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Implementation of Value Analysis in an Indian Industry: A Case Study

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Abstract

Value Engineering (VE) and Value Methodology are the two important constituents of Value Analysis. It is a methodical implementation of various tools and techniques by a multidisciplinary team. The team recognizes and categorizes the functions of a product and help in developing the alternative cost effective product with its value. In present day world, each one needs the desired product with best quality within the cost-effective zone. Value Analysis in generally used in automobile sector to maximize the profit by increasing the overall production in plant as well as its demand in the market.

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So, Value Analysis plays a very important role in maintaining worth of a product in the market. In this paper a case study is discussed showing implementation of Value Analysis principle in sub-assembly hydraulic Jack having a quality issue, used in compression testing machine. Results reveals that after implementing the Value Analysis Principle rejection rate decreased with increased production rate with improved quality of the sub-assembly Hydraulic Jack.

Keywords: Value Analysis, Value Engineering, Quality, Case Study

INTRODUCTION

Value Engineeringestablishes the relationship between worth and cost of a product by analyzing its functions to determine the best value. When a product performs its required functions consistently at a lowest life cycle cost while maintaining the quality termed as best value of that product. Value Analysis, created by L.D. Miles is also called as Functional Analysis. Value of a product is defined by the ratio of the functions performed by the product to the cost of that product. Concept of Value Engineering originated during the World War II and was adopted by the Federal Government Agencies that recognize its potential for yielding a huge return on investment. Value Engineering is being applied in various fields such as hardware, software, production and manufacturing, design and construction etc. It has been proved that Value Engineering capable of reducing costs by 25% to 45% or even more without affecting its quality.

Ten basic principles for evaluating the productforValue Analysis given by L.D. Miles shown in figure 1:

1. Does the use contribute to value?
2. Is it cost proportionate to its usefulness?
3. Does it need all its features?
4. Is there anything better for the intended use?
5. Can a usable part be made by a lower cost method?
6. Can a standard product be found that will be usable?
7. Is it made on proper tooling – considering quantities made?
8. Do materials, reasonable labor, and profit total its cost?
9. Will another dependable supplier provide it for less?
10. Is anyone buying it for less?

Figure 1. Basic Principles involved in VA

Due to material shortage during the world war II, number of manufacturers were enforced to find a substitute materials with different designs. It was found by General Electric Company that most of the alternates were providing pleasant performance at less cost, company tried an effort in 1947 to advance the product throughput systematically using substitutes.

Miles L.D [1972]proposed that value engineering is a value enhancing technique to be applied as a problem-solving system with the field of knowledge and supporting techniques for achieving the targets of lower cost without affecting the functions of the product.Society ofJapanese Value Engineering [1981] introduces the concept of VE in an organization, procedure for implementation & measures the effectiveness of VE.The executive office of President USA [2013], issue a circular to guide & support the sustained use of value engineering by Federal Departments & Agencies to reduce programs and acquisition cost.G.Young [1999] describes the planned value analysis assimilates decision analysis with business plan to develop a spreadsheet-based models. McDowell T. [1996] describes the value management as a surviving tool in management studies. He uses the concept of value analysis in management processes.Rich N. et al.[2000]gives insight into the Value Analysis process. All the business that wishes to become lean will ever succeed only if product designs changed continuously with improvement in the manufacturing process. Company can reduce the costs of a product due to less appropriate design that is unchanged from a long time.SAVE [2005]describes "Value Methodology" as a collection of technique.This guides a team through a structured job plan, which improves value.SAVE [2007] describes the steps and components that constitute a valid value study. It provides job plan with sequential phases for implementation of Value Analysis. Gurria [2012]studied the global value chains (GVCs) and helped the government and enterprises to invest in this field to excel. Further study is not very vastly done in the field of Value Analysis. This concept is also used in the field of agriculture and construction line by some researcher and published their views.Gereffi [1994] worked on a new theory that would draw from the empirical evidence on global integration. Yvonne Chen(2012)studied about "The Value Chains" spreading the gains from globalization which appeared in the July 2001 issue of Institute for Development Studies Bulletin. Fowler [1990] and Dell A. and Isola [1997], presented brainstorming as the ideal creative technique.They described brainstorming as one of the most common creativity technique used in the alternative phase of value Engineering. Garg R.K. et al. [2007] studied about the quality and reliability aspects in different fields. Gupta A. ae al. [2012, 2013] studied about the inventories and gave the idea of classification and selection. Brightman H. J. [1980], & some Value Engineering researcher & professional have questioned the usefulness of group brainstorming, claiming that it blocks the creative thinking efforts of a group. Thesethings were described in his book Problem Solving:A Logical & Creative Approach.Robert Sproule et al. in 1972 developed the concept of value analysis at that time at which many companies are facing the problem of continuously decreasing profit. After that he joined the McHill University to analysis this concept and share his views. David Pfeiffer in 1973, arranged the VE workshop along with Bob Sproule and Henry Wales, certified value specialist of USA.

