Abstract
With the development of faster means of communication, better quality computers and rapid transportation systems, manufacturing is no longer restricted at local level, but has become global in character. As a manufacturing company has to become competitive for its survival, it has to supply products of consistent high quality at reliable and reduced delivery time. Market also demands more product variants that means reduced lot size and high flexibility in operations. Manpower cost has also risen. All these factors tend to increase the product cost. But the industry has to maintain the cost at a reasonable level. Confronting these challenges, companies worldwide are forced to find ways to reduce costs, improve quality, and meet the ever-changing needs of their customers. One successful solution has been the adoption of Just-in-time (JIT) manufacturing strategy in which many functional areas of a company such as manufacturing, engineering, marketing, and purchasing etc. are involved. This paper first reviews literature on JIT and then literature on JIT in developing countries like India and identifies some research issues.

Keywords
JIT, Manufacturing, Quality, Cost

I. Introduction
JIT may be described as an extension of the original concept of managing the material flow in a factory to reduce the inventory levels. In fact, there is much more involved in a manufacturing organization than reducing inventories to control costs. Manufacturing has to deal with other issues, such as process control, level of automation, flexible manufacturing, machine set up times, direct labor productivity, Overhead, supplier management, engineering support, and the quality of product delivered to customers. A modern manufacturing Organization has to deal efficiently with these issues in order to operate a smooth, productive, and quality minded department.

II. Literature Review
There is reasonable consensus among researchers that Just in Time (JIT) is a philosophy of continuous improvement in which non-value adding activities are identified and removed in order to reduce costs, improve product quality, improve performance, improve delivery, add manufacturing flexibility and stimulate innovation in the workplace [6,15,28-32,55]. Numerous organizations have reported cost cutting and improved quality due to JIT practices [12]. JIT was a technology that permitted many firms to compete successfully in the face of growing competition [37, 65]. Wallace [64] defined JIT as an approach to achieving excellence in a manufacturing company based on continuing elimination of waste and consistent improvement in productivity. Continuous monitoring of production processes with the goal of eliminating all forms of waste is a key point in understanding JIT [47, 64]. American Production and Inventory Control Society (APICS) defined JIT as a philosophy of manufacturing based on a management plan that identifies and then eliminates all waste and emphasizes continuous improvement in plant productivity.

Advocates of JIT view inventory as a waste and a source of all evil because inventory build-ups tend to hide production problems rather than solve them [18, 23, 46, 46]. JIT provides authorization for single parts that arrive just in time to be consumed, resulting in stockless production and significant cost savings [47, 52]. Research has shown that JIT organizational philosophy has the potential to increase organizational efficiency and effectiveness [2, 4,8,12, 35, 40, 50, 58, 61]. On the other hand, if JIT is not properly implemented, desirable benefits are not realized [48, 66]. In theory, it is easy to understand the concepts of JIT in terms of eliminating waste and improving productivity. But, in reality, the concepts are difficult to implement because of the need for fundamental organizational changes.

Operationally, JIT production requires that waste be identified and eliminated in the following areas: waste from overproduction, waste created by waiting or idle time, waste of motion, transportation waste, inventory waste, processing waste and waste from product defects [11, 33]. The essentials required for a successful JIT production facility are, first, the minimization of inventory in supply chains. Efficiencies are gained from frequent deliveries of small quantities to meet immediate demand [1, 5]. Second is the application of Kanban-a ‘pull’ system of production and materials control [43, 44,55], and, third there must be an employee participation and involvement strategy in place to encourage worker input, which aids in the elimination of waste [1,24]. In addition, the immediate awareness of quality causes workers to generate ideas for controlling defects and ideas for improving JIT delivery (i.e. more convenient workspaces). Perhaps more importantly, workers hold the authority to stop the line when problems are identified, and so it is critical for the success of JIT to train and motivate the workforce [53-54, 59].

When JIT principles are implemented successfully across many parts of an organization, a significant competitive advantage can be enjoyed. Enhanced efficiency from waste reductions in order taking, purchasing, operations, distribution, sales and accounting, [9, 22, 25, 41]. Some other benefits of JIT as cited in the literature:

1. Elimination of waste in production and materials [34, 58]
2. Improving communication internally (within organization) and externally (between the organization and its customers and vendors) [35].
3. Reducing purchasing costs which is a major cost to most organizations [3, 21].
4. Reducing lead-time, decreasing throughput time, improving production quality, increasing productivity and enhancing customer responsiveness [4,13,14,34,65]
5. Foster organizational discipline and managerial involvement [18]
6. Integration of the different functional areas in the organization. It especially bridges the gap between production and accounting [36, 46].

