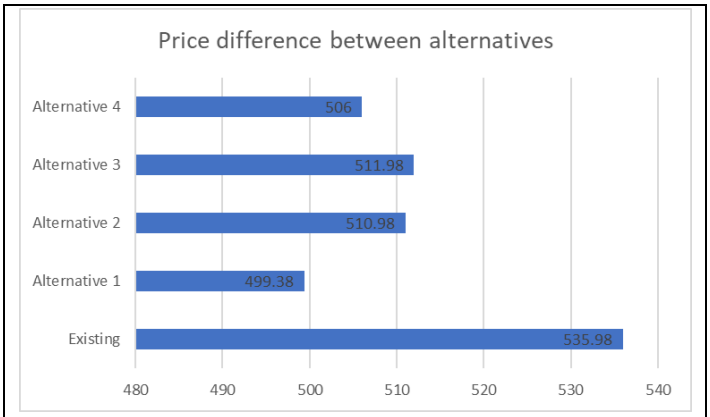

Fig. 4. Comparison of prices between the alternatives

Comparison between the 5 option shows that, alternative 1 is the most suitable and profitable for business. Alternative 1 fulfills both the business and customer requirement. Without decreasing the quality, Walton can redesign the product by changing the material of the body stand.

6 CONCLUSIONS AND FURTHRER RESEARCH

6.1 Conclusion

The article is shows a proper way of applying value engineering to any product in a company. Value engineering can be done to most of the products in a company. If it is not done to any product then the product is in its optimized situation and no value engineering can be done to that product. In this case study, there are 4 alternatives. Altering the material of body stand, liner and compression baseplate, reducing the thickness of the side cabinet were the alternatives. After the value analysis and study, altering the material of the body stand is selected as the best alternative for the product.

6.2 Further Research

This case study is based on a complex product considering some components of the product, and taking only four alternative solutions. Further scope of study can take into account by combining both of the alternatives together. One can also find more alternatives from more components and reduce the cost without changing its value. Moreover, improvement of the VE structure can be another research topic. Further research can be conducted in value engineering and product portfolio to apply value engineering at any stage of the product portfolio. Sustainability is another alternative. Although most of the studies are conducted on either construction projects or manufacturing, further VE research can be conducted in IT systems or in services.

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