Just-in-time is not just for manufacturing: a service perspective

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Abstract
Confronting the challenges of global competition, companies are focusing more on the needs of customers to improve product quality and customer service. The manufacturing sector has long been aware of the need to reduce waste as a means to reduce costs and improve product quality. Just-in-time (JIT), the formalized process of waste reduction, has achieved a strong foothold in the manufacturing sector. The service sector, however, has not been as quick to recognize the benefits of JIT. Services are much like manufacturing in that both employ processes that add value to the basic inputs used to create the end product. JIT focuses on the process, not the product. It can, therefore, be applied to any process within manufacturing or service operations. This paper provides a framework for applying JIT to processes in the service sector, with the goal of investigating how JIT principles can be implemented in services.

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Introduction

Expanding global competition, emerging new technologies, and improved communications have increased customers' expectations for full satisfaction with products and services they purchase. Consequently, in recent years, many manufacturing and service companies have been challenged to increase their focus on customer satisfaction and quality of products and services. Confronting the challenges of global competition, companies world-wide 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 systems, which involve many functional areas of a company such as manufacturing, engineering, marketing, and purchasing. JIT was developed in Japan in the 1950s and subsequently achieved considerable success at Toyota. JIT can be defined as an operating concept designed to eliminate waste (Chase *et al.*, 1998; Hernandez, 1989; Krajewski and Ritzman, 1999; Schlesinger and Heskett, 1991). Waste is defined as anything other than the minimum amount of equipment, materials, parts, space, and workers' time, which are absolutely essential to add value to the product or service.

The JIT process has been primarily applied to the manufacturing industry. Its obvious and measurable applications for manufacturing make it relatively easy to employ in a manufacturing environment. A more elusive area for application of JIT is the service industry. Yet, the US economy is experiencing a rapidly growing service base. It is estimated that the percentage of personal consumption expenditures for services is near 50 percent. Increased growth and competition in the services industry will mandate that businesses work toward some applications of JIT principles.

When JIT is used in the context of services, the focus is often on the time to deliver the service. Examples of fast delivery are Domino's Pizza, Federal Express and Express Mail, fast-food restaurants, and emergency services through 911 (Stevenson, 1999). Service environments with repetitive operations, with high volumes, and with tangible items such as mail, checks or bills are expected to benefit more from application of JIT principles (Krajewski and Ritzman, 1999).

Services are much like manufacturing, in that both employ processes that add value to the basic inputs used to create the final product. JIT focuses on the process, not the product. It can therefore, be applied to any group of processes, whether manufacturing or service. The philosophy behind JIT is to continuously seek ways to make processes more efficient. The ultimate goal of JIT is to produce a good or a service without waste. This goal is approached by testing each step in a process to determine if it adds value to the product or to the service. If the step does not add value, then, it is examined closely to determine possible alternatives. In this way, each process gradually and continually improves. Thus, one of the key requirements of JIT is the constant and continual testing of processes, whether they are in manufacturing or in services.

The purpose of this paper is to provide a framework for the integration and application of JIT principles in the service sector. The next section will discuss JIT concepts in manufacturing. In section three, issues involved in service operations are presented. The fourth section focuses on the integration and application of JIT in

service operations. Conclusions and areas for further research are provided in the last section.

JIT in manufacturing

Owing to its relatively small geographical area, Japan was forced to find ways to efficiently use its scarce resources. The Japanese have turned these disadvantages into advantages by successfully developing and implementing JIT production systems. They view the manufacturing process as a network of linked work centers where the optimal arrangement enables each worker to finish his or her task and deliver it to the next worker exactly when it is needed. The ultimate goal is to completely eliminate all waiting time so that inventory investment can be minimized, production lead times can be shortened, demand changes can be quickly addressed, and quality problems can be uncovered, and solved.

