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Cost Reduction through Value Engineering: A Case Study of Packaging Improvement in Rubber Thread and Rubber Tape Industry

[1]Korakot Hemsathapat, [2]Jakkree Sonpibool, [3]Dumrongkiat Ratana-amornpin,
[4]Narongpon Boonsongpaisan

Graduate School in Industrial Management, Thai-Nichi Institute of Technology
1771/1 Pattanakarn Rd., Suanluang, Bangkok 10250, Thailand
[1]korakot@tni.ac.th, [2]mai065@yahoo.com [3]dumrongkiat@tni.ac.th
[4]narongpon@tni.ac.th

***Abstract*— The objective of the concepts and techniques of Value Engineering (VE) is to make possible degree of effectiveness in identifying and removing unnecessary cost which approaches the effectiveness of identifying performance improvements for the product. In the process of lowering cost, three steps are used 1) identify the function 2) evaluate the function by comparison and 3) develop cost value alternatives. For the achievement of removing unnecessary cost, it has been carried out with an effective overall plan that includes all three essential steps. An implementation of VE for packaging cost cutting at a rubber thread and rubber tape factory is demonstrated.**

***Keywords*— Value Engineering (VE), Cost Reduction, Packaging Improvement**

I. Introduction

Packaging is defined as a science and an art. It is more of an art when considering consumer products and more of a science when considering industrial products. When considering cost reduction, there are lots of conflicting requirements. A packaging designer needs to trade-off among many stakeholders. Transporters are concerned with convenience in loading and unloading operations in terms of speed and time. Retailers are more concerned with aesthetics because it helps turnover of the products. Laws and regulations are needed to be considered in packaging. Eco-friendly, and easy-to-dispose packaging material must be used in some certain trade zones [1].

In this paper, VE, the process of reducing cost, is demonstrated to separate unnecessary cost from necessary cost of rubber thread and rubber tape packaging, without affecting the performance. The outline of this paper is as the following. First, VE is briefly explained. Then, implementation of VE at rubber thread and rubber tape factory is described. Finally, conclusion and discussion concerning further implementation are presented in the last section.

II. Value Engineering

Value Engineering (VE) was developed at General Electric Corp. during World War II and is widely used in industry and government, particularly in areas such as defense, transportation, construction, and healthcare. VE is defined as "an analysis of the functions of a program, project, system, product, and item of equipment, building, facility, service, or supply of an executive agency, performed by qualified agency or contractor personnel, directed at improving performance, reliability, quality, safety, and life cycle costs [2, 3]."

VE has been widely applied to many cost reduction projects. Department of the US Army utilized VE to reduce total ownership costs of the US army equipment life cycle [4]. Xingcheng department store in China deployed VE to determine the reasonable number of salesclerks of each shop counter based on the Basic Point Method in VE to reduce the cost of labor force [5].

Different methodologies for implementing VE have been used. However, the methodology proposed by Arthur E. Mudge [6], called value engineering job plan, is probably the most widely implemented. This methodology has a general procedure which consists of the following seven phases.

1. *Selection Phase:* define the scope of the project
2. *Information Phase:* collect and understand the project's necessities.
3. *Functional Phase:* defines what it does to meet the requirements
4. *Creative Phase:* search for new ways to achieve functions
5. *Evaluation Phase:* rank ideas against specific criteria
6. *Investigation Phase:* expand ideas into alternatives
7. *Recommendation Phase:* report findings

III. Implementation at a Rubber Thread and Rubber Tape Factory

The rubber thread and rubber tape factory has been established in Thailand for more than 30 years. The rubber

thread and rubber tape are part of many final products, for examples, underwear, swim suit, lingerie, handbag, shoes, etc. In this study, VE has been implemented for packaging improvement at the slitting department of the factory [7].

Currently, packaging materials of rubber thread and rubber tape consist of 12 parts as shown in Fig. 1. The cost breakdown of each material is shown in Table 1.

