Maintaining the overall equipment effectiveness based on evaluation phase of value engineering

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Abstract-Today many industries are challenging together in competition. In industry the final product should be manufactured with desired and several quality.it should possess the several features with least cost so that the customer can be satisfied by its value. This can be achieved if there are minimization of equipment failure and reduction of defect both can be done by maintaining the overall equipment effectiveness(OEE).There are evaluation phase of value engineering method which will be beneficial for improvement of OEE. The Cost and quality can be optimized by maintaining the OEE in production.in these scenario we gave the value engineering process with the supporting tool i.e. Just-In-Time(JIT) and Plan-do-check-act(PDCA) And the technique has been applied in a process industry in Jharkhand in India.

Keywords: Overall Equipment Effectiveness, Plan-do-check-act**,** Just-in-Time, MTTR, MTBF

INTRODUCTION

In these days the value engineering is running in many industries successfully. There are some factors which are related in the manufacturing process. The cost, quality are main factors which should be optimized by reducing the scrap defect. These are the critical factors that decide the production and overall equipment effectiveness. Value engineering (VE) method identifies opportunities to remove unnecessary cost while assuring that quality, reliability performance, The Value engineering is rigours systematic effort to improve and optimized the life cycle cost of system. The factor compression study which is the part of VE i.e. evaluation phase and it has been applied in this paper as a model. The overall equipment effectiveness (OEE) always influenced by some losses. And these losses represented by some losses factor. In the timing of production process the cost, quality, safety etc. are the parameter which should be considered as a main parameter so that if we do not analyze them will result the poor efficiency and these will cause a lower condition of OEE.so for improving all the level, we gave the tool i.e. P.D.C.A.(PDCA) And Just-in-Time (JIT). Theses Tool's will be used for upgrading the component of OEE.

2. LITERATURE SURVEY

Value Engineering methods are very popular in these days. The author Behncke G.H.F.[1] has proposed some approaches like value engineering and target costing to counter this challenge from different angle combining benefit and summarize any immediate information during the application of both the approaches. Sarokolaee M.A. [11] explain some approaches such as target costing and value based pricing have been applied mostly as a result of considering these long term relationship in industries.Lindgree A.[7] offers an overview of research on the value that business and industrial market less analyze, create and deliver. Matt D.T. [8] describes in detail a methodology to design an integrated and customized value stream map for construction industries requirement. Hahn G.J. [6] develops a comprehensive approach to designing model driven support system for value based management. Takelioglu M. [13] a theoretical expression of general form of value based described and then optimized. R.Duight [10] an audit approach is developed using performance defined in the terms of value. Williams T.J. [14] for a manufacturing perspective it is important to recognize the manufacturing process in general and physical tasks as well as cognitive task in particular automation is used to increase productivity and reduce the cast of man-hour .G.Chand et al [5] in their work has investigated in collaboration with first tier automotive component supplier to determine the overall equipment effectiveness (OEE) of semi-automated assembly cell. The study by Corsten et al [3] shows that in retail industry almost half of the cases of shortage result in last sales lost sales also appear to be a typical mechanism for handling shortage in some spare parts industries. The literature contains a variety of definition for the terms "just-in-time" these range from Schonberger's [12] to produce and deliver finished goods just in time to be sold, sub-assemblies just-in-time to be assembled into finished goods and purchased material just-in-time to be transformed into fabricated parts. Mclachiln [9] examines the service aspect inherent in JIT operation. He argues that the inherent service aspect of jit operation have much in common with the operation of service firms. Consequently JIT firms will respond to

operational problems in ways characteristics of service firms. Droy [4] noted that highly successful practitioners of JIT look beyond the manufacturing function of the firm for applications of the JIT methodology. Chase et al [2] further simplify the definition of JIT as essentially a process oriented waste elimination philosophy because both service firms and manufacturing firms employ processes to create on end product or service, JIT technology should be applicable to both environments