JIT can be seen as a new way of thinking, planning, and performing with respect to manufacturing. JIT is simplicity, efficiency, and minimum waste (Hernandez, 1989). The basic principle of JIT is to eliminate all forms of waste, defined as anything that does not add value to the product (Burnham, 1987). The first step is to identify activities that are waste-producing. The major areas for different forms of waste that may be present in many departments are (Hernandez, 1989; Stonebraker and Leong, 1994):

1 Waste in the production line.
2 Waste in the materials department.
3 Waste involving suppliers.
4 Waste in design engineering.
5 Waste from waiting.
6 Waste from transportation.
7 Waste from defective parts.

JIT also emphasizes simplifying the manufacturing process in order to quickly detect problems and force immediate solutions (Fitzsimmons and Fitzsimmons, 1994; Hernandez, 1989). Several researchers recognize JIT as a system-wide approach to manufacturing which focuses on the timely delivery of quality products sought by the customer and the elimination of waste (Burnham, 1987; Byard, 1987; Chase *et al.*, 1998; Hernandez, 1989; Krajewski and Ritzman, 1999; Lee, 1990; Schniederjans, 1993). The implementation of a JIT system yields minimum inventories by having each part delivered when it is needed, where it is needed, and in the quantity needed to produce the product. A JIT system enables companies to operate efficiently with the least amount of resources, and thus, improves quality, reduces inventory levels, and provides maximum motivation to solve problems as soon as they occur (Hernandez, 1989; Krajewski and Ritzman, 1999; Lee, 1990; Schniederjans, 1993).

In summary, the objective of JIT can be simply stated as "produce the right item, at the right time, in the right quantities". By achieving this objective, companies work toward the elimination of waste in their manufacturing processes and realize the following benefits (Chase *et al.*, 1998; Hernandez, 1989):

1 Lower raw material, work-in-process, and finished goods inventories.
2 Higher levels of product quality.
3 Increased flexibility and ability to meet customer demands.
4 Lower overall manufacturing costs.
5 Increased employee involvement.

JIT principles, if successfully applied in the service sector, should yield similar benefits to those found in manufacturing. JIT has been applied successfully to job shops, which typically produce a wide variety of custom products in varying amounts (Billesbach and Schniederjans, 1989). If the principles of JIT can be utilized successfully in these diverse environments, it seems reasonable to conclude that these principles can be applied to non-manufacturing activities that are repetitive in nature (Krajewski and Ritzman, 1999).

Service operations

The service industries in developed countries have been continuously increasing relative to manufacturing. In the USA, during the past 15 years, the non-goods-producing sector of the non-agricultural labor force rose 52 percent, versus 38 percent in the goods-producing sector (Murdick *et al.,* 1990). In fact, there is a massive hidden service sector – the components of manufacturing companies involved in internal support functions (maintenance, administration, human resources) and external product and service support (warranty repair, post-sale help, pre-sale consultation).

We are now in the midst of a post-industrial or service economy. This is borne out by the fact that the percentage of gross national product (GNP) attributed to the manufacturing sector has decreased approximately 42 percent since the period 1947 through 1985, while during the same period the GNP in the service sector has risen approximately 21 percent. In 1988, the service sector accounted for approximately 60 percent of the total GNP, the

manufacturing sector for approximately 30 percent, and the government sector for the remainder (Riddle and Brown, 1988). Currently, the service sector accounts for approximately 70 percent of the national income in the USA (Fitzsimmons and Fitzsimmons, 1994). Looking at employment levels, we find that service sector employment has risen by approximately 30 percent since 1982, and now accounts for approximately 78 percent of all jobs, while the manufacturing sector has remained fairly flat (Fitzsimmons and Sullivan, 1982; Fitzsimmons and Fitzsimmons, 1994; Schlesinger and Heskett, 1991) (see Table I).

