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Quality Improvement and Inventory Cost Reduced By Implementation of JIT

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Abstract-: ***In today's highly competitive work environment, companies have to find ways to be able to compete effectively with their competitors. JIT production system identifies the hidden problems in the value chain and reduces the production waste of the system while increasing the throughout (Sales-Raw Material Cost). They have to find ways to reduce cost, improve quality, and increase customer satisfaction. Just-In-Time production system is among the tools that companies can use to become competitive. The implementation of Just-In-Time manufacturing system will provide companies with competitive advantage; however the system requires companies to change radically. Cost accounting is among the areas that are affected by the implementation of Just-in-Time production system. The aim of this paper is to discuss the effects of Just-in-Time production system from cost and management accounting perspective. This article discusses in depth the implementation of JIT manufacturing. The objectives are twofold. The first objective is to acquaint the reader with the overall JIT concept and the factors necessary for its implementation; the concepts presented here represent the ideal principles and methods of implementation.***

Keywords: Just-in-Time, Cost management, JIT implementation, Work culture, Traditional manufacturing.

I. INTRODUCTION

The product quality is very important for survival of a company. Therefore, the question of `how much quality is enough' seems relevant. During the late 1970s and early 1980s, the common answer to the question in western countries was to accept a allowable amount of poor quality in the manufactured goods. The Japanese during same time chose a different course of action called `JIT Based Quality Management'. Under this approach, product perfection is goal and poor quality of any kind is not acceptable. JIT Based Quality Management has not only affected the manufacturing but also marketing, planning, human resource management, and other organizational functions in today's highly competitive business environment. This approach requires detailed attention to quality both in purchasing and production because it cannot function with high defects. The ideal goal of JIT Based Quality Management philosophy is to operate entire production system without interruption and without non-value added activities. This approach put stress on long-term benefits resulting from waste elimination, and continuous improvement in system, people, and products. Just in time' is a management philosophy and not a technique. It is referred as the production of goods to meet customer demand exactly, in time, quality and quantity, whether the `customer' is the final purchaser of the product or another process further along the production line. It is also related with mean producing with minimum waste. "Waste" includes time and resources as well as materials. JIT not only appreciates quality improvement concepts; but also concentrates on existing culture, habits, norms and values of employees because people commitments, involvement and promotion of open decision-making are essential for quality improvement. Now a day, Indian industries are facing many difficulties in competing with the multinational company at global level .The competition has forced the industries to new manufacturing approaches, managerial philosophies. JIT Based Quality Management has emerged as a key competitive strategy for business organizations in the global market place. Its effects are significant in improving the overall performance of whole organization. But still Industries are not able to fully exploit this new strategy because its implementation is a big problem in India. Vrat et.al (1993) conducted a Delphi study to assess the applicability or difficulty of implementing JIT elements in Indian context indicates that quality circles and good communication are not very- difficult to implement while other critical elements like, multifunctional workers, long term relationship with vendor, support from labour union and top management attitude have rating which indicates that JIT implementation in India is difficult not impossible.

II. LITERATURE REVIEW

JIT Based Quality Management can be summarized as an approach to eliminate waste and achieve manufacturing excellence.

Therefore, it is essential to review the literature to identify the various dimensions of JIT Based Quality Management. The global status of this approach can be studied through surveys, case studies, empirical studies, and modelling work. Fortunately, the literature related to this approach is rich with these types of studies. This chapter reviews the literature related to JIT Based Quality Management

Ebrahimpour and Schonberg {1984} explained the Just-in-time problems in developing countries. They have suggested that developing countries desperately need to improve the quality and productivity of their goods to survive and reduce the gap in these areas between developed and developing countries. JIT is an appropriate tool for the companies of developing countries, as this technique are simple and less resource consuming. The chief obstacle to rapid adoption of this technique is lack of training.