The JIT benefits do not just happen. Before an organization enjoys the fruits of JIT, it must accept JIT as an organizational philosophy. This requires the organization to change or modify its operating procedures, production system and organizational
culture. Plant layouts have to be adjusted, relationships with suppliers and customers have to be modified, quality circles have to be installed and accurate demand forecasts has to be achieved [7, 14, 34, 57, 61]

Researchers have documented some factors that break or make the implementation process of JIT. Top management involvement and proper employee training are essential factors for successful implementation of JIT [42, 48, 62]. The importance of the presence of a logistical planning system was noted by Vickery [60], Prasad [48], and Lee [40]. Zhu et al. [66] educated advocacy and training administrative as well as production workers to facilitate the success of JIT. Francis [18] stressed the importance of accurate data, especially demand forecasts, for JIT to operate smoothly. Hobbs [34], Lee [40], Minahan [42], Romero [51], and Wafa et al. [63] stressed the significance of strong working relationships with vendors.

Gunasekaran & Lyu [27] analyzed the case of JIT implementation in a small company in Taiwan that produces different kinds of automobile lamps such as rear combination lamps and front turn signal lamps. Continuous improvement, involvement of all people in the organization, reductions in throughput time and elimination of non-value adding activities and simplification of essential activities were the elements of JIT on which the company placed emphasis. The company proved that with JIT system, the company could survive with lower manufacturing costs and higher quality. Education of workers about JIT concepts and top management commitment were proved essential to ensure the effectiveness and success of implementing JIT.

Deshpande and Golhar [16] examined human resource practices of JIT firms in Canada through an empirical study. Worker flexibility; ability to work in groups, self-inspection and a concern for a firm’s success were some extremely important characteristics of some of JIT firms. Without these workforce qualities, continuous improvement in the workplace will be difficult. Recruitment practices indicated that the JIT firms preferred to recruit from within organization. There was a strong commitment of the JIT firms in upgrading employee skills and, therefore, the number of training programs and training budget had increased significantly. There was also a significant increase in group incentive programs, teamwork and communication within the organization. JIT firms also made concerted efforts towards employee retention by providing better work environment. The firms that had adopted JIT were benefitting from its implementation. Productivity, product quality increased significantly with a significant decrease in the overall inventory, lead time to meet customer demand, and the labor cost/unit. These benefits further helped the JIT firms in successfully competing in the global environment. Resistance to change, production scheduling, and union resistance were the most often cited problems by firms during JIT implementation managers.

Chang and Lee [10] presented the results of an empirical study to see the impact of critical success factors of JIT implementation on organizational performance. Based on literature review, some variables selected to measure organizational performance included inventory turnover, work-in-process inventory turnover, quality, flexibility etc. were the dependent variables. Factors required for successful JIT implementation served as independent variables and were identified from review of relevant literature. Finally, five independent variables were selected for multiple regression. Multiple regression models based on dependent variables and independent variables were employed to find the most significant factors among JIT requirements. Communication between the production and marketing departments was determined to be a critical success factor for increasing inventory turnover in JIT firms. Employees’ participation and bottom-up management were identified as the critical factors for improving quality and flexibility. Contrary to previous studies, however, a negative correlation between integration of MRP and JIT, sales in dollar per employee and inventory turnover was identified, and top management support was not determined as a critical factor for successful JIT implementation. The results of this study further suggested that in JIT environment, personnel management practices, such as bottom-up management encouraging employees’ participation, and organization management, such as a communications linking the production and marketing departments should be enhanced.

The next section reviews the literature related to JIT in developing countries like India. Goonatilake [26] and Ebrahimpour and Schonberger [17] have exposed the problems of developing countries on the basis of their studies of manufacturing firms, in developing countries. The problems include underutilization of capacity, low productivity, unreliable and long lead times, shortage of raw materials and parts, inferior quality, lack of technology transfer and management etc. Some other problems identified by researchers [17, 26, 49] in context of developing countries (including India) include inferior quality, little workers’ motivation, exact quantity on exact time, and unreliable transportation system etc. Since most manufacturers enjoy a certain degree of monopoly status, they are more concerned about maintaining efficiency rather than reducing cost (two main inventory control objectives), which is just reverse the case of developed countries, where maintaining efficiency is automatically achieved due to better infrastructure and practices. Ebrahimpour and Schonberger [17] have also suggested JIT and TQC (total quality control) to solve such problems of developing countries.

Singhvi [56] has described Eicher experience in implementing JIT. Significant improvements were observed in throughput time reduction, reduction in space, WIP inventory reduction, material handling, and quality levels. Large investments were not found to be essential, but it is impossible to implement JIT without employee involvement, mutual trust, and unrelenting focus on quality. Supplier is found to be an essential part of the business and there is nothing so difficult about Japanese approach, which cannot be applied in India.