US companies are becoming better targets for foreign takeovers with the fluctuation of the dollar overseas. Leading service organizations such as TWA, Pan AM, Stouffers Hotels, Saks Fifth Avenue, Spiegel retailers, and 20th Century Fox, have already changed ownership to foreign investors. Additionally, in 1982, the USA was viewed as a world leader in services. In 1986, *The Economist* ranked the USA sixth in worldwide services behind the UK, Spain, France, Switzerland, and Italy, respectively. In March 1987, the *Institutional Investor* had lowered the credit rating of the USA from first to fourth place behind Japan, Switzerland, and Germany (Riddle and Brown, 1988). This threat to the US service sector is real and must not be ignored.

As the underdeveloped countries of the world progress and gradually catch up with the more established nations, conventional wisdom predicts that the advanced nations will lose their competitive advantage. The shift in the developing nations from craft to industrial labor, and from hand to machine work, produces great increases in productivity. The service sector has demonstrated a remarkable capacity to improve productivity in the USA. In services, the greatest productivity gains will come from defining the critical or value-added service activities and eliminating what does not need to be done (Drucker, 1991).

The definitions and descriptions found in the literature for the term "service operations" are somewhat ambiguous (Crosby, 1979; Grönroos, 1983; Juran *et al.*, 1974). It is typically easier to describe service operations by what they are not. For example, Lovelock (1984) defines services as "all those economic activities in which the primary output is neither a product nor a construction". This definition seems straightforward, but is not particularly helpful when one attempts to classify a restaurant, or a company such as IBM, for that matter. IBM manufactures equipment but also provides customer service, education, maintenance, etc. In fact, all organizations can be looked at in terms of the continuum shown in Figure 1, which depicts the service content of the organization (Snyder *et al.*, 1982).

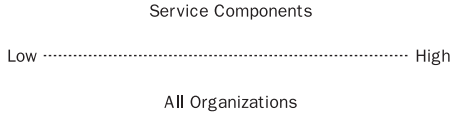
We think about service in humanistic terms; we think about manufacturing in

Table I
Rate of growth of US jobs, January 1982-January 1992

	Non-farm jobs, January 1982 ('000s)	Non-farm jobs, January 1982 %	Non-farm jobs, January 1992 ('000s)	Non-farm jobs, January 1992 %	Growth of non-farm jobs %
Service-producing: Finance, insurance, real estate	5,341	6.0	6,665	6.2	24.8
Miscellaneous services	19,036	21.3	28,577	26.4	50.1
State and local government	13,098	14.6	15,476	14.3	18.2
Wholsesale trade	5,296	5.9	6,010	5.6	13.5
Retail trade	15,161	16.9	19,118	17.7	26.1
Transportation and utilities	5,082	5.7	5,746	5.3	13.1
Federal government	2,739	3.1	2,981	2.8	8.8
Total	65,753	73.5	84,573	78.3	
Goods producing:					
Construction	3,905	4.4	4,587	4.2	17.5
Mining	1,127	1.3	657	0.6	–41.7
Manufacturing	18,781	21.0	18,283	16.9	–2.7
Total	23,813	26.7	23,527	21.7	
Total jobs	89,566		108,100		20.7

Source: Council of Economic Advisors (1992)

Figure 1
The service continuum



technocratic terms. This is why manufacturing industries are considered to be progressive and efficient while service industries are, by comparison, primitive and inefficient. Levitt (1972) argues that service industries must take a manufacturing approach to service activities – one that substitutes "technology and systems for people and serendipity".

Given the unique operational nature of services, an investigation of any management concern should begin with an understanding of the service environment. Chase and Tansik (1983) indicate that the major environmental factor is the length of time a customer spends in the system (the operations viewpoint), whereas Berry *et al.,* (1983) believe the major factors to be the expectations and perceptions that a customer has of a particular service (the marketing viewpoint). Schmenner (1986) states that the major challenge of service systems is to devise delivery systems that meet acceptable service levels based heavily on the degrees of labor intensity, contact, and customization provided for the customer. Fitzsimmons and Sullivan (1982) view the primary environmental factor as how one changes from product-oriented management styles to people-oriented management styles. For services, inputs are the customers themselves. Customers typically arrive at their own discretion, with unique demands on the service system. Resources (i.e. goods, labor, capital) are applied by the service manager to facilitate interaction with the customer.