3. VALUE PARAMETER USED IN EVALUATION PHASE

In manufacturing view there are general parameter which are focused there mainly these are features of product which should be possessed by product. We can say these parameters play role as function of product and they are –
"Cost" is the total of material, labor, design and overheads allocated to product. "Quality" implies that if the products features are satisfied by customer's is known as quality. "Safety" is meant to make safe from affection of accidents if we considered the safety we can prevent accidents. "Reliability" is that function of the product by which the product possesses the good quality

"M.T.B.F." (Mean Time between Failures) is a ratio of operational time to frequency of failure. If it is high then the maintenance practice will be high so the equipment can sustain its perfect efficiency. "M.T.T.R." (Mean Time to Repair) is ratio of repair time to frequency of failure so lesser the M.T.T.R. more the point value. Manoeuvrability - it mean ease to control the variable as well as fuzzy parameter of any system within defined constraints. "Durability" means the duration of lift of any product economical to the industry. "Acceptability" means that the product is acceptable by user or not.

4. OVERALL EQUIPMENT EFEECTIVNESS (OEE)

Before discussing the factors which affect the OEE.we should familiar with OEE.The overall equipment effectiveness is focus point in production process which is related to losses by machine in production. A good product with least cost can be achieved if it is maintained OEE is based on three part of component it consist of availability, performance efficiency and rate of quality.so we can say that

OEE = Availability × performance efficiency × rate of quality
Where

$$*\text{Availability} = \frac{\text{loading time} - \text{down time}}{\text{loading time}} \times 100$$

Loading time = the time at which machine has to be operated per day.

$$* \text{ Performance efficiency} = \frac{\text{Theoritical cycle time} \times \text{processed amout}}{\text{loading time} - \text{idling minor stoppage}}$$

$$* \text{ Rate of Quality} = \frac{\text{Processed amount} - \text{defective amount}}{\text{processed ammount}}$$

The overall equipment performance is intended to minimize life cycle cost that includes initial cost also.

From the above formula we get knowledge that the OEE is based on the above formula. But these are relative factors which is substitute of OEE.These factors will support the OEE following are the main factors.
(1)**Down time factor** – The weightage of down time factor is more in OEE.As it consist of breakdown and setup adjustment with equipment.so we cannot avoid the interference with production process.
(2)**Scrap rate factor**- if the chance to scrap the whole equipment or system in the case of failure of any component are high then the scrap factors value is taken more and so on. The loss associated with this factor is quality loss.
(3)**Safety factor** – It represent risk which will be attached in case of failure if the chances of injury are high in case of equipment failure more than value given to the safety factor and less the chances of injury less is the value given to the safety factor should have the major consideration.
(4)**Protection factor**- It is correlated with the speed loss.it is a number awarded on the account of ease to protect the equipment from failure minimum number is given when Protection against the failure is easy, maximum number is given when protection against the failure is very difficult.
(5)**Frequency factor**- It is number awarded depending on the frequency of failure. In operation of running equipment. If these are breakdown due to end age of equipment and old age of equipment is occurring in production process the frequency factor should be checked by operation.

So these are factor which are influencing the component for the OEE.These component can be graded by giving the rating points to the evaluation phase of matrices. The model will be created by use of function of the product. So before generating the model of evaluation phase we have to take the priority to the value parameter as a demand of production

process and we have to take as a prioritized sequence of function of product.

Table1. MODEL OF VALUE PARAMETRE COMPARISON MATRICES

	A	B	C	D	E	F	G	H	I	Total	Sum
	Cost	Quality	Safety	Manoeuvrability	MTTR	MTBF	Durability	Reliability	Acceptability		
A	0	A_2	A_3	A_1	A_2	A_2	A_2	A_2	A_2	16	17
	B	0	B_2	B_3	B_2	B_1	B_1	B_2	B_3	14	15
		C	0	C_1	C_2	C_3	C_1	C_2	C_2	11	12
			D	0	D_2	D_2	D_2	D_2	D_1	09	10
				E	0	E_3	E_2	E_2	E_2	09	10
					F	0	F_3	F_2	F_2	07	08
						G	0	G_2	G_2	04	05
							H	0	H_2	02	03
								I	0	0	01