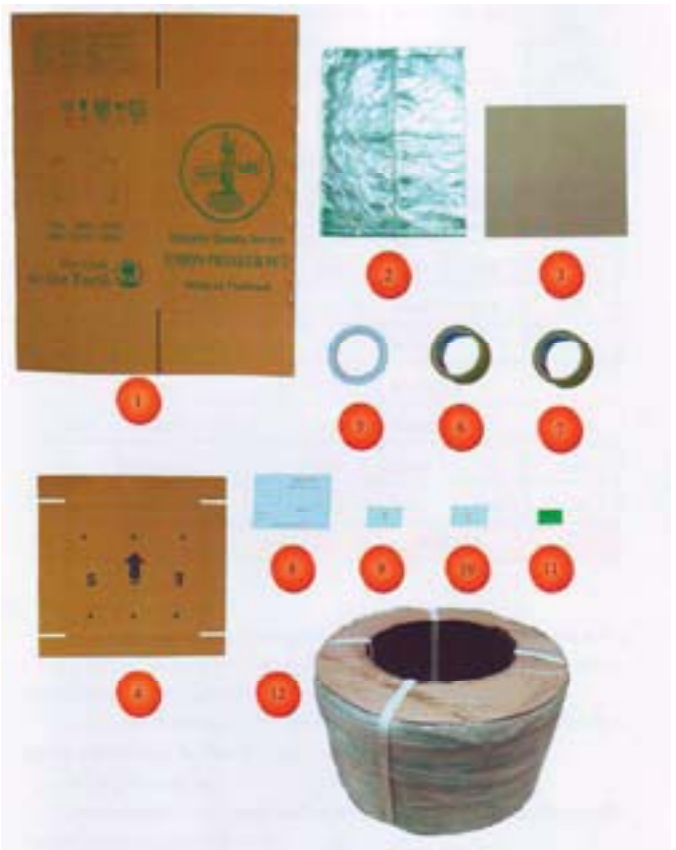

Fig. 1 Packaging materials

TABLE I
COST BREAKDOWN OF RUBBER THREAD AND RUBBER TAPE PACKAGING BOX

Item	Description	Cost/ Unit	Unit	Qty. Used	Cost of Material (Baht)
1	Carton	25.00	Baht/pcs	1	25.00
2	PE Bag	3.47	Baht/kg	1	3.47
3	Bottom Plate	2.00	Baht/pcs	1	2.00
4	Top Plate	5.50	Baht/pcs	1	5.50
5	Double Side Tape	0.00	Baht/cm	66.6	0.18
6	Clear Tape 2 ½"	0.01	Baht/cm	266	1.92
7	Clear Tape 1 ½"	0.00	Baht/cm	89.6	0.39
8	Label	0.22	Baht/pcs	2	0.44
9	S Sticker	0.11	Baht/pcs	1	0.11
10	E Sticker	0.11	Baht/pcs	1	0.11
11	QC Sticker	0.22	Baht/pcs	1	0.22
12	PP Band	0.32	Baht/m	3.26	1.04
Total		**40.38 Baht**			

The carton (item no. 1) has the highest cost, accounting for 61.91% of the total material cost. The labor cost for assembling one package is 2.55 Baht. In total, the cost of material and labor is 42.94 Baht/package. The processes to assembly one package are shown in Fig. 2- Fig 8.