With the rapidly increasing modernization, customer needs new designs and technologies to perform its tasks. The value analysis/value engineering plays a vigorous role in the improvement of quality without compromising on value of the equipment. Now a day's organizations could only stand on quality and functionality of the product.

In present work data collected was used for selecting the instrument for value analysis. The data for problems / rejection faced at various stages was collected &analyzed. At initial stage,several workshave been done to define and develop the product life cycle for the current product. Focus of the work is to improve the profit of an organization by improving its existing product quality of compression testing machine by calculating its productivity time and reducing the complaints. After this,implementation of value analysis can be done to reduce the overall production time, increase overall equipment efficiency & maintain quality system.

This study was conducted to offerits needed functions safely, reliably, and at the lowest overall cost. Further it improves the value and quality of the product, and finally reducing the product completion time.

METHODOLOGY USED IN VALUE ANALYSIS IMPLEMENTATION

In Value Analysis process, we must use & understand many quality tools which will simplify the concept and result. They help us better in controlling the process of product planning and quality level at internal as well as external end.

Now a day's,Value Analysisused in different sectors to improve the overall efficiency and net profit without sacrificing the product value, quality and customer satisfaction level. In this concept the first step is to identify the assembly and then the best possible area where the product quality level is low or production time is more as per our requirement which results in rejection of complete assembly at customer end.In the selection of process various steps need to be followed:

- Pareto analysis graph of the external failure at customer end i.e. minimum last three month.
- Rejection Analysis can be performed by the Pareto analysis using the data based on defect wise and part wise.
- Now the graph will help us to identify the part which has maximum rejection and decreases net profit.
- Now we canunderstand easily, what is the cause of rejection at customer end.
- After selecting that part make the bar graph on monthly basis.
- Now selectthe part which gets the maximum rejection at customer end
- Identify the process planning of that part
- Collect design data.
- Then use quality tools and brainstorming method to be apply to solve or minimize the manufacturing cost and overall quality issue at customer end.
- Then afterproblem analysis and getting appropriate solution of problem data is presented and to maintained the system for future production.
- Check sheet for Quality control

Value Analysis concept is completed in eight basic steps.