Crawford and Cox {1990} they recognized the need for innovative performance of measurement systems in JIT environment. They have developed a series of proposition for constructing JIT performance measurement system. The developed propositions are based on detailed examinations of the performance measurement systems of six companies, which were addressing the problem of performance evaluation. It has been found that standards or goals for performance are difficult but attainable. **Prem vrat et al. (1993)** they conducted a Delphi study to assess the applicability or difficulty of implementing JIT elements in Indian context indicates that quality circles and good communication are not very difficult to implement while other critical elements like multifunctional workers, long term relationship with vendor, support from labour union and top management attitude have high rating, which indicates that JIT implementation in India is slightly difficult, but not impossible. The study also indicated that attention must be focused on poke-yoke, reduced set up time, Kanban system and quality of incoming material **Padukone and Subba rao (1993)** they have stated that India might provide an excellent case study to determine, if JIT practices implemented in Indian industries. But JIT implementation without understanding the conceptual framework cannot result in long lasting improvements. In addition, this study suggested that JIT should be implemented in two stages. First stage of JIT implementation includes setup reduction, lot size reduction, small machines, quality, layout, buffer stock reduction and flexible workforce. These techniques are essential for full JIT to work because these focus on four main elements of JIT that can be achieved in short term. These are: simplicity, flow quality, and fast setup and lay the foundation for moving on the more difficult techniques like Kanban, JIT purchasing, Buffer stock removal, multifunctional worker, pull scheduling, enforced improvement and visibility. **S.M. Moattar Husseini (2006).** He studied the issue strategic flexibility in manufacturing is reviewed to establish a link between output flexibilities and resource level characteristics. Considering a JIT environment does this, KANBAN system is also determined with respect to demand of fluctuation in the market place. He has an integer linear programming technique to flexibly determine the number of KANBANS AT each stage of JIT production, minimizing total inventory cost. The effectiveness is than compared and examined with the results for the conventional method of fixed KABAN determination. **Ash Aksoy (2011).** The purpose of this paper is to aid just-in-time (JIT) manufacturers in selecting the most appropriate suppliers and in evaluating supplier performance. Many manufacturers employ the JIT philosophy in order to be more competitive in today's global market. The success of JIT on the production floor has led many firms to expand the JIT philosophy to the entire supply chain. The procurement of parts and materials is a very important issue in the successful and effective implementation of JIT; thus, supplier selection and performance evaluation in long-term relationships have became more critical in JIT production environments.

III. METHODOLOGY

This study includes four phases' a) questionnaire preparation b) data collection c) analysis d) final conclusions. First phase includes the preparation of questionnaire. The questions in questionnaire were based on the implementation of JIT based quality management and related problems and expected benefits. The Questionnaire given to 15 companies of KARNAL of "Agricultural and implementation industry". An experiment was conducted 26 attributes given of JIT based quality management & data generated through attributes .The Out of 15 companies only 5 companies responded with suitable data.

A. Analysis

The data collected from various companies is analyzed. Than new data is generated through various attributes taken on a five point LIKET scale measuring the degree of difficulty in implementation of these attributes is subjected to statistical analysis to draw scientific and logical conclusion. Each was given to 15 respondents. The distribution of response was recorded on LIKET scale. The score of 3 was taken as neutral or average & above that measuring a degree of satisfaction. However a below 3 response for any attribute was tending towards low satisfaction. The underline null hypothesis was $\mathbf{H_0}$ **$\mu = 3$ against** H_1 alternate $\mu>3$. Since the product is likely to accepted by the masses if it is scoring average more than 3. To be satisfactorily true 95% confidence limit per each attribute score were generated which indicates that an attribute is having a probability of 95. The mean score is calculated for attributes from the data that is filled by each

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respondent taken degree of difficulty as X_1, X_2 ..... X_5 and data filled by the respondents is as F_1, F_2 ..... F_5

TABLE 1

SCORE (X)	FREQUENCY(F)	FX
X_1	F_1	$F_1 X_1$
X_2	F_2	$F_2 X_2$
X_3	F_3	$F_3 X_3$
X_4	F_4	$F_4 X_4$
X_5	F_5	$F_5 X_5$

$\overline{X} = \frac{\sum FX}{\sum F}$; Let $X1, X_2$ ..... X_5 be the average mean of the k variables under study taken for measuring the satisfactory level of the respondents. To measure the impact of these variables a index known as satisfaction index. In this satisfaction factor or index (I) is calculated on the base of the mean score by using

$$I = \frac{\overline{X}}{\overline{\overline{X}}} * 100 \quad ; \text{Where}$$

$\overline{X}$ = mean score

$\overline{\overline{X}}$ = average mean score

$$\overline{\overline{X}} = \frac{\overline{X_1} + \overline{X_2} + \overline{X_3} ..... + \overline{X_n}}{15}$$