Differences between services and manufacturing

Any discussion of service systems must look at how they differ from manufacturing systems. A review of the specific characteristics of services and the implications for operations managers follows (Rosen, 1990).

1 *Inseparability of production and consumption*. This involves the simultaneous production and consumption which characterizes many services. Since the customer must be present during the production of many services, inseparability "forces the buyer into intimate contact with the production process" (Carmen and Langeard, 1980). Simultaneous production and consumption also eliminates many opportunities for quality control intervention. Unlike manufacturing, where the product can be inspected before delivery, services must rely on a sequence of measures to ensure the consistency of output. This emphasizes the importance of process control in services even more so than in manufacturing, since services at times do not deal with a physical product to inspect.
2 *Intangibility*. Because services are performances, ideas, or concepts, rather than tangible objects, they often cannot be seen, felt, etc., in the same manner in which goods can be sensed (Zeithaml *et al.,* 1985). When buying a product, the consumer may be able to see, feel, and test its performance before purchase. With services, the consumer must often rely on the reputation of the service firm. These less measurable considerations have the potential to greatly influence consumers' perceptions and expectations of quality.
3 *Perishability*. This refers to the concept that a service cannot be saved or inventoried (Benson, 1986; Thomas, 1978). The inability to store services is a critical feature of most service operations. Vacant hotel rooms, empty airline seats, and unfilled appointment times for a doctor are all examples of opportunity losses. Perishability leads to the problem of synchronizing supply and demand, potentially causing customers to wait or to not be served at all.
4 *Heterogeneity*. Since the same service can be provided by various employees at one or more facilities, the quality of the service can vary from provider to provider, from customer to customer, and from day to day. Attempting to measure the variability of different performance types and offer a consistent service can be difficult.

It is readily apparent from the above discussion that there are many potential differences between manufacturing and service operations.

Until recently, services have been sheltered from competition and have had little incentive to drive out inefficiency. Shielded by regulation and confronted by few foreign competitors, service companies have allowed their white-collar payrolls to become bloated, their investments in information technology to outstrip the paybacks, and their productivity to stagnate. Deregulation and foreign direct investment are introducing

> new players that are challenging the practices and philosophies of individual companies, whole industries, indeed the entire US service sector. Service companies should not make the same mistakes as their manufacturing counterparts did: cutting costs at the expense of securing enduring competitive strength. Overzealous cost-cutting may make the companies more efficient over the short run but unable to motivate, respond to customers, or provide quality services over the long run. The US service sector must re-examine its strategy to meet the imperatives of a new competition ... (Burnham, 1987).

The above discussion expresses the need to improve productivity and quality in service businesses. Many of the JIT techniques used by manufacturing firms can be successfully applied by service organizations (Chase *et al.*, 1998; Schniederjans, 1993). As in manufacturing, the suitability of each technique to the corresponding work process depends on the characteristics of the company's markets, production technology, skill levels, and the corporate culture.

JIT issues in service industries

Service system design is similar to that of manufacturing, which indicates that service industries could benefit from the application of materials requirements planning (MRP) and other inventory control techniques in the same way as have manufacturing operations (Khumawala *et al.*, 1986; Wasco *et al.,* 1991). The majority of JIT research and case studies focus on the manufacturing sector and the technical elements of JIT, and thus, generally exclude the service sector. Manufacturing and service organizations both produce a product, whether that product is a good or a service. The JIT concepts and techniques are equally applicable to both manufacturing and service operations because they are process rather than product oriented. It may even be argued that service organizations have a *better* chance of successful applications of JIT because of the lack of work-in-process and finished goods inventories in pure service environments. In analyzing the differences between services and manufacturing, it would be insightful to explore how JIT themes can support the unique operating characteristics of services, and their usefulness in improving service-sector performance measures. Vonderembse and White (1991) suggest that JIT approaches in the service sector could be implemented in terms of simplifying production processes, reducing inventories of supplies, and focusing on the quality of the service being provided.