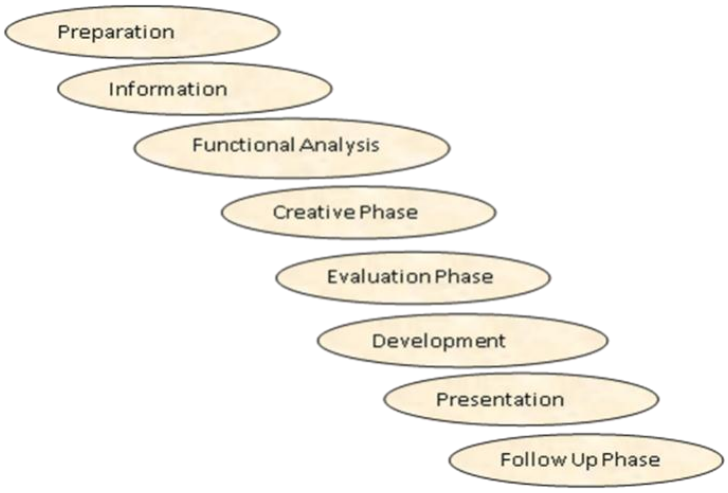

Figure 2. Phases of Value Analysis

Figure 2 shows various phases involved in the Value analysis.First step is to identify the area in case study where this system is to be applied. After analyzing the area use various quality toolsto increase the overall efficiency of equipment & productivity. So,it could improve the overall profit & efficiency of organization.

CASE STUDY

Context

To achieve greater customer satisfaction and effective quality managementValue Analysisused as a powerful tool. Infact, the implementation and accomplishment of Value Analysis in an organization entitles a certain amount of expense.This should be justified by potential cost savings.

To closely view implication of VA,a case study was carried out for Value Analysis implementation in a civil instrument manufacturing company, Aimil Ltd., located in New Delhi.Compression Testing Machine(CTM) is one of the main instruments manufactured by the company having a sub-assembly hydraulic jackassembly. Tocheck the strength of concrete mix CTMwas used for applying the load on the concrete.To have in depth analysis case study has been done as per the co-relation with requirements of quality level and productivity rate of plant.

Company Profile

Aimil Ltd is a pioneer Instrumentation Company located at Mathura Road, New Delhi.It is an ISO 9001: 2008 certified & NABL Accredited Laboratory for Testing & Calibration as per ISO/IEC/IS 17025:2005 in various parameters.

Value Analysis Steps involved

The value analysis is applied on the hydraulic jack assembly of the 2100kN Compression Testing Machine. The steps followed for this process are given in figure 3:

1. Information collection of products
2. Product Selection plan
3. Functional Analysis
4. Creativity worksheet
5. Evaluation Sheet
6. Cost analysis
7. Results

Figure 3. Steps in VA process

Company Measurable Parameters

Company measurable parameters are measured on the monthly bases which areshown in Table 1.

Table 1: Company Measurable Objective

COMPANY MEASURABLE OBJECTIVE								
S. NO.	PARAMETER TO BE MEASURED	OBSER-VATION 2014-2015	OBSER-VATION 2015-2016	TARGET 2016-2017	OBSER-VATION 2016-2017 (Sep. 2016)	TREND	REVIEW PERIOD	HOD
1	Rejection at Customer end	21	25	15	20	Monthly	Monthly	HOD - QA
2	Rework at Customer end	656	645	450	350	Monthly	Monthly	HOD - QA
3	Rejection at supplier end	115	179	90	78	Monthly	Monthly	HOD - QA
4	Rework at supplier end	574	625	450	258	Monthly	Monthly	HOD - QA
5	Rejection at Inhouse	17	21	16	18	Monthly	Monthly	HOD - QA
6	Rework at Inhouse	347	379	270	195	Monthly	Monthly	HOD - QA
7	Cost of poor quality	13.5 lac	14.3 lac	10 lac	2.98 lac	Monthly	Monthly	HOD - QA
8	Logistic cost VS sale	78 lac	80 lac	73 lac	35.6 lac	Monthly	Monthly	HOD- Dispatch
9	Assembly line stoppage	22	17	9	7	Monthly	Monthly	HOD -MFG.
10	Supplier Audit	as per plan				Monthly	Monthly	HOD-QA
11	Training	as per plan				Monthly	Monthly	HOD-QA
12	Calibration jobs	as per plan				Monthly	Monthly	HOD-QA
13	ECN released	13	12	39	26	Monthly	Monthly	HOD- R&D

Product Selection Plan

Table 2 gives the performance review data of manufacturing division with respect to their categories.From table the quantity dispatched under various categories in last 2.5 years can easily be observed.Figure 3shows the pie chart for selling percentage with respect to category. From charts, it is observed that concrete sales figureis 40-45 % of total sales. These category sales figures are crucial for the company. Bar chart also shows that every year sales figure of concrete section was always high. So, we choose concrete category for further analysis.