Fig. 2 Assemble top plate

Fig. 3 Attach doubled-side tape with the bottom plate

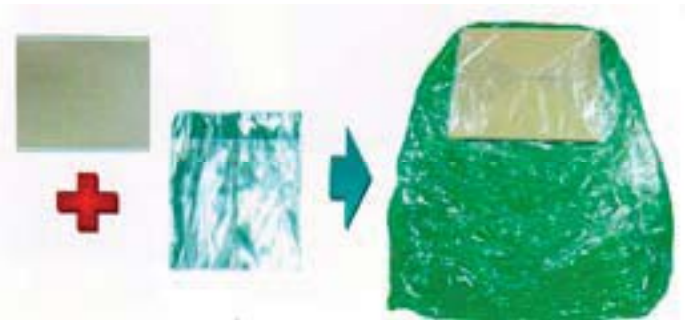

Fig. 4 Attach the bottom plate with the PE bag

Fig. 5 Unfold and seal the bottom of the carton

Fig. 6 Put the PE bag in the carton

Fig. 7 Prepare all the labels

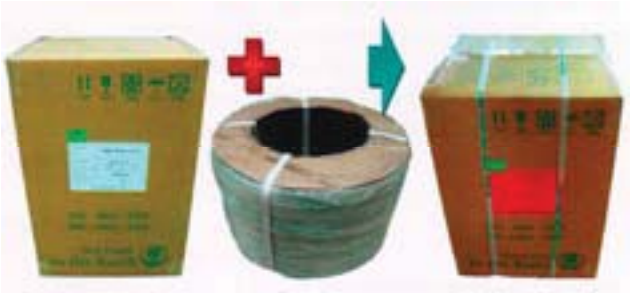

Fig. 8 Seal and strap before keeping in store room

Functional analysis of all 12 materials has been performed to analyze the primary and secondary function of the materials. From the analysis, five primary functions are obtained as followings:

A: Product protection
B: Easy to transport
C: Aesthetic
D: Easy to assemble
E: Easy to use

Pair comparison has been used to rank the difference amount between the primary functions classifying into 3 levels (see Fig. 9).

1 = less different
2 = moderately different
3 = significantly different

	B	C	D	E	Score
A	A1	A3	A2	A2	8
B		B3	D1	E2	3
C			D2	E3	0
D				E1	3
E					6

Fig. 9 Analysis of Primary Functions by Pair Comparison

From Fig. 9, it can be concluded that product protection (A) is the most important primary function with 8 point weight representing 40% from the total weight. Aesthetic does not have any weight (see Table 2).

TABLE II
SUMMARY OF FUNCTIONAL ANALYSIS

	Function	Weight	Percent
A	Production protection	8	40
B	Easy to transport	3	15
C	Aesthetic	0	0
D	Easy to assemble	3	15
E	Easy to use	6	30
		20	100

The material and labor cost can be distributed according to weight assigned by functional analysis (see Table 3).

TABLE III
COST DISTRIBUTION BY FUNCTIONAL ANALYSIS

	Function	Cost
A	Production protection	17.18
B	Easy to transport	6.44
C	Aesthetic	0.00
D	Easy to assemble	6.44
E	Easy to use	12.88
		42.94

Four primary functions (A, B, D, and E) are evaluated and analyzed for improvements. Thirty creative ideas for each primary function have been investigated. Consequently, the packaging is redesigned into four packaging models as seen in Fig. 10-Fig. 13.

