JIT Based Quality Management: Concepts and Implications in Indian Context

VIKAS KUMAR*

Abstract

The product quality is very important for long-term 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 this 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 "Just-in-Time (JIT) Based Quality Management". Under this approach, product perfection is goal and poor quality of any kind is not acceptable. This paper presents the concepts, implementation strategies and benefits of Just-in-Time (JIT) Based Quality Management in detail.

Keywords: Just-in-Time (JIT), Quality Management, Work culture, Implementation strategies.

1. Introduction

In today's competitive global business environment, the goal of all manufacturing systems is long-term survival. A manufacturing company's survival in an increasingly competitive market closely depends upon its ability to produce highest quality product at lowest possible cost and in a timely manner with shortest possible lead-time. In addition, these goals should be achieved by paying utmost respect to the humanity of the employees who make the system work. Sometime, the difficulty of achieving the goals lies in the complexity of manufacturing operations. It is not difficult to build the high quality product, but is extremely difficult to do so while maintaining excellent quality, and at some time respecting the humanity of people who do the actual work of building that product. A Just-in-Time (JIT) based approach, which is suggested here, is capable of achieving all above stated goals. Just-in-Time (JIT) Based Quality Management is both philosophy and guiding set of principles that integrates the basic management techniques, existing improvement efforts, and technical tools. This approach stressed on long-term benefits resulting from waste elimination, and continuous improvements to systems, programs, products, and people. It has significant impact on quality control, purchasing functions, and work culture with a philosophy that encompasses cost, meeting delivery schedules, employee's empowerment and skill development, supplier relations and development of new products. But, this approach requires the plants to keep trim inventories because even small glitch in supply chain management, and small failure rate of defective items can bring production to standstill. Some unique techniques of purchasing and quality control are therefore developed in such a way that raw material or components of high quality can be arrived at factory just as they needed, and production of defective items can be reduced to near zero level.

Conceptually, this approach combines apparently conflicting objectives of low cost, high quality, manufacturing flexibility, and delivery dependability. Its effects are significant in improving the overall performance of the whole organization. However, there is no standard to implement JIT other than continuous progress towards the ultimate objective of delivery as wanted, with a smoothly synchronized continuous flow keyed to final demand, with perfect quality of incoming goods. Even with this problem, it provides a wide range of benefits as shown in table 2. The adoption of JIT based approach in Indian context may be helpful for those industries, which are still

* Dr. Vikas Kumar,
Assistant Professor, Mechanical Engineering Department,
YMCA University of Science and Technology
Faridabad-121006 (Haryana), INDIA
e-mail address: vikasturk@gmail.com
Mobile no. 09312899357

struggling with problems of unreliable and long lead-time, inferior quality, low productivity, high rate of scrap and defects, shortage of raw-material, and under utilization of workers and equipments.

2. Theory of JIT production

JIT Based Quality management is combination of inventory control, quality control and production management functions that makes sincere efforts for quality improvement by two ways. First, it concentrates on philosophical aspect of quality improvement by making the quality everyone's responsibility, and then focused on effective implementation of quality control techniques [28]. It recognized that most valuable resources of an organization are its workers, and workers work best when they are motivated, valued, encouraged to contribute, and allowed to make their own decisions. Under this approach, Workers inspect the product quality after each successive operation. They are trained along with managers in preparation and interpretation of process control charts. Managers motivate the workers to think quality first and production rate second. The workers have authority to halt the production line or cell, if quality problems are uncovered. Thus, this concept not only gives the quality responsibility to workers but also match that responsibility with authority to share the