Total rejection goes beyond the set objective it may be a possibility that the part which rejected at customer end also get rejected due to these internal failures of process.

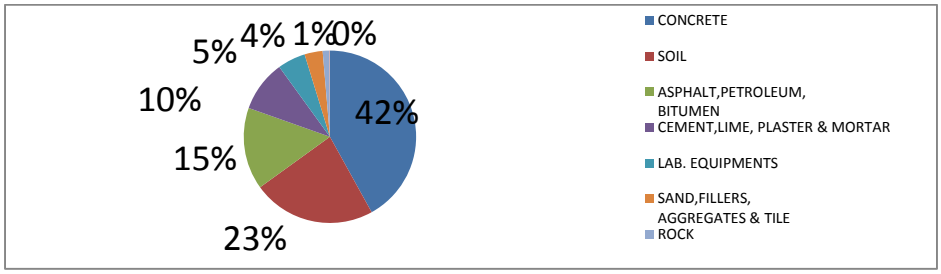

Figure 3. Proportion of sales in 2016-17 (Up to Sep. 2016)

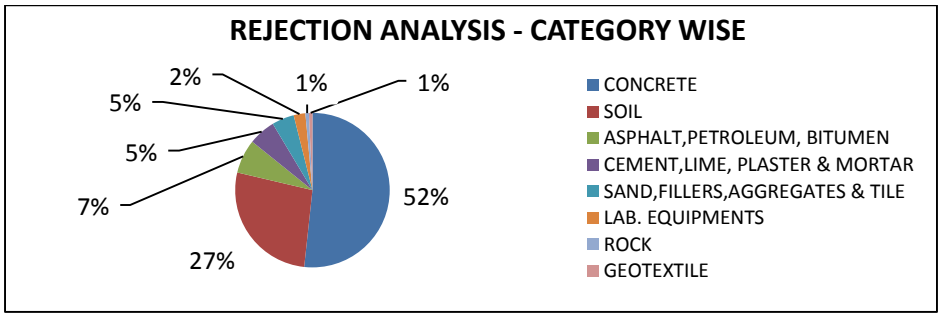

Figure 4. Rejection analysis based on Complaints Vs Category

To achieve customer satisfaction level in first stage we must find out the most critical complaints in concrete category. We do the further analysis about which instruments in concrete section has maximum rejection as shown in figure 4.

Fig 5 shows the Pareto chart for rejection in compression testing machine. Now we do further classification for the complaints trend in the compression testing machine. The maximum rejection trend was found in hydraulic jack assembly due to oil leakage in compression testing machine. So, this was the sub assembly where we have done the Value Analysis for the product improvement.

Table 2: Performance Review Data Sheet

PERFORMANCE REVIEW DATA SHEET								
S. No.	**Category**	**No of inst.**	**Financial Year 2014-2015**		**Financial Year 2015-2016**		**Financial Year 2016-2017 (Up to Sep. 2016)**	
			Qty. Dispatch 2014-2015	**Selling cost (in Lacs)**	**Qty. Dispatch 2015-2016**	**Selling cost (in Lacs)**	**Qty. Dispatch upto Sep. 2016**	**Selling cost (in Lacs)**
1	CONCRETE	190	18890	231.05	14027	221.05	7383	103.67
2	SOIL	245	20900	130.26	19224	122.65	9948	58.05
3	ASPHALT, PETROLEUM, BITUMEN	53	2810	80.84	2075	59.62	982	39.07
4	CEMENT,LIME, PLASTER & MORTAR	42	21860	52.35	22835	56.71	9615	23.98
5	LAB. EQUIPMENTS	218	5270	24.45	3864	27.91	1976	12.95
6	SAND,FILLERS, AGGREGATES & TILE	16	1250	18.95	1067	18.32	596	9.23
7	ROCK	27	125	8.79	96	7.45	32	2.99
8	GEOTEXTILE	14	59	0.87	64	0.93	23	0.27