Integration of JIT themes and service characteristics

The main themes of JIT consist of:

1. total visibility;
2. synchronization and balance;
3. respect for people;
4. flexibility;
5. continuous improvement;
6. responsibility for the environment;
7. simplicity; and
8. holistic approach (Chase *et al.,* 1998; Stonebraker and Leong, 1994).

These basic themes of JIT have been successfully applied in the manufacturing sector and they can be modified and extended further in application to the service sector. These themes of JIT can be examined within the framework of the differences between manufacturing and service operations outlined earlier.

1. *Inseparability*. The customer's participation in a service delivery process suggests a multifunctional approach that incorporates both marketing and operational concepts. Such a combined approach provides service managers with an improved understanding of business that otherwise could not be obtained through a single functional perspective.
   - *Total visibility*. With the simultaneous offering of marketing and operations functions in services, the customer is very aware of not only the tangible aspects of the service (i.e. the food in a restaurant) but also of the service delivery system (waiting time, atmosphere, wait staff, etc.).
   - *Respect for people.* Forcing the buyer into intimate contact with the production process requires all customer contact personnel to go the extra mile to ensure positive service encounters, lest a negative impression of the service be formed. Improvements in quality and productivity cannot be achieved without support from employees.
   - *Flexibility*. By virtue of the customer being part of the production process, services must be flexible in nature to respond or react to unique requests made on them by the customers.
   - *Continuous improvement.* As in any manufacturing or service business, continuous improvement is critical for continued profitability and success. More emphasis on labor rather than capital may take place in services.
   - *Holistic approach.* JIT is a total organizational approach to improvement, a factor which becomes

even more important in services because of the issue of inseparability.

2 *Intangibility*. The lack of a physical product in most services presents unique applications for JIT themes.
- *Total visibility*. Services provide an intangible output that cannot often be seen or felt. This exposes the service firm in all areas to the customer; the customer is able to see all aspects of the organization through the service delivery process.
- *Synchronization and balance*. Service providers typically have a more difficult time matching supply and demand than a goods producer. Since the service is an act or performance there is a greater reliance on employee scheduling than in the manufacturing sector.
- *Flexibility*. The service organization must by nature be flexible in its offerings. The customers' requests for service can change mid-stream in the service encounter.

3 *Perishability*. The perishability of services can be approached from the customers' or providers' views. From the customers' view, even though they do not have a physical commodity to enjoy, the lingering benefits of the service may last some time (i.e. a motivational seminar). In most cases, from the provider's viewpoint, we assume that most inventories in services are perishable, such as unused seats at a showing of a movie or unfilled reservations at a restaurant.
- *Synchronization and balance.* This is critical for services. Service organizations must be able to successfully balance supply and demand for the service. Otherwise, customers will use a competitor's service.
- *Respect for people*. Owing to the labor-intensive nature of services, and the need for employee scheduling to provide the service, each worker should be allowed to participate in the production/service process. Thus, the workers will get a chance to make suggestions, propose improvements, and receive awards (Monden, 1993).
- *Flexibility*. Without physical inventories to act as a buffer against fluctuations in demand, the service provider must be flexible enough to handle all incoming requests that may deviate from the normal flow of operations.