Major Difference – 3

Medium Difference – 2

Minor Difference – 1

No Difference - 0

For creating the factor evaluation matrices we have taken value parameter as a base.in value parameter we have taken {Sum = (Total + 1)} because there is also existence of end parameter.so

Table 2. MODEL OF FACTOR EVALUATION MATRICES

	Cost	Quality	Safety	Manoeuvrability	MTTR	MTBF	Durability	Reliability	Acceptability	Total
	A= 17	B= 15	C= 12	D= 10	E= 10	F= 08	G= 05	H= 03	I= 01	
Down time Factor	7 [119]	9 [135]	9 [108]	9 [90]	8 [80]	8 [64]	8 [40]	8 [24]	9 [9]	669
Scrap rate Factor	7 [119]	8 [120]	8 [96]	7 [70]	7 [70]	7 [56]	7 [35]	8 [24]	8 [8]	598
Safety Factor	8 [136]	8 [120]	8 [96]	8 [80]	7 [70]	8 [64]	9 [45]	9 [27]	8 [8]	646
Protection Factor	9 [153]	7 [105]	8 [96]	7 [70]	7 [70]	7 [56]	7 [35]	8 [24]	8 [8]	617
Frequency Factor	7 [119]	7 [105]	8 [96]	7 [70]	8 [80]	8 [64]	7 [35]	7 [21]	7 [7]	597

Now On the basis of Factor evaluation Matrices we can get pareto graph. These pareto graph will give the indication of flexibility of equipment condition. There are individual pareto graph that give the explanation that what are the contribution of each factor, in these scenario we focus on the five main factors that will track the overall equipment efficiency.

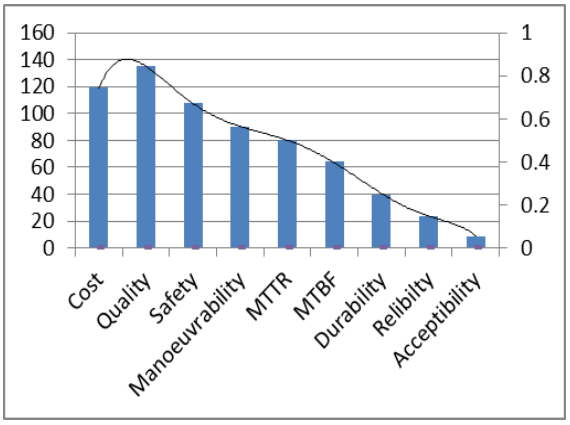

Fig1. Down Time Factor

The figure 01 is explaining for the condition of breakdown losses and setup adjustment losses that the cost is low but the quality is getting more count meant that quality parameter will be affected more as compare to all the parameter like cost and safety respectively.

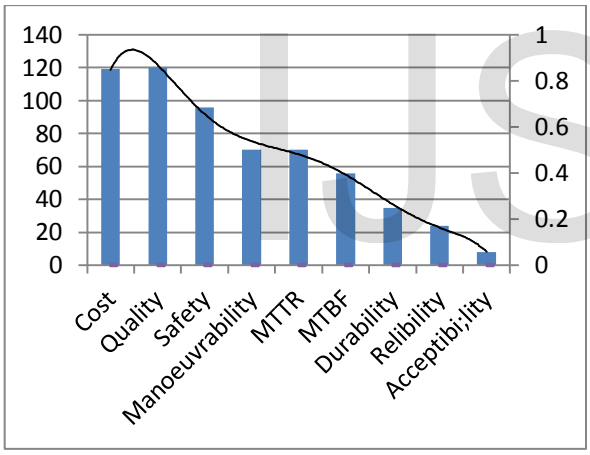

Fig2. Scrap rate Factor

From the figure 02 gave the explanation that there is not so more difference between cost and quality both will be affected simultaneously with loss of this factor because of scrap of equipment is occurring will also be affected after the influence of cost and quality