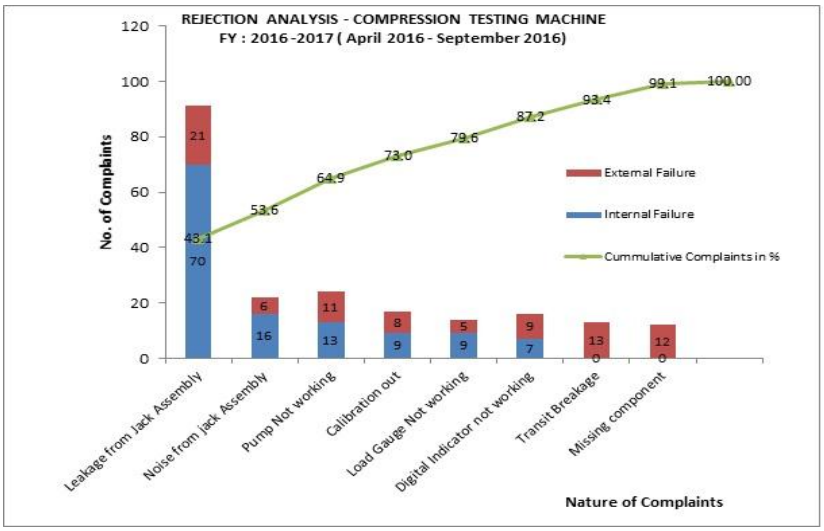

Figure 5: Pareto chart for Rejection in Compression Testing Machine

Functional Analysis of Hydraulic Jack Assembly

To understand the problem, we first understand the machine by general components of the machine. Compression Testing Machine basically consist of three main parts:

a) Load Frame consist of Hydraulic jack, spacer & platen set

b) Digital Indicator for read the load reading

c) Pumping Unit for converting the pressure into load byhydraulic jack

The leakage from hydraulic jack assembly is shown inFig 6.

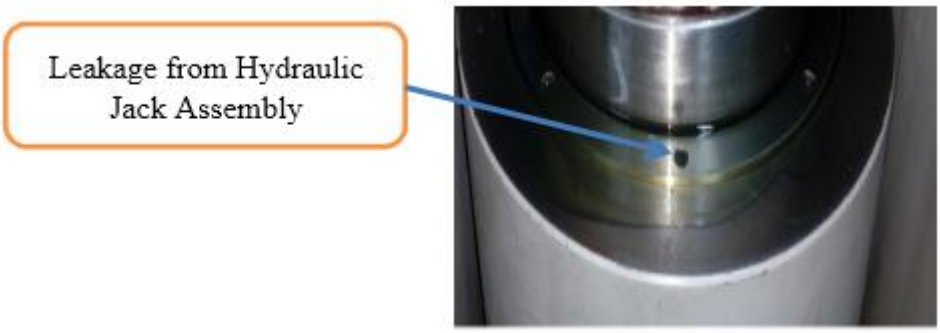

Figure 6. Problematic Sub Assembly

Calculation of the pressure for hydraulic jack assembly:

Force = Pressure X Area ……..……..1

Ram Diameter of Piston = 215.4 mm

Ram Area = 364.55 cm^2 = 0.03646m^2

Force = 2100kN

Pressure = 2100 X1000/0.03646

= 57597366.98 Pascal

Conversion of pressure from Pascal to kgf/cm^2

1 Pascal = 0.000012kgf/cm^2

Pressure = 57597366.98 X 0.0000102 kgf/cm^2

= 587.49 kgf/cm^2

In this assembly, total pressure applied for applying the load of 2100kN is 588 kg/cm^2(Approx.)

Creativity Phase

This phase requires a certain amount of creative thinking by the team. All rules of brainstorming are allowed, and criticism needs to be avoided.The main idea highlighted during the discussion to develop a new design jack assembly which can eliminate the root cause.

Evaluation Phase

Here the VA team considers all the ideas developed during the creative phase with their viability & give them ranking. Irrelevant ideas were disregarded, those ideas that represents the greatest potential for cost savings & improvement are selected for the implementation.