4 *Heterogeneity*. System performance is an important concept and measure for all organizations. For goods providers, in which there is a product that is homogeneous, the measurement of performance is simplified. For service providers, the "product" is offered by various employees at various facilities and at different times. This lack of homogeneous input/output complicates the measurement of performance in services.
- *Total visibility*. With the service delivery system being the most tangible aspect of some services, performance of the system should improve by removing variability in the delivery of the service. Customers typically notice variance in the system, and this could affect the perceived level of quality.
- *Synchronization and balance.* Machines with different speeds or workers with different qualifications can be allocated properly to maintain synchronized production of the service.
- *Respect for people*. Services are characterized by many interactions between staff and customers, providing numerous moments of truth each day (Albrecht and Zemke, 1985). The key to high quality services is to respect the employees who are in contact with the customers and to listen to their suggestions for improving the process.
- *Flexibility*. At times it is not only the service system that is variable, but also the customer. All customers will have varying needs and criteria to be met at various times. The service system must adjust to these variances through flexibility of staffing, scheduling, etc.
- *Continuous improvement.* Service organizations operate with a wide variety of personnel that may be totally interchangeable at any time. Thus, they must strive to improve all employees and systems throughout the lifetime of the organization.
- *Responsibility for the environment*. The service firm can emphasize environmental awareness by reducing all types of waste from excessive production resources, overproduction, excessive inventory, and unnecessary capital investment (Monden 1993).
- *Holistic approach.* The more each employee knows and understands the company as a whole, the less variance in the service delivery there will be. This can significantly reduce the heterogeneity associated with the service.

- *Simplicity*. To reduce heterogeneity in services, and to move toward offering a homogeneous "product", a service firm should strive toward simplifying processes to allow those who work within the firm to isolate areas of improvement and help themselves to improve.

Areas of greatest potential for improving performance

The following activities would most likely demonstrate the greatest potential for improving performance in services and achieving the successful implementation of the JIT themes stated earlier. These are in accord with those found in Chase *et al*. (1998) and Schneiderjans (1993).

Training of employees

As the expectations of the customers from the service businesses increase, companies have started to value investments in people as much as investments in machines (Schlesinger and Heskett, 1991). The largest portion of service employees includes receptionists, waiters, telephone operators, insurance company claims processors, flight attendants, sales clerks, and others with low pay and little input in their companies. Companies need to make recruitment and training as important for service employees as for managers. Service employees who are well trained and fairly compensated provide better service, need less supervision, and are much more likely to stay on the job. Consequently, customers who are in contact with well-trained service employees are likely to be more satisfied, return more often, and perhaps even purchase more than they otherwise would (Schlesinger and Heskett, 1991). Training provides service employees the ability to identify and resolve problems and operational weaknesses hindering organizational effectiveness and efficiency (Billesbach and Schniederjans, 1989). Training service employees to perform a variety of service activities will also provide an organization with a great deal of flexibility.

Proper training and empowerment will allow these workers to resolve any perceived conflicts before they become a negative service encounter for the customer. Hotel desk clerks or airline counter employees, for example, should have the training and authority to make a decision whether a customer should be given some form of restitution to ensure a positive service interaction.

Technology

Over the past decade, the service sector has created nearly 20 million new jobs, which is more than the jobs lost in manufacturing. In the 1970s, the service sector accounted for 55 percent of all jobs in the private economy; in the 1990s, it accounts for 75 percent (Chase *et al.,* 1998; Krajewski and Ritzman, 1999; Murdick *et al.*, 1990; Roach, 1991). It is important to address the problems and opportunities in the service sector since the USA has become more dependent on services. Roach (1991) asserts that "the massive investments in technology have not improved productivity; they have made service organizations less profitable and less prepared to compete on other fronts". Roach also points out that US service companies are spending more than $100 billion annually for the new technologies. The advances in technology should be used to support the activities of the service employees, not to monitor or replace them.

Because customers participate directly in some service processes, the success of technological innovations will depend to some extent on customer acceptance. To enhance productivity of various services, the customer is able to interact directly with the system without the intervention of an employee. ATMs at banks and credit card readers at gas pumps are two such examples.