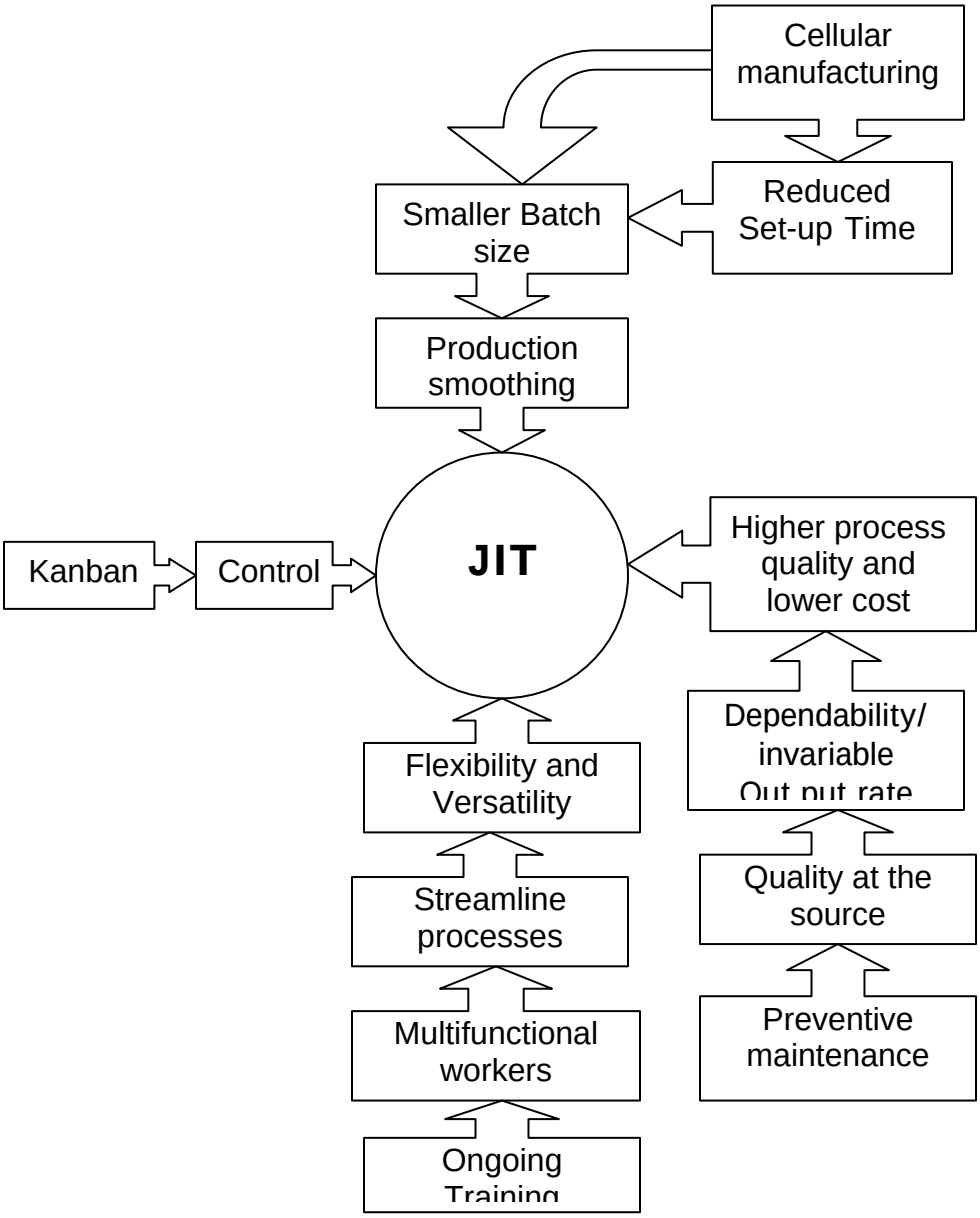

Figure 1: The interrelationship of JIT elements

quality control functions so that quality problems can be uncovered and solved quickly [7]. Also, JIT production system demands to buy parts in small lots. Small lots require less space and time. Less space and time require less peoples and facilities to complete the same job. Besides, small lots easy to inspect, and defects can be immediately detected. Thus, the parts that are purchased steadily in small lot sizes with frequent deliveries contribute to higher quality and productivity through lower levels of inventory and scrap, lower inspection costs for incoming parts, and early detection of defects [11]. In short, JIT based approaches has potential to improve the product quality and productivity to significant level but organizations must adopt its principles in way that meet their own organizational structure, design and processes.

