Application of Value Analysis with Ergonomic Considerations on Construction Equipment

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Abstract- *New product development with value engineering analysis and ergonomic considerations are key to success of product and product life cycle in an organization. With the advent of new technology and shorter life cycle of product due to change in customer requirement pattern it is obvious for organization to introduce new product for sustainable profit as well as growth. Increase in value of product can be ensured only by optimization of cost and quality of function, therefore, Value analysis is having its own importance in product design as well as production process to ensure value for customer investment which in turn provide customer satisfaction of different levels like, expecters, spokens, unspoken and exciters. Here new product "Wall plastering Semi-Automatic spray gun" which is used for plastering of outer surface of construction work has been taken for value analysis, therefore required tools, charts and methodology has been applied to the design process for developing a cost efficient, quality performing and featured product.*

I. INTRODUCTION

Today's competitive scenario, every organization mainly focuses on customer satisfaction, which is directly or indirectly depends on the functions of product. This function defines "Value" of product. Organization always works on the increasing value of product by fulfilling functional requirement. The second phase which gives equivalent importance is "Cost" of the product. Customer satisfaction and performance of the product in market will gained by combined effect of function and cost of the product. Proper balance of function and cost of product is created by increasing functional performance of product with constant or decreased overall cost. These can be done with the help "Value Analysis".

In present, every organization focuses on detailed design along with performance of work system for better healthy and safe work environment that leads to improve productivity. Due to technical advancement some of the problems related to safe work environment are solved but the risk factors emerging from complex interaction of employees and elements of work system needs to be sufficiently dealt in involving ergonomic concepts in order to enhance human performance. Therefore, ergonomics design considerations become highly desirable. Ergonomics solve physical problems associated with work environment with the lesser mismatching between user anthropometric and biomechanical parameters with physical measurement of work place, paraphernalia, furniture (Bridger, 1995; Jeong and Park, 1990).

II. LITERATURE SURVEY

Jing Taoet al.[1] have discussed about use of value engineering in sustainable product development. The model is used with different tools like Quality function deployment (QFD) with understanding of economic, social and environmental perspectives. In process engineering, industrial management the life cycle simulation is used for modelling of complicated close-loop type product life cycle. Expert from various field with common vision help to develop more sustainable process and product with their specific strata of acumen.

Marjan Leberet al. [2] have suggested to use basics of VA to eliminate the characteristics not provide the value for their money. Innovative management -VA and conjoint analysis are used to show the outcome based new product design relevant to customer satisfaction.

Gleison Hidalgo Martinset al.[3] This study used Pinch Bottom with Simple Fold(PBSF) for Value stream mapping along with Earned value analysis in multiwall paper bag production process line. Diagnosis of wastages, operational efficiency, product costing is done by continuous monitoring with PBSF. This system can be used as auxiliary tool for Lean manufacturing process. Potential gain in production efficiency and relevant quality also found in this process.

Pranish M. Naoghareet al.[4] have introduced value analysis to reduce takt time and throughput time which are indicator for best practice in production cycle of work rate and per piece production time in long run production. In this rubber hose moulding and assembly line which is govern by concept of value analysis with the help of combining of process operation and internal design parameters gives huge positive change in cost reduction as well as productivity. Simplification of workplace design and layout gives good result in material movement which in turn reduce the throughput time.

Satish M. Silaskaret al.[5]have discussed about the utilization of value engineering with example of ball valve design. Weight optimization is done based on value engineering principle used for customer satisfaction and value for their money. Improvement in machining process to reduce cost by effective utilization of design tolerances.

III. STEPS FOLLOW DURING VALUE ANALYSIS/ENGINEERING

Functional analysis worksheet is prepared for the different parts of the product
Functional Evaluation of each part is done
Creativity Phase
Selection of alternation is done through Decision Matrix
Fining and Recommendation
Conclusion

3.1 Functional analysis worksheet is prepared for the different parts of the product

Part Name	Sub-part/ Description	Qty	Function		Part		Assembly	
			Verb	Noun	Basic	Secondary	Basic	Secondary
Holding and flow of mixture unit	Hopper	1	Hold	Container	√		√	
			Flow	Material			√	
	Handle	1	Hold	Hopper		√		√
			Grip	Stability		√		√
	Bolt	2	Support	Handle		√		√
	Nut	2	Lock	Handle		√		√
	Washer	4	Vibration	Surface		√		√