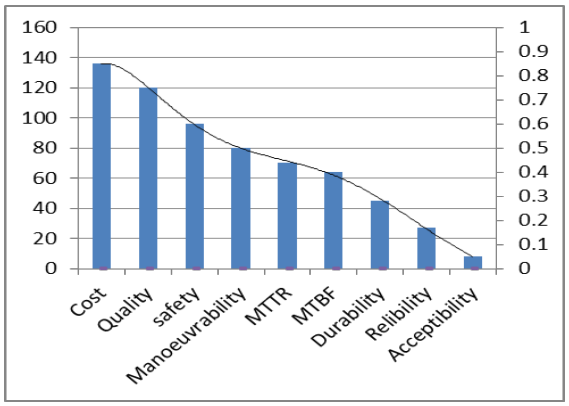

Fig3. Safety Factor

From the figure03 we are getting the knowledge that there are gradually decrement of cost, quality and safety and the count is decreasing up to acceptability.

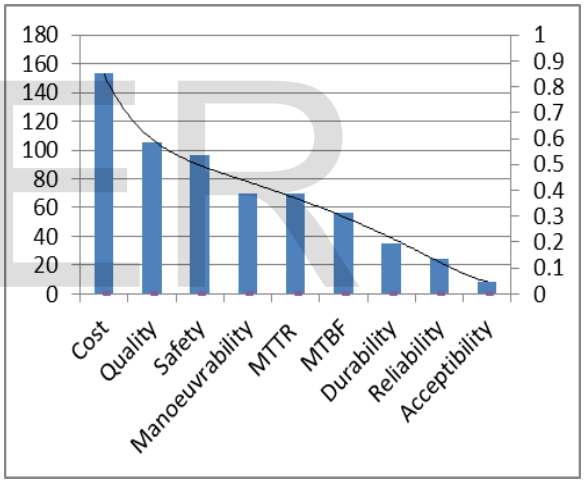

Fig4. Protection Factor

This figure 04 giving the knowledge that there are affection of cost is more but there are not so much difference between the quality and safety. There are also not so much difference between manoeuvrability and MTTR because of there is speed loss as per given performance of equipment.

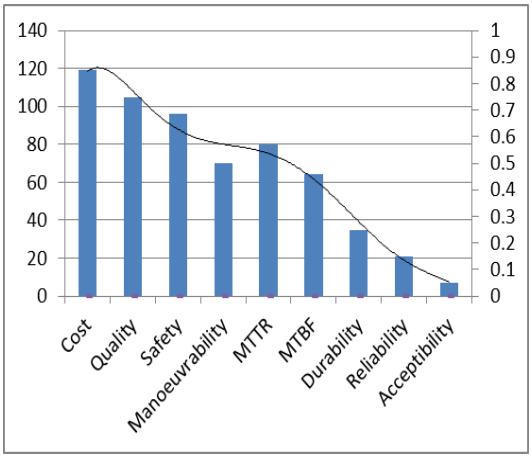

Fig5. Frequency Factor

From the figure 05 we are getting the knowledge that manoeuvrability is affecting more comparing to cost,quality,safety and MTTR because there are chance of failure of equipment is getting more or several time so as a result there is difficulty to ease to control of equipment.

Here Pareto graph shows the contribution of Quality, Cost, and safety are high. Here the graph shows the big indication of knowledge that the OEE can be more perfect and more maintained with the consideration of value parameter. The production process is correlated with equipment performance so for the production process it should be adjusted with the following tools. These tools will be used as a support to track the Overall equipment Efficiency (OEE).

5. TOOLS

(1) **Just-In-Time (JIT)** – Just –in-time is a basic concept that reduces the process delays, reduce waste, and scrape in the product. JIT is Japanese management philosophy applied in manufacturing process; it involves having the right items with right quality in right place at right time. Many North American Company are considering this approach and this philosophy should be associated with Plan-do-check and act (PDCA) tool.