As per objective of study 26 attributes of JIT based quality management were subjected to further analysis. To draw a conclusion about the effectiveness of these attributes. For this purpose an index is generated to measure the degree of difficulty based on five LIKET scale mean score. As per logic If Index (I) taken as 100 indicates a normal level of satisfaction contribution of the attributes. If index is less than 100 give an idea that particular attribute is low intensity in its implementation comes out to be more than 100 or equal to be 100 than the attributes satisfactory (I>=100) good or excellent and if the I<100 than work has to be done on that attributes so that the overall performance can be improved. Table 1 gives the classification of attributes, which found to be considerably. If the value of satisfaction index is comes greater than 100 that attribute is satisfactory and if value comes out be less than 100 work has to be done that attribute. After finding out the Satisfaction index the T-test has to be conducted by using the data of respondents. A ***t*-test** is any statistical hypothesis test in which the test statistic follows a Student's *t* distribution, if the null hypothesis is supported. It is most commonly applied when the test statistic would follow a normal distribution if the value of a scaling term in the test statistic were known. When the scaling term is unknown and is replaced by an estimate based on the data.

Formula used

$$t = \frac{\overline{X} - \mu}{S / \sqrt{n}} \qquad S = \sqrt{\frac{\sum FX^2}{\sum F} - \left(\frac{\sum FX}{\sum F}\right)^2}$$

Where X = Mean of each attribute

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μ	=	null hypothesis
S	=	Standard deviation
n	=	No of attributes
t	=	T test

MODEL TABLE 2

Attributes	Degree of difficulty					Mean Score
	High				low	
	5	4	3	2	1	
Buffer stock removal	18	10	4	7	21	177
Continual quality improvement	7	10	7	10	26	142
Effective Communication	12	15	10	3	20	176
Employee Empowerment	28	7	10	9	6	222
Error prevention	2	17	12	6	23	149
Frequent and reliable delivery	4	19	10	10	17	133
Group incentive scheme	19	14	11	9	7	209
Kanban system	11	16	9	7	27	187
Line stop strategy	28	16	7	4	5	238
Long term contract	`4	12	7	6	31	144
Long term quality commitment	18	16	12	7	7	211
Multi-function worker	4	13	14	4	25	147
Total preventive maintenance	05	12	12	7	24	147
QC training to worker s	4	13	8	10	25	141
Self-correction defects	20	15	7	8	10	207
Set up time reduction	30	18	7	4	1	252
Short lead time	4	14	10	8	24	146
Small lot size	10	4	9	7	30	121
Standard containers	3	15	8	4	30	137
Standardization	18	16	13	3	10	209

Process control	5	13	13	7	22	152
Statistical Quality control	13	14	5	7	21	171
Strong buyer relation ship	34	8	13	2	3	248
Team work	18	16	3	26	4	182
Vendor rating	13	14	5	7	21	171
Scheduling facility	34	8	13	2	3	248

After applying the T test on the available data it is to be checked that the values which are coming greater 3 are accepted otherwise value are rejected. The attributes which are rejected as per the calculation they are taken care. After doing these calculations the questionnaire is send to same respondents for taking the data on the expected benefits of implementing JIT based quality management in the same calculation is done for finding mean score and $T_{calulated}$

V. ANALYSIS AND DISCUSSION

A. Calculation of Mean And Average Score For Attributes

TABLE 4 CALCULATION OF MEAN AND AVERAGE SCORE

Sr. No	Mean score $\overline{X}$	Average mean score $\overline{\overline{X}}$
1	4.07	2.94
2	4.2	2.94
3	3	2.94
4	3.27	2.94
5	3.73	2.94
6	3.53	2.94
7	2.6	2.94
8	4.13	2.94
9	3.67	2.94
10	3.4	2.94
11	3.27	2.94
12	3.2	2.94
13	3.73	2.94

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14	3.2	2.94
15	2.8	2.94
16	3.73	2.94
17	3.4	2.94
18	3.46	2.94
19	2.53	2.94
20	3.13	2.94
21	3.33	2.94
22	3	2.94
23	3.2	2.94
24	2.6	2.94
25	2.67	2.94
26	3.33	2.94

After calculating the mean score and average mean score of the attributes .The next is to calculate the satisfaction index by using the formula given in eq.2. The satisfaction index of 26 attributes is calculated. The index having more than 100 is tabulated in one table and index having less than 100 is tabulated in another table. The satisfaction index which less than 100 need to be worked out. Table 5 shows the satisfaction index more than 100 and table5 shows the satisfaction index less than 100.

