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# "Implementation of JIT Methodology to Increase Manufacturing Industries Performance"

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## ABSTRACT

**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 of the question in western countries was to accept a small but allowable amount of poor quality in outgoing manufactured goods. The Japanese during same time chose a different course of action called 'JIT '. Under this approach, product perfection is goal and poor quality of any kind is not acceptable. With a philosophy that calls for eliminating all sources of waste, including unnecessary inventory and scrap in production, JIT has not only affected the manufacturing but also marketing, planning, human resources 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 properly with high defects. Some unique purchasing and quality control techniques are therefore essential for its success so that raw material or components can be arrived at industrial just as they needed. The ideal goal of JIT 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, products, and programmes. This project work is focused on implementation of JIT and has presented its impact on various organizational parameters, when they are implemented into an existing production system. A preliminary report is made for finding the probable cause by using Cause & Effect Diagram, Parato Chart, Scatter Diagram etc**

## I. INTRODUCTION

A simple definition of JIT is to produce and deliver finished goods just in time to be sold, subassemblies just in time to be assembled into finished goods, fabricate parts just in time to go into subassemblies, and purchase parts just in time to be transferred in to fabricated parts. JIT is just not a technique or set of techniques of manufacturing, but is an advanced approach or philosophy which embraces both new and old techniques and provides a wide range of benefits by renovation of existing manufacturing systems.

## II. ELEMENTS OF JIT

**Table 1 Elements of JIT**

| Sr. No. | ELEMENTS NAME | DETAILS |
|---|---|---|
| 1 | Standardization | Standardization is the process of implementing and developing technical standards. It is the development of a set of defined reference conditions and procedures (standards) to consistently apply to a process or artifact to obtain consistent results. |
| 2 | Communication and Information Sharing. | No communication gap between Employers and Employees so that there is no time laps in collecting the information again and again. |
| 3 | Employee Training | Training should be given to the employees regarding JIT implementation. |
| 4 | Group Incentive Scheme | Incentives should be given to the employees for their good work. |
| 5 | Top Management Support | Top Management Support has been recognized as the most important factor in the implementation of JIT because JIT is an innovative approach, which requires changes throughout the organization as well as the commitment of all people within the organization. |

| | | |
|---|---|---|
| 6 | Group technology | Group technology or GT is a manufacturing technique in which parts having similarities in geometry, manufacturing process and/or functions are manufactured in one location using a small number of machines or processes. |
| 7 | Frequent and Reliable Service | Service as fast as possible and reliable. |
| 8 | Improved plant layout | The ability to design and operate manufacturing facilities that can quickly and effectively adapt to changing technological and market requirements is becoming increasingly important to the success of any manufacturing organization. In the face of shorter product life cycles, higher product variety, increasingly unpredictable demand, and shorter delivery times, manufacturing facilities dedicated to a single product line cannot be cost effective any longer. |
| 9 | Just-in-time purchases | (JIT) purchasing as a management innovation can be adopted by organizations as a strategy to gain advantage over their competitors. |
| 10 | Sole Sourcing | Traditionally, buyers regard price as a major factor to select vendors and tend to have multiple sourcing to avoid locking themselves into sole source. The downside of this strategy is that it is hard to maintain a long-term relationship while JIT relies very much on vendor loyalty. |
| 11 | Judoka (use of modern aid) | Use of modern computers and automation. |
| 12 | Total quality control | Total Quality Control is an imputable feature of the product and has several attributes, which means that it is measured by various properties of the product. These properties must be controlled throughout the entire production process. If a product does not meet any of these characteristics or attributes, it can be considered defective and will not be accepted in the market by the customer |
| 13 | Error Prevention (Kaizen/Poka Yoke) | Poka Yoke, also called mistake proofing, is a simple method to prevent defects from occurring in business processes |
| 14 | Continuous quality improvement | The quality of a product depends on the production process, but above all, it relies on the ability and skills of human resources. A quality plan or program should include strategies for continuous quality improvement, since no product is totally perfect; all products can be improved. Continuous quality improvement is mainly supported by two concepts, quality circles and Kaizen. |
| 15 | Six Sigma | Six Sigma is business development and quality improvement experts, the most popular management methodology in history. Six Sigma is certainly a very big industry in its own right, and Six Sigma is now an enormous 'brand' in the world of corporate development. |
| 16 | Customer Awareness | The world is changing, and it can be challenging to keep up. All manufacturing industries are educated, aware, and safe against the threats facing us. |
| 17 | Multifunctional workers | This element refers to the availability of workers or people responsible for the production process to perform various activities in the production line. Hence, if any member were missing or stopped attending, any other worker could replace him/her in the position or job. |
| 18 | Job Satisfaction | Satisfaction of employees in terms of working condition, salary, recognition etc. |
| 19 | Customer Satisfaction | Customer satisfaction, a business term, is a measure of how products and services supplied by a company meet or surpass customer expectation. Customer satisfaction is defined as "the number of customers, or percentage of total customers, whose reported experience with a firm, its products, or its services (ratings) exceeds specified satisfaction goals." |
| 20 | Commitment | An agreement to perform a particular activity at a certain time in the future under certain circumstances. |