Table 1: Elements of JIT

Buffer stock removal [1,4,6,7,10,11,12,16,24,25,27]
Cellular Manufacturing [1,10,11,12,14,24,26,27]
Continual Quality Improvement [4,7,11,12,14,23]
Kanban System [1,10,11,12,14,16,24,26,27]
Error Prevention (Poke-yoke) [4,11,12,14,24,27]
Group Technology [1,4,12,16,25,26,27]
High QC Visibility [6,7,14,18,28]
Kaizen [7,11,26]
Layout improvement [10,11,12,16,26]
Long term Contract [10,11,12,24,27]
Long Term QC Commitment [6,14,18,28]
Multifunctional Worker [3,5,11,12,13,21,23]
Preventive Maintenance [11,12,24,27]
Quality certification of supplier [10,11,12,28]
Quality Circles [1,3,4,11,12,13,15,16,18,23,24]
Quality control authority to worker [1,5,12,14,18]
Quality culture [9,23,28]
Quality development program [4,11,26]
Quality oriented training [1,10,13,23,24]
Regular Quality and reliability auditing [12,15,28]
Self -correction of defects [7,11,12,13,26]
Set up time reduction [1,12,16,23,24,26,27]
Short lead-time [1,4,7,12,23,26,27]
Simplification of quality control processes [3,7,28]
Small lot size [6,7,10,12,14,23,24]
Standard containers [7,12,26,27]
Process control [1,12,16,18,28]
Statistical Quality control [1,6,12,16, 18, 26,27,28]
Total quality control [6,7,9,11,14,16,24]
Vendor rating [10,11,12]
W.I.P. reduction [7,12,24,27]
Worker motivation [3,5,8,13,21,24,28]
Zero defect [7,11,12,27]
Zero deviation schedule [1,7,11,12,13,26]
100% quality inspection [1,27,28]

Table 2: Potential Benefits of JIT

1. Reduced set cost [1,4,6,7,10,11,12,27]
2. Reduced labour cost (Both direct and indirect) [7,10,12,13,18,25]
3. Reduced move distances [1,3,7,10,26]
4. Reduced paper work [7,10,27]
5. Reduced number of parts [11,26,27]
6. Reduced job classification [3,4,7,28]
7. Reduced scrap and rework [7,9,10,12,14,23,24,27]
8. Reduced material handling [1,6,7,24]

9. Increased process quality [1,16,24]
10. Increased product quality [1,6,9,14,16,18,24,26,27,28]
11. Increased process flexibility [4,6,10,12,28]
12. Increased communication [12,26]
13. Increased productivity [1,3,7,8,9,10,13,16,18,24,27]
14. Increased team work [2,3,8,12,14,23]
15. Increased innovation [14,28]
16. Increased efficiency and responsiveness [7,12,27]
17. Increased resources utilization [9,11,12,127]
18. Improved worker motivation [2,6,12,14,16,22,26]
19. Integrate different manufacturing activity [11,19]
20. Lower overhead [1,12,14,27]

3. Past Studies in Indian Context

Ajit singh [1] have identified number of essential elements of Just-in-Time (JIT) practices and their relationship with Total quality control (TQC). Both JIT and TQC offer the complementary means of reaching quality objective. JIT removes the buffer of inventory accrued by traditional stocking methods and expose the quality problem at earlier stages. TQC detects the pattern and exact locations of quality problems. But, operator must be trained in SQC to trace and remove the defects. They also needed to be trained to perform the preventive and maintenance activities so that preventive or corrective action can be taken instantaneously in case of machine failure. Workplace should be neat and cleaned. Since clean and orderly workplace provide the visibility for earlier detection of problems and enhances the work disciplined needed for further challenges.

Prem vrat et al. [24] 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 poka-yoke, reduced set up time, Kanban system and quality of incoming material.

Garg et. al. [13] have stated that JIT require a culture that allows the worker to become a participant in decision making and thus necessitates putting trust and responsibility in the hands of workers and supplier to become same interest group by the way of having long term relationship. In JIT environment, work culture required is marked by trust, locality, responsibility, development, motivation, authority, long term relationship and respect for human being. It is critical for a firm to make conscious and deliberate efforts to change the work culture for successful implementation of JIT. These changes in work culture require top management commitment, involvement and leadership, worker participation in decision making and massive education and training to the people concerned. Generally, cultural factors are biased against above said rapid and massive changes because people prefer an existing inequity to known improvement. Finally, it was felt that JIT could be great opportunity for India.