Development Phase

In this phase, design of jack assembly hasmany problems so wedecided to develop the new design which will eliminate the mentioned problems. Hydraulicjack assembly was changed to avoid the leakage problem. In earlier process, threemetallic rings with bucket seal were used for oil leakage while in new design these were replaced with Ram seal & Teflon ring for preventing the oil leakage. The new design was simple to manufacture.

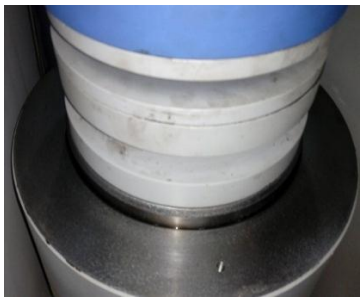

Figure 7. Shows the new jack assembly at full load without any leakage.

Presentation Phase

It gives alternatives solution for the rejection or product improvement. Here the data related to quality issue,increased saving in sales.From the figure 8 we can conclude that major rejection due to leakage was reduced and remaining leakage problem reported either due to wrong fitting of rams seal or old machines in the field which were not installed earlier due to various reasons.

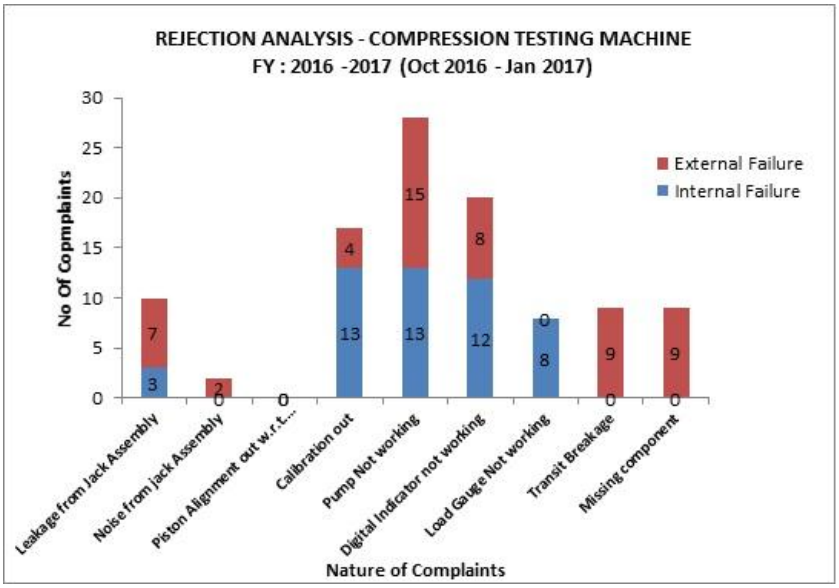

Figure 8. Rejection Analyses - Compression Testing Machine (After Modification)

Table 3. Rejection cost analysis of Oil Leakage in Hydraulic Jack Assembly before Value Analysis

REJECTION COST DUE OIL LEAKAGE IN HYDRAULIC JACK ASSEMBLY (BEFORE VALUE ANALYSIS) FY : 2016-2017 (Up to September 2016)						
Part/ Subassembly	**Cost of part / Sub Assembly**	**Total production**	**Rejection Internally**	**Rejection externally**	**Rework In house**	**Rework Externally**
Hydraulic jack Assembly	26510	300	1	2	69	19
Total Rejection cost – internally	43070		Total Rejection cost – Externally		227725	
Total Rejection cost	270795					

Table 4. Rejection cost analysis of Oil Leakage in Hydraulic Jack Assembly after Value Analysis

REJECTION COST DUE OIL LEAKAGE IN HYDRAULIC JACK ASSEMBLY (AFTER VALUE ANALYSIS) FY : 2016-2017(From Sep 2016 to January 2017)						
Part/ Subassembly	**Cost of part / Sub Assembly**	**Total production**	**Rejection Internally**	**Rejection externally**	**Rework In house**	**Rework Externally**
Hydraulic jack Assembly	21970	300	0	1	3	6
Total Rejection cost – internally	720		Total Rejection cost – Externally		77140	
Total Rejection cost	77860					
Saving due to cost cutting	300 X 4540 =1362000					
Time saving due to reduction in repair/ rework	15840+119535= 135375					
Total saving due to value analysis	1419515					

For Inhouse repair/ Rework = No. of piece reject X cost of piece + No of pieces repair / rework (@2 hr. / repair) X Time in hr. X 120 /hr.