B. Calculation Of Satisfaction Index (I) >100 For Attributes

TABLE 5 SATISFACTION INDEX (I)>100

RANK	ATTRIBUTES	INDEX
1	Continual quality improvement	142.81
2	Kanban System	140.51
3	Buffer stock removal	138.27
4	Total preventive maintenance	126.94
5	Error prevention	126.94
6	Set up time reduction	126.94
7	Line stop strategy	124.67

8	Frequent and reliable delivery	120.14
9	Small lot size	117.871
10	Short lead time	115.61
11	Long term contract	115.61
12	Process control	113.34
13	Scheduling flexibility	113.34
14	Employee Empowerment	111.07
15	Long term quality commitment	111.07
16	QC training to workers	108.81
17	Multi functional worker	108.81
18	Strong buyer relation ship	108.81
19	Standardization	106.54
20	Statistical Quality control	102.01
21	Effective Communication	102.01

CALCULATION OF SATISFACTION INDEX (I) <100 FOR ATTRIBUTES

TABLE3 SATISFACTION INDEX (I) <100

RANK	ATTRIBUTES	INDEX
1	Group incentive scheme	88.41
2	Team work	88.41
3	Vendor rating	90. 67
4	Self correction defects	95.21

C. Calculation of T-Test For Attributes

The next step is to make calculation for T test. For making calculation T test formula is used from eq. And for calculating T. Standard deviation is using data of respondents by using equation.

After calculating the S.D. Calculation for T test can easily be made.

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Table 6 CALCULATION OF T-TEST

Attributes	Degree of difficulty: High ← low 5	4	3	2	1	Mean Score	$T_{calculated}$	Let H_o = 3.00
Buffer stock removal	5	6	4	0	0	4.07	7.05	H_o = accepted
Continual quality improvement	6	6	3	0	0	4.2	8.17	H_o = accepted
Effective Communication	0	4	7	4	0	3	0	H_o = rejected
Employee Empowerment	3	1	8	3	0	3.27	1.36	H_o = rejected
Error Prevention	4	6	3	1	1	3.73	3.32	H_o = accepted
Frequent and reliable delivery	3	6	3	2	1	3.53	2.37	H_o = rejected
Group incentive scheme	0	3	4	7	1	2.6	-2.32	H_o = rejected
Kanban system	7	4	3	1	0	4.13	6.04	H_o = accepted
Line stop strategy	4	5	4	1	1	3.67	6.04	H_o = accepted
Long term Contact	3	4	5	2	1	3.4	1.83	H_o = rejected
Long term quality commitment	2	4	6	1	2	3.26	1.21	H_o = rejected
Multi functional worker	4	6	3	1	1	3.2	0.87	H_o = rejected
Total preventive maintenance	2	4	5	3	1	3.73	3.32	H_o = accepted
QC authority to worker	3	2	7	2	1	3.2	0.92	H_o = rejected
Self correction defects	2	3	3	4	3	2.8	-0.76	H_o = rejected
Set up time reduction	4	5	4	2	0	3.73	3.74	H_o = accepted
Short lead time	3	4	5	2	1	3.4	1.78	H_o = rejected
Small lot size	5	3	3	2	2	3.46	1.69	H_o = rejected
Standard containers	0	3	4	6	2	2.53	-2.48	H_o = rejected
Standardization	2	4	5	2	2	3.13	0.56	H_o = rejected
Process control	4	2	6	1	2	3.33	1.30	H_o = rejected
Statistical Quality control	2	3	5	3	2	3	0	H_o = rejected
Strong buyer relation ship	2	5	3	4	1	3.2	0.87	H_o = rejected
Team work	1	2	4	6	2	2.6	-1.88	H_o = rejected
Vendor rating	1	2	4	7	1	2.67	-1.68	H_o = rejected
Scheduling flexibility	2	4	6	3	0	3.33	1.80	H_o = rejected

The value of H_o = 3 if the value comes out to be more than 3 it is accepted otherwise it is rejected. Now after Applying T test on the data available from the degree of difficulty in implementing JIT based quality management. With help of out coming data of T test the analysis is done and the attributes which are the proving as a hurdle in implementing JIT in the Industry are studied and work is done to remove these hurdles.

VI. CONCLUSION &THE SCOPE OF FUTURE WORK

A. Conclusion

The effects of JIT Based Quality Management are significant in improving overall performance of whole organization. The industries in India have great need of JIT Based Quality Management to improve their efficiencies especially in manufacturing sector. However, the attributes of JIT Based Quality Management may not be proved effective unless implemented by cross-trained, multi-skilled workforce with a high level of motivation.