Table 1 : Functional analysis worksheet of Holding and flow of mixture unit

3.2 Costing of Holding and flow of mixture unit

Unit	Part	Quantity	Cost in Rs.
Holding and flow of mixture unit	Hopper	1	1700
	Handle	1	350
	Bolt	2	40
	Nut	2	30
	Washer	4	10
	Total		2130

Table 2 : Costing of Holding and flow of mixture unit

3.3 Functional Evaluation of Holding and flow of mixture unit

A	A3	A3	A3	A3	12	13
	B	B2	B2	B2	06	07
		C	C1	C1	02	03
			D	D1	01	02
				E	00	01

Weight Factors(Like A1, A2, A3)		
1	2	3
Minor difference in importance	Medium difference in importance	Major difference in importance

Unit	Key Letter	Part	Function	Weight	%Cost
Holding and flow of mixture unit	A	Hopper	Hold Material	13	28.64.%
	B	Handle	Hold Hopper	07	5.89%
	C	Bolt	Support Handle	03	0.67%
	D	Nut	Support Handle	02	0.50%
	E	Washer	Support Nut/ Bolt	01	0.16%

Table 3 : Functional Evaluation of Holding and flow of mixture unit

3.4 Function- Cost –Worth –Analysis

Sr. No.		Existing Product				New Product (Value analyzed)			value gap	% value gap
	Part name	Qty	Mat.	Cost per unit	Total Cost	Mat.	Cost per unit	Total Cost		
1	Hopper	1	SS304	350	350	SS201	265	265	85	24.28%
2	Handle	1	SS304	50	50	SS201	37	37	13	26%
3	Bolt	2	SS304	20	40	SS304	20	40	00	00%
4	Nut	2	SS304	15	30	SS304	15	30	00	00%
5	Washer	4	SS304	2.5	10	SS304	2.5	10	00	00%
6	Handle	1	35C8	60	60	35C8	60	60	00	10%
7	Valve Body	1	35C8	80	80	35C8	80	80	00	10%
8	Top Flat	1	35C8	30	30	35C8	30	30	00	10%
9	Lever	1	35C8	15	15	35C8	15	15	00	13.33%
10	Housing	1	LM6	400	400	LM9	170	170	230	57.5%
11	Bush	4	SS304	60	240	SS304	60	240	00	00%
12	Cover Plate	1	SS304	20	20	SS304	20	20	00	00%
13	Nozzle	4	SS304	20	80	SS201	15	60	20	25%
14	Bolt	5	SS304	16	80	SS201	12	60	20	25%
					1485			1117	368	

Table 4 : Function- Cost -Worth –Analysis

3.5 Evaluation phase

Parameters used in evaluation phase

a) Rigidity
b) Light weight
c) Durability
d) Appearance

- Alternative I- Change material SS304 to SS201 of different components of product.
- Alternative II- Change material LM6 to LM9 of different components of product.

A B C D RAW SCORE FINAL SCORE

A3	A2	A2	07	7
B	B2	B2	04	4
C		C1	01	1
D			01	1

Parameter Weightage	Rigidity	Light Weight	Durability	Appearance	Total
Alternative	7	4	1	1	
Existing	4 28	3 12	3 3	3 3	46
Alternative-I	5 35	4 16	4 4	3 3	58
Alternative- II	5 35	3 12	3 3	4 4	54

Table 6 : Evaluation phase

3.6 Recommendation Phase

Cost benefit matrix

Sr. No.	Parameter	Existing	Alternative-I and II
1	Hopper	265	265
2	Handle	37	37
3	Bolt	40	40
4	Nut	30	30
5	Washer	10	10
6	Handle	60	54
7	Valve Body	80	72
8	Top Flat	30	27
9	Lever	15	13
10	Housing	170	170
11	Bush	240	240
12	Cover Plate	20	20
13	Nozzle	60	60
14	Bolt	60	60
Total (in Rs.)		1485	1117

Table 7 : Recommendation Phase

IV. RESULTS AND CONCLUSION

1. Cost of the product has minimized by value engineering principles with no compromise of quality of product.
2. Functional aspect of product has been increased with no any increment in the cost of the product.
3. Product should be easy to operate with decreased fatigue and increased safety of user by applying Ergonomics principles in the product.

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