## III. LITERATURE REVIEW

A. **Gunasekaran and J. Lyu (2010)** suggested that implementation of JIT in a small company should start with layout revision, schedule stability, and the development of long-term supplier-customer relationships. Top management commitment is necessary to ensure the effectiveness and success of implementing JIT in a small company.

**Fullerton and McWatters (2000)** measured the degree of implementation of JIT in US by taking a sample of 2ll companies. With the help of ANOVA (Analysis of Variance) test 28% of the responses indicate that the firms have had significant improvements in their operations since implementing JIT. More than 61% of the responses were positive, whereas only 5% of the responses were negative with respect to changes after adopting JIT.

**Khorshidian et al. (2011)** proposed a new model, with non-linear terms and integer variables which cannot be solved efficiently for large size problems due to its NP-hardness. To solve the model for real size applications, genetic algorithm is applied. These genetic procedures are also quite close to the optimum and provided an optimal solution for most of the test problems. Numerical examples how that this algorithm inefficient and effective**.**

**Telsung and Patil (2006)** concluded that work culture in JIT implemented companies have a positive impact on competitive advantage. The work culture system consists of those human resource practices that provide a cooperative and communicative atmosphere so that tasks within and across the functional units are coordinated.

**Zhang Qinghua et al. (2009)** studied the medical equipment production and analyzed the characteristics and problems in mixed production of original equipment and maintenance spare part. Based on the research result, the paper brought out the MRP and JIT integration solution applied in maintenance spare part production.

## IV. DEGREE OF IMPORTANCE OF JIT ELEMENTS IN INDIAN MANUFACTURING INDUSTRIES.

The following table gives the mean score of Degree of Importance of JIT elements in various manufacturing industries.

**Table 2 Degree of Importance of JIT Elements In Indian Manufacturing Industries.**

| Sr. No. | JIT ELEMENTS | RESPONSE | | | | | Mean Score (0-80) |
|---|---|---|---|---|---|---|---|
| | | 4 | 3 | 2 | 1 | 0 | |
| 1 | Standardization | 9 | 5 | 4 | 2 | 0 | 61 |
| 2 | Communication and Information Sharing | 13 | 3 | 2 | 2 | 0 | 67 |
| 3 | Employee Training | 13 | 4 | 2 | 1 | 0 | 69 |
| 4 | Group Incentive Scheme | 10 | 4 | 2 | 3 | 1 | 59 |
| 5 | Top Management Support | 10 | 5 | 2 | 3 | 0 | 62 |
| 6 | Group technology | 9 | 1 | 2 | 5 | 3 | 48 |
| 7 | Frequent and Reliable Service | 15 | 3 | 2 | 0 | 0 | 73 |
| 8 | Improved plant layout | 8 | 4 | 1 | 0 | 7 | 46 |
| 9 | Just-in-time purchases | 7 | 3 | 1 | 2 | 7 | 41 |
| 10 | Sole Sourcing | 9 | 4 | 2 | 3 | 2 | 55 |
| 11 | Judoka (use of modern/automatic age) | 8 | 3 | 5 | 2 | 2 | 53 |
| 12 | Total quality control | 11 | 4 | 3 | 2 | 0 | 64 |
| 13 | Error Prevention (Kaizen/Poka Yoke) | 5 | 2 | 3 | 5 | 5 | 37 |
| 14 | Continuous quality improvement | 4 | 5 | 1 | 2 | 8 | 35 |
| 15 | Six Sigma | 5 | 1 | 3 | 5 | 6 | 34 |
| 16 | Customer Awareness | 14 | 4 | 2 | 0 | 0 | 72 |
| 17 | Multifunctional workers | 4 | 3 | 2 | 3 | 8 | 32 |
| 18 | Job satisfaction | 14 | 3 | 2 | 1 | 0 | 70 |
| 19 | Customer Satisfaction | 14 | 2 | 3 | 0 | 1 | 68 |
| 20 | commitment | 12 | 4 | 2 | 1 | 1 | 65 |