Padukone and Subba rao [16] 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.

Roy and Guin [19] have exposed the applicability of JIT in Indian industries. They have also reviewed the literature related to applications of JIT in different sectors of manufacturing and identify the various requirements need to be fulfilled include: leveled and stable final assembly schedule, change in layout, multi-skilled workforce and training for workers.

Singhvi [23] has presented the experience of an Indian automobile company in implementing JIT. Some quality improvements like improvements in quality level, reduction in W.I.P., reduction in space and reduction in material handling. The study found that ‘employee involvement’ is a critical element for implementing the JIT. Large investments are not found to be essential, but it is impossible to implement JIT without employee involvement and persistent focus on quality. It is also felt that implementation of JIT is not so difficult in India and its implementation could be a great opportunity for Indian industries due to its wide range of benefits.

Vikas et al. [28] have stated that traditional view permits small but allowable amount of poor quality product in outgoing manufacturing goods. On contrary, JIT Based Quality Management doesn't allow poor quality products in any quantity by focusing the special attention on efforts to get high quality products in small lots. They have presented the basic principles of JIT Based Quality Management such as high level of visibility on quality, strict product quality compliance, participation in control of product quality, self-correction of worker-generated defects, 100% quality inspection of products, routine maintenance and house cleaning duties, continual quality improvement and long-term commitment to quality control efforts. Consistent with these principles, JIT motivates workers to achieve product quality perfection.

Vikas Kumar and Garg [27] have conducted a survey of Indian industries to find out the applicability of JIT in Indian context. The study reported that statistical quality control, statistical process control and work centred quality control can be easily implemented, but the goal of zero defect is difficult to achieve in Indian context. The survey also revealed that some benefits like increased quality, increased productivity, reduced inventories, improved competitive position, improved worker efficiency, increased flexibility, reduced production lead time, reduced purchase lots size and reduced work in process are highly expected JIT benefits in Indian context. They also stated that perfect JIT implementation are not possible in most Indian industries due to lack of training, lack of resources, non availability of multifunctional workers. Indian industries must implement the JIT in phased manner. This will certainly make them more competitive.

Garg et al. [11] have conducted a case study in JIT implementation of an Indian tractor assembly industry. Record of company indicated that significant benefits were achieved by improvement in quality and productivity, and reduction in inventory, material movement, space, manpower, work-in-process and lead-time. The key steps in JIT implementation were extensive training of employees on pull concepts; identification of key performance parameters; new layout based on U-shaped cells; standardization of operations; a maintenance plan for each machine, housekeeping, visual control and multi-skill training.

Garg and Deshmukh [12] have reviewed and classified the literature on JIT purchasing. The relative attributes were identified and frequency of citation of an attribute in the literature was assumed to be measure of its importance. High quality, fair price and frequent deliveries was found more important as these attributes had been discussed in all types of conceptual, survey and case studies. Furthermore, this study pointed that there is great need for education and training for employees, and involvement of top management is must for implementation of JIT purchasing. This concept gives support to implement the quality management techniques in JIT environment, and also provide significant benefits in area of cost, quality and service.

Garg et al. [10] were conducted a survey of Indian industries to find the extent of relevance of JIT attributes. Questionnaire was developed and administered to 70 industries. Responses from 31 industries (response rate=44.3%) were obtained. Data collected were analyzed with help of factor analysis on a scale (0-100). The scope of JIT implementation was found 70 on scale (0-100), which can be said 'fairy good'. This study has predicted better scope of JIT implementation in India compared to earlier studies. This indicated that scope of JIT implementation is increasing.

4. Work Culture for JIT organization

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. Some essential elements of work culture under JIT are briefly outlined as follows:

4.1. Flexible workforce

The workforce is main source of flexibility in JIT. With this flexible workforce, when one worker is not available or falls behind to perform his work, another worker can do this job. Therefore, flexible/multifunctional workers are trained to perform a wide range of jobs at very short notice.