For external rejection = No of piece reject X cost of piece + No of pieces repaired X cost of visits (@9195 / complaint)

RESULT AND DISCUSSION

To improve the performance and profit of an organization value engineering plays vital role. It results in significant improvement in quality and reliability of the products by eliminating the unnecessary problems associated with that product while manufacturing. In this case study concept of value engineering used to analyze the leakage problem in hydraulic system. With the change in design of the hydraulic jack assembly its value and life cycle increases.

Advantages associated with the development of the new design includes increase in overall production, reduced manpower, reduced scrap, sequentially reducing the cost. With the decrease in the cost,thereby increasing the value is very important. In this final phase of value analysis overall saving of the product have been calculated in the table 5 and 6, these tables are known as cost cutting calculation sheets.

Various benefits related to Value Analysis are

a. Speed of getting an effective design
b. Reliability and durability of the product
c. Low overall cost
d. Enhanced quality and compliance with minimal costs
e. Differentiation by creating product designs as platforms.
f. Some basic & direct benefits such as material saving, reduction in labor cost, reduction in production time.
g. Fewer inventories and increased overall efficiency.

Table5. Saving v/s investment calculation of Overall Product (Internal)

Saving v/s investment Calculation of Product (INTERNAL)		
a) Saving of Product by Rejection control	Current Rejection (External and Internal)	122
	Rejection After modification	10
	Rejection Saved	112
	Monthly Production	50
	Cost reduced due to design modification	4660
	Saving-Monthly	233000
	Saving-Yearly	2796000
b) Investment in Product	Ram seal (Rubber Ring + Teflon seal)	-70
	Die cost	45000
	Yearly consumption @50 /PM	600
	Cost of investment	3000

c) Time Lost	Total Rework time in Hrs.(yearly)	300
	Man Hour production lost	300
	Total Rework Cost (Total Hrs X 120)	72000
d) Net Saving yearly	Total Saving+ Reduction in Rework cost-Investment in the project in Rs/-	3486000

Table6. Saving v/s investment calculation of overall Product (External)

Saving v/s investment Calculation of Product (EXTERNAL)		
a) Saving of Product by Rejection control	Current Rejection due to hydraulic jack assembly (External and Internal)	36
	Rejection After Modification	2
	Rejection Saved	34
	Monthly Customer Complaints	5.7
	Cost of per complaint	9195
	Cost saved due to design modification (monthly)	52411
	Saving-Monthly	52411
	Saving-Yearly	628938
b) Net Saving yearly	Total Saving	628938
c) Net Saving yearly	Total Saving+ Reduction in Rework cost-Investment in the project in Rs/-	312600

Further the Value Analysis helps in achieving primary goal of any organization so that the firm can sustain in the market.Some limitations of Value Analysis are which cannot be overlooked includes team-orientedknowledge-based approach and high resource utilization.

CONCLUSION

Through error-free manufacturing processes, firm provide effective design of the product in the market. Due to this reliability and durability of the product enhanced and subsequently the profit as well as reputation of the organization improves. It also leads to the reduction of overall cost of the product manufacturing while maintaining

the value of the product as desired. In this case study, the leakage problem in hydraulic jack was rectified through design change required by the product. Several worksheets were developed and their critical analysis helped the engineers to solve the identified problem through the value analysis principle. It leads to a changed scenario of the workplaceas the environment of the workplace changes effectively. In future, also this analysis methodology can lead in eliminating various problems related to the products and processes associated with the manufacturing.

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