Fig. 10 Model 1: Plastic box with separated lid

Fig. 11 Model 2: Corrugated box with attached lid

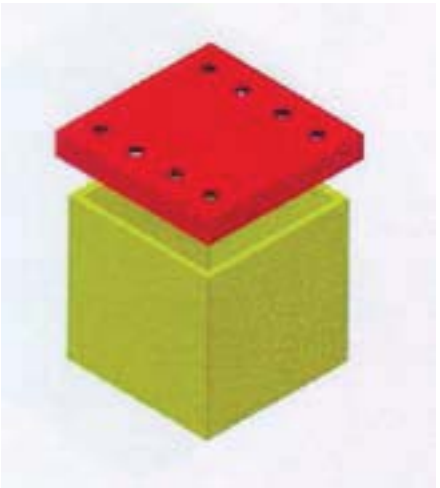

Fig. 12 Model 3: Foam box with separated lid

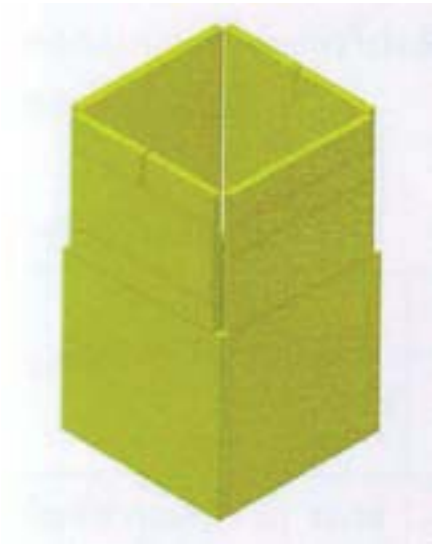

Fig. 13 Model 4: Corrugated box with inner lid

Comparison of cost distribution between the current packaging model and the four new models is shown in Table 4.

TABLE IV
COST DISTRIBUTION OF DIFFERENT PACKAGING MODELS

Function	Current Model	Model 1	Model 2	Model 3	Model 4
Production protection	17.18	16.21	18.47	16.21	14.21
Easy to transport	6.44	6.08	6.63	6.45	5.23
Easy to assemble	6.44	8.11	4.51	7.15	5.15
Easy to use	12.88	8.11	13.02	7.85	10.40

Comparison of the Value Index (VI) of current model and other models is shown in Table 5. Model 4 with the highest VI, is the best model, can save cost in the amount of 7.95 Baht/package comparing to the current model.

TABLE V
VALUE INDEX (VI) AND COST DIFFERENCE

Function	Current Model	Model 1	Model 2	Model 3	Model 4
Current Cost (C)	**42.94**				
New Cost (W)		38.51	42.63	37.66	34.99
VI = C/W		1.12	1.01	1.14	1.23
Diff. = C-W		**4.43**	**0.31**	**5.28**	**7.95**

At the store room, 4-layer stacking is required, so that the bottom most box must be able to withstand the compression from 3 boxes stacking on top of it which equal to 342 kg. According to Box Compression Test (BCT), the current model and model 4 can withstand the compression up to 479.72 kg and 417.84 kg, respectively. Even though the new model can withstand the compression less than the current model, it is more than enough to withstand the compression of 342 kg. In addition, the model 4 is easier to assembly than the current model because top plate preparation is not required.

Fig. 14 Actual picture of model 4 in use

TABLE VI
COMPARISON OF THE CURRENT MODEL WITH MODEL 4

Comparing Factor	Model 4	Current Model	Result	
			Unit	Percent
Material	KA-ConfidenZe150 5 Layer Lon BC	KA-ConfidenZe150 5 Layer Lon BC	-	-
Box Compression Test (BCT)	418.84 kg	479.72 kg	-60.87 kg	-12.69%
Number of Materials	10 pcs.	12 pcs.	-2 pcs.	-16.67%
Assembling Step	3 steps	4 steps	-1	-25%
Time to Assemble	236 sec.	269 sec.	-33 sec.	-12.27%
Cost of Materials	32.75 Baht	40.38 Baht	-7.63 Baht	-18.90%
Cost of Labor	2.24 Baht	2.55 Baht	-0.31 Baht	-12.16%
Total Cost	34.99 Baht	42.94 Baht	-7.95 Baht	-18.51%
Etc.	Better Packaging	-	-	-

From Table 6, the rubber thread and rubber tape factory can save cost up to 7.95 Baht/package. When considering monthly and yearly packaging usage, the factory can save cost up to 190,800 Baht/month and 2,289,600 Baht/year, respectively.

IV. CONCLUSION

The benefits of VE are tremendous. VE focuses on cost reduction without lowering product quality. The functionality of the product is often improved as well as creating tremendous saving as demonstrated in the implementation of VE at the rubber thread and rubber tape factory.

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