4.2. Cross training

Training of workers is strategic issue for success of JIT and its main objectives are to permit a rapid transfer of workers between the tasks without loss of efficiency and to enable the workers to play an active role in problem prevention. Cross training for all workers is must to develop their multiple skills so that they can do different jobs in the factory. [3] Training also helps them to understand the philosophy, concept and techniques of JIT. Furthermore, it induces better integration, communication and teamwork among the workers.

4.3. Long-term employment

Massive training programs are more expensive. Consequently, high turnover rate of trained workers is unfavorable for JIT. It may adversely affect on company's competitiveness. Workers feel safe and committed to their jobs by giving them long-term employment [13]. Accordingly, JIT demands long term employment to achieve lower turnover rate of workers.

4.4. Job enlargement and labour unions

In Just-in-Time environment, workers are also responsible for checking the quality of materials supplied by vendor. One worker may check the value added efforts of another worker. The inspection of one worker's effort by another places greater job responsibility on lobour and acts to broaden worker's job. This process is known as 'Job enlargement' [28]. Sometime, Job enlargement enhances the worker level to unrealistic level. Consequently, the lobour unions oppose the concept like multifunctional workers and zero buffer stock. So, support from the lobour union is especially imperative for successful implementation of JIT.

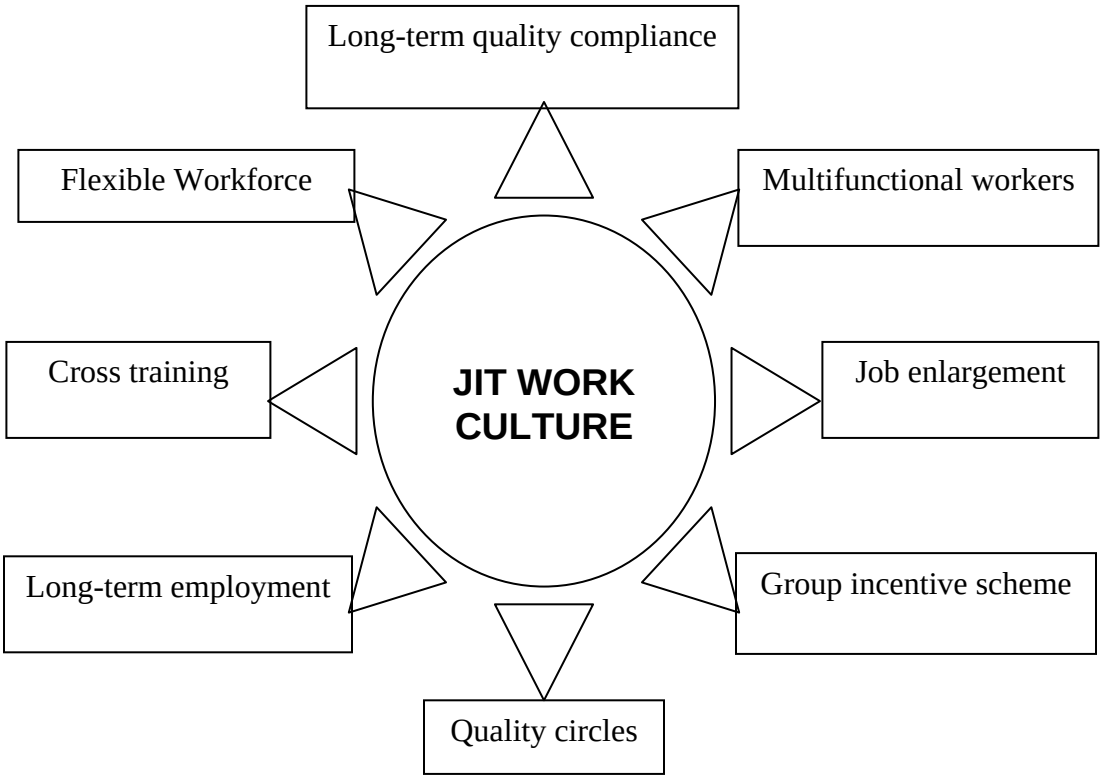

Figure 2: Dimensions of JIT work culture

4.5. Workforce involvement

JIT requires some changes in manufacturing system. These changes require employee's involvement from every person in the organization [8]. This is achieved by introducing the reward and compensation system. Reward systems are based more on group incentive scheme because an individual incentive scheme can destroy good teamwork and synchronized production.