Table 2 indicates that Frequent and Reliable Service has got the maximum value i.e. (73), hence is the most important element of JIT for manufacturing industries and Customer Awareness got (72), as mean score, which is second most important element of JIT whereas, Multifunctional workers got (32) as mean, which is the least one, hence it can be termed as least important in manufacturing industries in Indian context.

From Table 2 other most important elements are Job satisfaction, Employee Training, Customer Satisfaction, Communication and Information Sharing, Group technology, and improved plant layout.

## IV.1 DEGREE OF DIFFICULTIES OF JIT ELEMENTS IN manufacturing industries

Table 3 gives the mean score of Degree of Difficulties of JIT elements in various manufacturing industries.

**Table 3 Degree of Difficulties of JIT Elements in Manufacturing Industries**

| Sr. No. | JIT ELEMENTS | RESPONSE | | | | | Mean Score (0-80) |
|---|---|---|---|---|---|---|---|
| | | 4 | 3 | 2 | 1 | 0 | |
| 1 | Standardization | 7 | 6 | 4 | 1 | 2 | 55 |
| 2 | Communication and Information Sharing | 2 | 6 | 2 | 5 | 5 | 35 |
| 3 | Employee Training | 2 | 2 | 3 | 7 | 6 | 27 |
| 4 | Group Incentive Scheme | 8 | 3 | 5 | 2 | 2 | 53 |
| 5 | Top Management Support | 8 | 5 | 3 | 3 | 1 | 56 |
| 6 | Group technology | 3 | 1 | 2 | 6 | 8 | 25 |
| 7 | Frequent and Reliable Service | 4 | 2 | 6 | 3 | 5 | 37 |
| 8 | Improved plant layout | 2 | 4 | 1 | 7 | 6 | 29 |
| 9 | Just-in-time purchases | 3 | 1 | 4 | 5 | 7 | 28 |
| 10 | Sole Sourcing | 6 | 5 | 3 | 4 | 2 | 49 |
| 11 | Judoka (use of modern/automatic age) | 5 | 2 | 7 | 8 | 0 | 48 |
| 12 | Total quality control | 5 | 2 | 5 | 5 | 3 | 41 |
| 13 | Error Prevention (Kaizen/Poka Yoke) | 5 | 5 | 2 | 4 | 4 | 43 |
| 14 | Continuous quality improvement | 2 | 2 | 3 | 4 | 9 | 24 |
| 15 | Six Sigma | 5 | 2 | 4 | 2 | 7 | 36 |
| 16 | Customer Awareness | 2 | 4 | 2 | 7 | 5 | 31 |
| 17 | Multifunctional workers | 6 | 4 | 3 | 3 | 4 | 45 |
| 18 | Job satisfaction | 2 | 3 | 4 | 8 | 3 | 33 |
| 19 | Customer Satisfaction | 3 | 4 | 6 | 2 | 5 | 38 |
| 20 | commitment | 6 | 3 | 4 | 4 | 3 | 45 |

From the above Table 3 most difficult elements are Top Management Support, Standardization, Group Incentive Scheme, Sole Sourcing, Judoka (use of modern/automatic age), Multifunctional workers, Commitment, Error Prevention (Kaizen/Poka Yoke), Total quality control and Customer Satisfaction.

The least difficult elements from Table 3 are Frequent and Reliable Service, Six Sigma, Communication and Information Sharing, Job satisfaction Customer Awareness, Improved plant layout, Just-in-time purchases, Employee Training, Group technology and Continuous quality improvement.

## V XY SCATTER CHART

XY scatter chart is drawn between importance as abscissa and difficulty as ordinate. The axis crosses at their relative value of population mean (μ) i.e. for x axis it is 40 and for y axis its value is 40.

In Figure 4.1, the lower right quarter i.e. Part-1 highlights those elements of JIT which are highly important and very easy to implement. These elements are Frequent and Reliable Service, Customer Awareness, Job satisfaction, Employee Training, Customer Satisfaction, Communication and Information Sharing, Group technology, and Improved plant layout.