Garg et al. [20] have found ‘work culture’ a critical element if a company wants to implement JIT. Adopting JIT culture in India is not an impossible task. According to them, dimensions of work culture in JIT include multifunctional workers, long term employment, motivation and trust, top management attitude and commitment, support from union leaders, effective communication, poka yoke inspection method, and incentive scheme. It is felt that JIT could be a great opportunity for India in the context of recent reforms in economy and trade towards opening of economy and globalization. Some benefits attained in quantified form were also presented when some elements (quality circles, suggestion schemes, kaizen etc.) were applied in an Indian automobile company.

Garg et al. [19] examined critically JIT purchasing in Indian context. An analysis of a questionnaire supplied to various industries is carried out with the help of statistical tests. A test of significance (t-test) was applied for the importance of JIT attributes, problems in implementing JIT attributes, and expected percentage benefits of JIT purchasing implementation. There was an indication that Indian industries were giving importance to JIT attributes, facing some
problems in implementing JIT, and expecting an overall benefit on an average 59.8% if JIT purchasing is fully implemented. Tests confirmed that the scope of JIT implementation in India was fair and it was independent of the type of industries, layout, and number of employees. Small industries were more optimistic than large and medium scale industries about JIT implementation. Kumar and Garg [38] took a closer look on JIT implementation problems and benefits in Indian context. A survey of Indian industries was conducted to identify those JIT elements which are highly difficult to implement, those which are easy to implement in Indian context and to identify the most expected JIT benefits in Indian context. It was found perfect JIT implementation may not be feasible in most Indian industries due to lack of resources, lack of technology, non availability of multifunctional workers etc. However, some elements such as continuous improvement, layout improvement, quality circles, small lot size etc. are easy to implement as reported by Indian industries. Therefore maximum weightage must be given to these elements to reap maximum benefits. The elements which found to be difficult to implement included zero defects, automation and automation, JIT purchasing, kanban system, set up time reduction etc. Reduced work in process, reduced purchase lot size reduced production lead time, improved competitive position etc. were found some of the high ranked expected benefits as a result of JIT implementation. Prem Vrat et al. [49] have identified problems in JIT implementation in Indian context. These included poor quality of incoming material, non-receipt of delivery by buyer of exact quantity on exact time, little workers’ motivation, unreliable transportation system etc. The Delphi study carried out by Prem Vart et al. [49] indicated the JIT index to be 23.38 on a 40 point (0-40) scale, implying that though quite difficult, JIT implementation in India is possible. It may take 10-20 years for JIT to be fully implemented in Indian industries. It further stated that in order to become competitive, the Indian industry can’t ignore the idea of JIT. The study also indicated that attention must be focused on poka yoke inspection methods, reduced setup times, 100 % quality of incoming material, kanban system, delivery by the vendor of exact quantity on exact time to achieve the results. Worker motivation and literacy need to be increased.

Kolay’s [39] approach to assess a vendor on an overall performance index was certainly useful in the area of supplier management in Indian context. Kumar et al. [38] reported that several Indian industries were implementing basic principles of just-in-time (JIT) in a fragmentary framework of Total Quality Management (TQM) with the belief that it would be helpful in facing global competition. The present status of JIT/TQM quality techniques in India had been analyzed through a survey of 46 Indian industries. The survey indicated that techniques such as quality circle, total preventive maintenance, cause and effect diagram, kaizen, JIT purchasing etc. require more attention since their implementation may be helpful to improve present position of Indian industries in the areas of quality, cost and flexibility.

III. Concluding Remarks and Directions for Future Research

Just-in-Time concept has changed the way manufacturing organizations do things. Some of the JIT concepts are completely opposite to traditional ways of thinking. It is human nature to resist change, and the implementation of JIT system is typical of this. People resist these new ideas and call them risky. But it is important to realize that JIT will not work if it has to be forced against everybody’s will. Voluntary participation and training is necessary. Being a philosophy, JIT does not restrict itself to high technology manufacturing environments which make extensive use modern technologies like flexible manufacturing systems (FMS) or computer integrated manufacturing (CIM). JIT philosophy is valid in any manufacturing environments, regardless of the level of automation in the technology hardware. Similarly, the philosophy is not limited to any specific type of industry nor does the size of the organization matter. Organizations of different sizes, in a variety of industries, have successfully implemented JIT philosophy. Indeed, some applications [5, 35] have shown that JIT is eminently suited to non-manufacturing situations as well as, such as in service and administrative work situations. It may not be possible to shift from traditional manufacturing system to JIT system at once. To start with companies may try to implement JIT elements that are easy to implement. Some case studies and survey studies must be done in developing countries like India to expand the base of JIT applications in India. As service sector as growing very fast in developing countries like India but poorly managed. JIT can be very useful in improving the performance of service sector. This becomes another area for future research.

References

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