4.6. Visibility

JIT demands for good visibility so that everything and everybody at plant-floor should see clearly, and quality problem can be solved quickly as they come on surface. Visibility involves poka-yoke inspection methods or fool-proofing system to ensure no error is made by the workers [23]. This helps in achieving high standard of quality, which is pre-request for effective implementation of JIT.

5. JIT implementation strategies

JIT comprises a fairly large set of techniques that cannot all be implemented at once. Due to its complexity, it is impossible to specify a sequence of well-defined steps for its implementation in any particular case. However, some general guidelines for its implementation have been suggested and these form a basis for finding the appropriate way for implementing JIT. Inman [97] suggested that key obstacles such as long change over time; unleveled production schedules; highly variable production processes; large container sizes; severe bottlenecks, and long lead times should be removed before implementing the JIT. Long changeover times must be addressed first. Because of the complex nature of JIT implementation, it is important to focus the system on a well-defined area by delimiting the domain of application appropriately. Broadly speaking, one can think about JIT implementation from different angles, the most common being people and the engineering angles. The former comprises aspects of attitude and motivation as well as education in the philosophy of JIT and training in the detailed procedures. 'Engineering', on the other hand, comprises aspects of JIT such as layout, product design for manufacture, and setup reduction. Many companies have sought to implement JIT from the engineering side. However, JIT experts such as Schonberger [7] and Hall [14] maintain that it is essential to begin JIT implementation with a good deal of attention first being paid to the people aspects. In order to build up a knowledge base of JIT implementation steps, Fiedler et al. [8] has proposed the following two stages process:

1) Prepare the plant and its people for flexibility, low costs, short lead-times and high quality by concentrating on design; maintenance; quality; layout; set-up time; and people.

2) Strive to produce zero lead-time with no waste by focusing on: total people involvement; visibility; process data collection; enforced improvement; flow scheduling; inventory control; buffer and lot size reduction, and supplier and customer relationship.

These two stages, however, don't specify a general sequence of steps for the implementation of JIT. Moreover, the ability of the different techniques in both stages depends highly on a specific manufacturing environment. Therefore all techniques of stage (a) do not necessarily have to be implemented before starting first stage. Rather, the implementation of JIT is an ongoing cyclic process of improvements--actions in one area make actions possible in another area. Likewise, Padukone and Rao[16] have grouped the JIT techniques into two stages. The first stage of JIT implementation is composed of areas that are necessary for full JIT to work. They focus on four main elements of JIT that can be achieved in the short term. These are simplicity, flow, quality, and fast set-up and lay the foundation for moving on to the more difficult techniques like kanban and JIT purchasing, which are a part of stage two.