The upper right quarter i.e. Part-2 shows those elements which are highly important but are difficult to implement. These elements are Commitment, Total quality control, Top Management Support, Standardization, Group Incentive Scheme, Sole Sourcing, Standardization, and Judoka (use of modern/automatic age).

The upper left quarter i.e. Part-3 depicts those elements which are less important and very difficult to implement in manufacturing industries. These elements are Error Prevention (Kaizen/Poka Yoke) and Multifunctional workers.

The lower left quarter i.e. Part-4 demonstrates those elements which are less important but are easy to implement. These elements are Just-in-time purchases, Continuous quality improvement and Six Sigma.

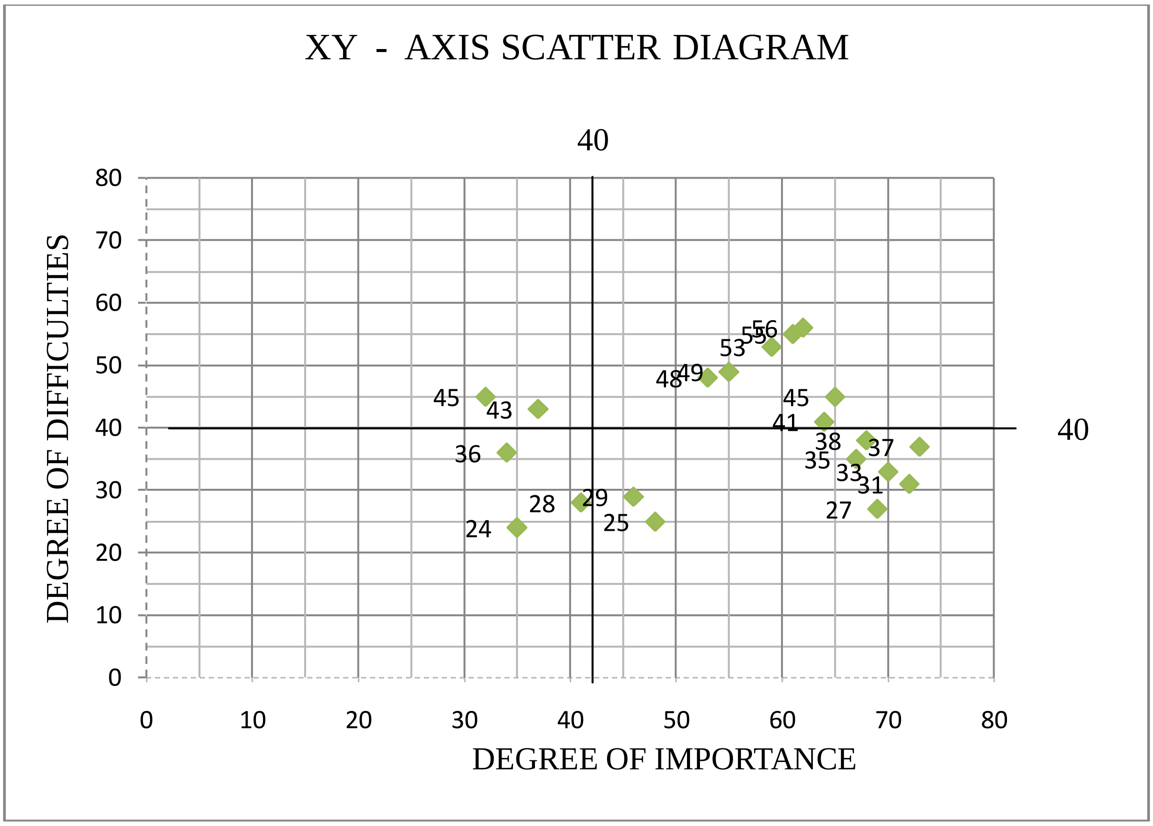


**FIGURE 1**

(1) Standardization, (2) Communication and Information Sharing, (3) Employee Training, (4) Group Incentive Scheme, (5) Top Management Support, (6) Group technology, (7) Frequent and Reliable Service, (8) Improved plant layout, (9) Just-in-time purchases, (10) Sole Sourcing, (11) Judoka (use of modern/automatic age), (12) Total quality control, (13) Error Prevention (Kaizen/Poka Yoke), (14) Continuous quality improvement, (15) Six Sigma, (16) Customer Awareness, (17) Multifunctional workers, (18) Job satisfaction, (19) Customer Satisfaction, (20) Commitment.