B. Scope of Future Work

The JIT has a great scope in future .The JIT has been implemented only at a small area of the company especially in inventory filed. Before implementing JIT the inventory, there is lot of capital invested in the inventory but after implementing JIT the inventory level is reduced to an optimum level. The JIT based quality management has been implemented in inventory field by considering 26 attributes , after considering more attributes the JIT can be implemented on the whole system i.e Production system , Administrative work (Purchasing , Delivery etc)

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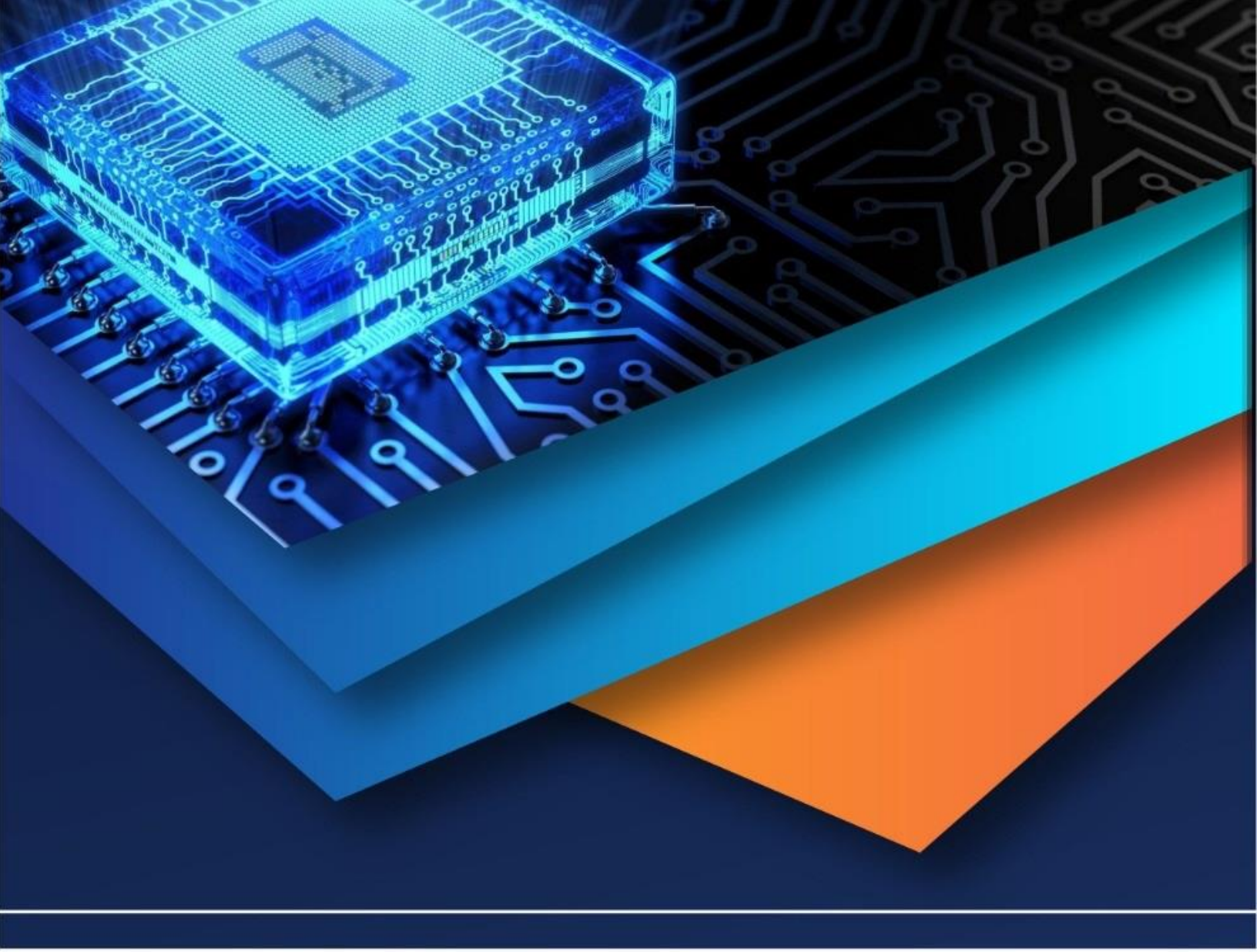

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