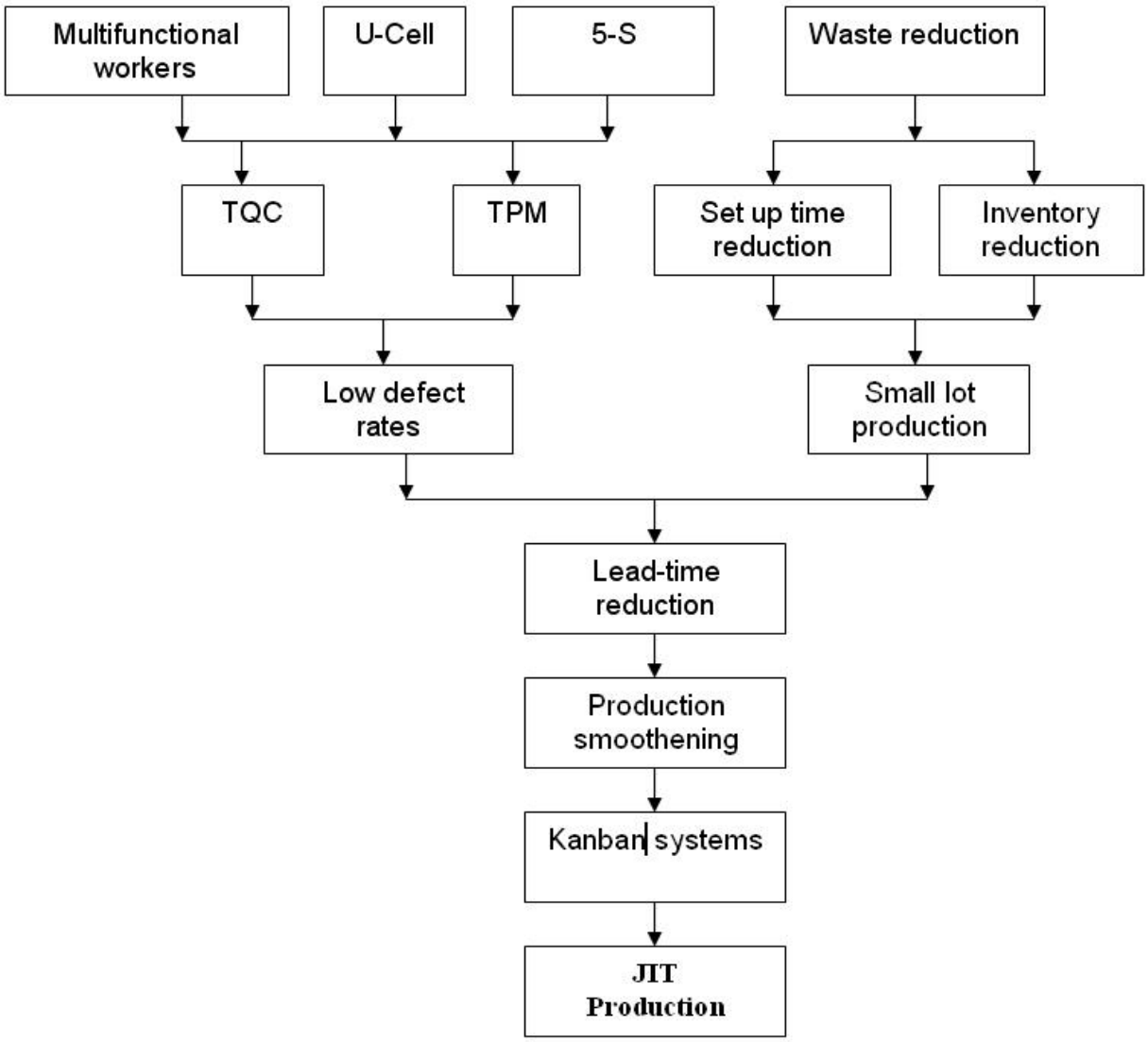

Figure 3: Process for achieving Just-in-Time production

6. Some Important Features of JIT Based Quality Management

This section explains the some unique features of this concept that play a vital role to achieve its objectives of continuous quality improvement, waste elimination and cost reduction.

- One most outstanding feature of JIT is that it generates great number of suggestions by worker's involvement in continuous improvement. Management works hard to implement these suggestions. The number of suggestions is regarded as an important criterion in reviewing the performance of a worker. Thus, management recognizes worker's efforts for quality improvement. Quality circles are also act as group oriented suggestion system for making improvement. In short, JIT requires efficient suggestion system to involve employees in manufacturing activities.
- JIT emphasizes awareness, and provides clues for identifying problems. Once problem identified, it must be solved. Therefore, this concept requires training for using various problem-solving tools.
- Improvement reaches new heights with every problem that is solved. In order to consolidate new levels, improvement must be standardized. Thus, JIT also requires standardization of methods and procedures.
- Often, The heterogeneous composition of workforce and adverse relation between labour and management makes difficult to introduce changes for improve productivity and quality control. Therefore, high motivation, employee empowerment, and an open organizational culture are essential for efficient implementation of JIT.