## VI. DATA ANALYSIS

The data analysis is done with ANOVA Technique.

### VI.1 Analysis of Variance (ANOVA)

The ANOVA technique is important in the context of all those situations where we want to compare more than two populations such as in comparing the yield of crop from several varieties of seeds. In such circumstances one generally does not want to consider all possible combination of two populations at a time foe what would require a great number of tests before we would be able to arrive at a decision. Professor R.A. Fisher was the first man to use the term 'Variance' and, in fact; it was he who developed a very elaborate they concerning ANOVA, explaining its usefulness in practical field. Later on Professor Snedecor and many others contributed to the development of this technique.

'ANOVA' is essentially a procedure for testing the difference among different group of data for homogeneity. "The essence of ANOVA is that the total amount of variation in a set of data is broken down into two types, that amount which can be attributed to chance and that amount which can be attributed to specified causes." There may be variation between samples and also within sample items. ANOVA consists in splitting the variance for analytical purposes.

### VI.2 Principle of ANOVA Analysis

The basic principle of ANOVA is to test for differences among the means of the populations by examining the amount of variation within each of these samples, relative to the amount of variation between the samples. In terms of variation within the given population, it is assumed the values of $X_{ij}$ differ from the mean of this populations only because of random effects i.e., there are influences on ($X_{ij}$) which are unexplainable, whereas in examining difference between populations we assume that the difference between the mean of the $J^{th}$ population and the grand mean is attribute to what is called a 'specific factor' or what is technically described as treatment effect. Thus while using ANOVA; we assume that each of the samples is drawn from a normal population and that each of these populations has the same variance. We also assume that all factors other than the one or more being tested are effectively controlled. This, in other words, means that we assume the absences of many factors that might affect our conclusions concerning the factor(s) to be studied.

In short, we have to make two estimates of population's variance i.e. one based on b/w samples variance and the other based on within sample variance. Then they said two estimates of population variance are compared with F-Test, wherein we work out.

$$F=\frac{\text{Estimate of population variance based on between samples variance}}{\text{Estimate of population variance based on within samples variance}}$$

This value of F is to be compared to the F-limit for given degree of freedom. If the F value we work out is equal or exceeds the F-limit value (to be seen from tables), we may say that there are significant differences between the sample means.

### VI.3 Model of ANOVA Technique

One way ANOVA: - Under the one way ANOVA, we consider only one factor and then observe that the reason for said factor to be important is that several possible types of samples can occur within that factor. We then determine if there are differences within that factor. The technique involves the following steps:-

**(i)** Obtain the mean of each sample i.e. obtain

$\bar{X}_1, \bar{X}_2, \bar{X}_3, \bar{X}_4 \ldots\ldots\ldots\ldots\ldots \bar{X}_k$

Where there are k samples.

**(ii)** Work out the mean of the sample means as follows:

$$\bar{\bar{X}} = \frac{\overline{x_1}+\overline{x_2}+\overline{x_3}+\cdots\ldots\ldots\ldots,\overline{x_k}}{\text{No.of samples (k)}}$$

**(iii)** Take the deviations of the sample mean from the sample means and calculate the square of such deviations which may be multiplied by the number of items in the corresponding sample, and then obtain their total. This is known as the sum of squares for variance between the sample (or SS between). Symbolically, this can be written:

$$\text{SS between} = n1\left(\bar{X}1-\bar{\bar{X}}\right)^2 + n_2\left(\bar{X}2-\bar{\bar{X}}\right)^2 + \ldots\ldots + n_k\left(\bar{X}k-\bar{\bar{X}}\right)^2$$

**(iv)** Divide the result of (iii) step by the degree of freedom between the samples to obtain variance or mean square (MS) between samples. Symbolically, this can be written:

$$\text{MS between} = \frac{\text{SS between}}{k-1}$$

where (k-1) represents degree of freedom (d.f.) between samples.

**(v)** Obtain the deviations of the values of the sample items for all the samples from corresponding means of the samples and calculate the squares of such deviation and then obtain their total. This total is known as the sum of squares for variance and then obtains their total. This total is known as the sum of squares for variance within samples (or SS within), Symbolically this can be written as:

SS within = $\sum(X_{1i} - \overline{X_1})^2 + \sum(X_{2i} - \overline{X_2})^2 + \ldots\ldots + \sum(X_{ki} - \overline{X_k})^2$
i = 1, 2, 3…

**(vi)** Divide the result of (v) step by the degree of freedom within samples to obtain the variance or mean square (MS) within samples. Symbolically this can be written as:

$$\text{MS within} = \frac{\text{SS within}}{(n-k)}$$

where (n-k) represents degree of freedom within samples.
N= total number of items in all the samples i.e. $n_1+n_2+\ldots\ldots+n_k$.
K=number of samples.