(2) **Plan-Do-Check-Act (P.D.C.A.)** – The JIT tool will be successfully implemented if we use P.D.C.A tool. The tracking of Overall equipment effectiveness will be easy if this tool will be attached with Value engineering Evaluation phase. For this process we have to accumulate the contribution of value parameter with this PDCA tool. The Key concept is that we create a model with support of it.Here the following diagram indicate the process of Plan-do-check and act.

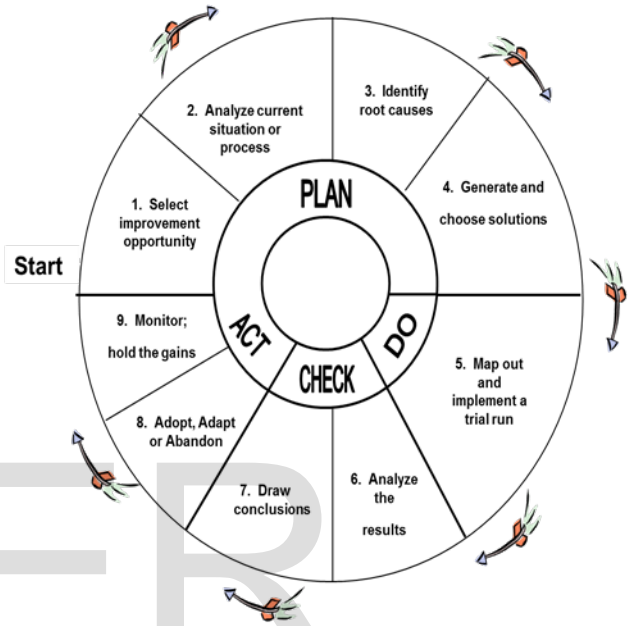

FIGURE 06: Plan-Do-Check-Act

6. EXAMPLE FOR OVERALL EQUIPMENT EFFECTIVENESS:

In this Section we bring an example which is related to the OEE.This example has drawn from recent case experienced by one of the authors and refers to automobile industries project. The Maximization of Overall Equipment Effectiveness (OEE) in any industries are basic requirement. We have already get the knowledge from formula which indicate the performance of production till the customer satisfaction.

(A) Total Available Time = 480 min.
(B) Planned downtime = 60 min
{Lunch (30min.) + Break (30min.)}
(C) Loading Time = 480 – 60
= 420 min.
(D) Down time = 70 min.

{Break down+ Setup and Adjustment}

(1)Availability = $\frac{\text{Loading Time}-\text{Down Time}}{\text{Loading Time}}$

$= \frac{420-70}{420}$

$= 0.83334$

(2)Performance Efficiency =

$$\frac{\text{Theoritical Cycle time} * \text{parts produced}}{\text{Loading Time} - (\text{Down time} + \text{Minor Stopage})}$$

Theoretical Cycle Time = 45 sec.

Parts Produced = 1875 per day.

Production time = (24 -1.3131)*3600

Performance Efficiency = $\frac{45 \times 1875}{(24-1.3131)\times 3600}$ =0.9666

(3)Quality Rate =

$$\frac{\text{Proceesed amount} - \text{Defective amount}}{\text{Processed amount}}$$

Defect amount = (Rework + Scrap)

= (30+12)

= 42

Quality Rate = $\frac{1875-42}{1875}$

= 0.9776

Finally Overall Equipment Effectiveness (OEE)

= 0.83334×0.9666×0.9776×10

= 78.70%

CONCLUSION

In This Paper we have generate the model based on value parameter. There are also another ways to reduce the life cycle cost with saturation of quality. These results can be gathered by finalization of product with better operating condition of equipment. Equipment Effectiveness will indeed affect the manufacturing process. We are looking that based on the proposed model there are possibility of tracking the OEE. Here we have used value engineering parameter that are used in evaluating the factors and these factor are totally related to Overall equipment effectiveness.so we have observed that value parameters are affecting more in maintaining the Overall Equipment Effectiveness (OEE).If the OEE will be maintained then defiantly reduced the life cycle Cost with improved quality can be achieved.

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