- JIT requires the habit of working with hard data. It therefore put more emphasize on the use and analysis of statistical data for quality control and problem solving.
- Because workers works on many different types machines at once, this system leads to significant expansion of worker responsibilities and skills. Therefore, effective training programs are primary requirements of JIT to develop the multiplicity of skills in the workers.
- JIT encourages the suppliers to make commitment to supply the excellent quality products. To fulfill this commitment, a permanent quality program is required for supplier's operations, with constant communication between buyer and supplier.

7. Implications for Indian industries

Indian manufacturing sector is one of the largest industrial powers in the world, which has never been allowed to realize its potential by bureaucratic governments and protectionists. Consequently, Indian goods are today ranked at bottom in competitiveness including industrial efficiencies, human resource management, product-quality, and employee productivity [15]. In such conditions, there is urgent need for implementing JIT practices in India. But, some state governments in India regulate the relationships of firms, lobour, supplier and financial institutions. These relationships have great effect in determining whether JIT can be implemented in India with existing economic structures, culture and social system, attitudes and inclinations.

By implementing the JIT in Indian industries, an enormous saving can be generated and a new productivity ethics can be created that may be helpful to strengthen the Indian economy. In addition, JIT practices can help the Indian industries to become more competitive by enhancing their export in world market. But, it is observed that social, cultural and political matters have a significant impact on JIT practices in different parts of world. In India, suppliers of several raw materials (imported and domestic) are subjected under government control through supply agencies, which translates into high uncertainty. Government control prices of key resources and taxation rates; all creates obstructions in way of implementing the JIT [16]. Some reasons for slow implementation of JIT are listed in Table 3. In addition, Indian labour is usually uneducated, lacking in motivation and more concerned with monetary benefits and job security than carrier progress and development of their potential. Labour unions and their reluctances are also unfavorable for implementing the JIT. Therefore, specific cultural changes are required for successfully implementing the JIT. Training can play a decisive role in this direction. On this issue, some researchers [11] stated that Japanese training models are not very successful in India. Therefore, some specific time bound training programs should be organized for Indian workforce after carefully studying their behaviour patterns, personal traits, attitudes and social values.

Table 3: Reasons for Slow Implementation of Just-in-Time (JIT) in Indian Context.

1. High cost of implementation [10,19,27,28]
2. Informal and casual quality auditing [10,27]
3. Lack of Communication at various levels [15,24]
4. Lack of customer awareness about product quality [15,27]
5. Lack of support from R & D department [28]
6. Lack of teamwork [11,23,27]
7. Lack of top management participation in QC Programs [15,22,28]
8. Lack of training [11,13,24]
9. Lack of understanding about JIT Techniques [11,19]
10. Negative attitude, traits & beliefs of Indian work force [28]
11. Poor and inadequate maintenance [11,27]
12. Shortage of multifunctional workers [2,11,27,28]
13. Traditional methods of quality control [22,27]

8. Conclusions

JIT Based Quality Management makes outstanding improvements in area of cost and quality through best use of human resources by focusing on simplicity, waste elimination and continuous improvement. It could be a great opportunity for Indian industries due to its relatively low investment needs and compatibility to small business environment. This approach utilizes the full capacity of workers and enables them to systematically analyze the hidden causes of quality problems by making small consistent changes in organizational arrangements. It allows the workers to become participant in decision-making by putting the trust and responsibility in their hands. Several Indian industries are implementing the JIT with belief that it would be helpful to face the global competition. Yet, it effectiveness would depend upon qualities, attitudes and values of Indian work force. In the end, it is hope that

Indian industries would initiate the necessary changes in their existing production system for adopting the JIT Based Quality Management to gain maximum benefits.

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Dr. Vikas Kumar received B.E. degree in Mechanical Engineering from Amravati University, Amravati (Maharashtra) in 1997. He did his M.Tech. and Ph.D. degree in Mechanical Engineering from National Institute of Technology Kurukshetra (Haryana). He is current working as Assistant Professor at YMCA University of science and Technology Faridabad (Haryana). His areas of interest are Quality management, Just-in-Time and production management.