**(vii)** For a check, the sum of squares of deviations for total variance can also be worked out by adding the squares of deviations when the deviations for the individual items in all the samples have been taken from the mean of the sample means. Symbolically, this can be written:

**(viii)** SS for total variance = $\sum\left(Xij - \overline{\overline{X}}\right)^2$

i = 1, 2, 3… and j = 1, 2, 3…

This total should be equal to the total of the result of the (iii) and (v) steps explained above i.e. SS for total variance= SS between + SS within

The degree of freedom for total variance will be equal to the number of items in all samples minus one i.e., (n-1). The degree of freedom for between and within must add up to degree of freedom for total variance i.e.

$$(n-1) = (k-1) + (n-k)$$

This fact explains the additive property of the ANOVA technique.

**(ix)** Finally, F-ratio may be worked out as under:

F-ratio = $\frac{\text{MS between}}{\text{MS within}}$

This ratio is used to judge whether the difference among several means is significant or is just a matter of sampling fluctuation. For this purpose we look into the table, giving the value of F for given degree of freedom at different levels of significance. If the worked out value of F, as stated above, is less than the table value of F, the difference is taken as insignificant i.e. due to chance and the null hypothesis of no difference between sample means stands. In case the calculated value of F happens to be either equal or more than its table value, the difference is considered as significant (which means the samples could not have come from the same universe) and accordingly the conclusion may be drawn. The higher the calculated value of F from the table value, the more definite and sure one can be about his conclusions.

## CONCLUSIONS

According to the XY scatter chart plotted between importance and difficulties for implementing JIT in manufacturing industries of India, important results found can be indicated as in Table 4

**Table 4 Elements Which Are Important As Well As Easy To Implement**

| S. NO. | ELEMENT | VALUE OF MEAN FOR IMPORTANCE (0-80) | VALUE OF MEAN FOR DIFFICULTY (0-80) |
|---|---|---|---|
| 1 | Frequent and Reliable Service | 73 | 37 |
| 2 | Customer Awareness | 72 | 31 |
| 3 | Job satisfaction | 70 | 33 |

| | | | |
|---|---|---|---|
| 4 | Employee Training | 69 | 27 |
| 5 | Customer Satisfaction | 68 | 31 |
| 6 | Communication and Information Sharing | 67 | 35 |
| 7 | Group technology | 48 | 25 |
| 8 | Improved plant layout | 46 | 29 |

## SUMMARY

In this chapter survey of 20 manufacturing industries was carried out. On the basis of the mean calculated for different elements of JIT on 0-80 scale, all the elements were analyzed and plotted on a scatter chart, from where most important and less difficult elements were found out. A comparison of extent of importance and difficulty of JIT elements was carried out. Bar charts were plotted depending upon the data collected from the survey. After identifying the elements from XY scatter chart, apply the ANOVA analysis on those elements. From the result of the ANOVA analysis, we have checked the value is significant.

The most beneficial elements for the surveyed manufacturing industries were also traced out. It is suggested that JIT elements should be implemented in a phased manner and after conforming its success, it should be implemented to the whole process. First of all one should implement the most important and less difficult elements to the critical processes only as a pilot project. The most important and highly difficult elements should be implemented after the successful implementation of the pilot project. In this chapter presents few important conclusions obtained from present work. In this work, some vital issues of JIT implementation have been analyzed on the behalf of a case study. The following conclusions have been drawn in above table.

## FUTURE SCOPE

Present work is exploratory in nature. JIT concept is growing very fast. So, there is a lot of scope for future research in this area. Some important issues identified for future research are as follows:

1. Some elements of JIT such as Top Management Support, Standardization, Group Incentive Scheme, Sole Sourcing, Judoka (use of modern/automatic age), Commitment and Multifunctional Workers etc. are difficult to implement in manufacturing industries as identified by the survey results. The main reasons for these difficulties should be traced out to solve the problems of implementation.

2. What changes should be made to optimize the JIT Process.

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