Service organizations must ensure that a customer's mistake does not turn into a defect. The ability to failsafe a service will be highly dependent on the ability to generate timely information concerning a customer's service encounter. With the advent of ATM machines, for example, numerous errors could occur because of customer mistakes or lack of operating knowledge. Advanced information and control systems will ensure that a minor transaction error will not result in a major flaw.

Layout

Another applicable JIT technique involves re-layout and merger of operations. Service employees whose tasks are interrelated should be physically close together, which facilitates better information flows and reduces throughput time. Layout changes should be allowed in order to improve operations. Service companies must strive to remove communication barriers and facilitate effective communication by proper layouts. If physical proximity cannot be achieved, then effective communication means must be developed.

Bottlenecks during service delivery can be devastating to the quality and success of a service firm. If one were to relate this to most US State Department of Motor Vehicles offices (a standardized service), it is evident that layout is critical to the timely delivery of services. At the opposite extreme, most fast-

food restaurants (another standardized service) have reduced bottlenecks to a minimum and increased throughput by efficient layout designs.

Quality

One of the basic requirements for successful implementation of JIT is the existence of total quality management (TQM) principles. One simple way to achieve quality in services is the establishment of processing consistency. Employees must perform their tasks correctly the first time, which requires adequate education of employees as to the proper way to perform their tasks. The use of the "quality circle" concept can be helpful in service companies. The employees' ideas for improving the quality of the services and increasing the satisfaction of customers should be carefully analyzed and implemented. In order to improve the quality of the services being provided, the existence of a mechanism to identify the individuals who are responsible for the performance of the different tasks enables the individuals to perform their tasks properly. Another benefit of this mechanism would be the identification of quality-related problems and solutions for these problems.

As previously discussed, the use of failsafing techniques will help ensure that a defect in the offering of a service does not harm the consumers' overall impression of quality. The idea of failsafing manufacturing systems, as originally promoted by Shingo (1986), can be applied to service situations with great success (Chase and Stewart, 1993).

Standardization

The emphasis on the standardization of activities arises from balancing between processes, which is expected to improve operational effectiveness and efficiency. By standardizing job activities, resources can be focused on only a few areas. The resulting impact on productivity can be significantly higher if one standardizes activities and concentrates organizational efforts and resources on those limited activities. Standardization of activities also reduces the time and cost of cross-training workers, but the "flexibility" theme has to be maintained in order to serve those customers with different needs.

H. & R. Block, the largest tax preparer in the USA, is the epitome of simplified procedures and paperwork reduction. H. & R. Block has reduced the confusing and, at times, frustrating activity of tax preparation to a few simple questions by the use of a preformatted, standardized set of forms.

Service delivery

One of the desired outcomes of JIT is reduced lead time for delivering the product or the service. The effort for lead time reduction begins with order entry and setting due dates. Simplifying the procedures for any other paperwork relating to this transaction will help in considerably reducing the order processing time. A major insurance company benefitted from JIT by reducing the average time spent for each claim (Lee, 1990).

Examples of JIT applications in the service sector

Increasing productivity and quality in the service sector are the two main issues to be addressed if the US service sector is to remain competitive. JIT concepts can provide some helpful insights into these issues. In order to compete successfully by providing better services at lower costs, some service companies have undertaken aggressive productivity improvement projects which included the application of JIT to service functions. For example, Hewlett-Packard's direct marketing division's implementation of JIT resulted in reduction of overdue receivables and the lead time in its shipment operations (Lee, 1990). Application of JIT principles at West Coast Finance Company reduced the time for the credit approval process (Lee, 1990). JIT and MRP II at Eastman Kodak improved customer service and resulted in cost savings (Wasco *et al.*, 1991). Inman and Mehra (1991) and Mehra and Inman (1990) describe the benefits resulting from the application of JIT concepts at a large corporation providing telecommunication services, a government contractor to the Department of Energy, and an overnight package delivery service company. Wieters (1984) claims that service companies such as hospitals, education facilities, finance services, communications services, advertising agencies, and transportation services, can benefit from JIT through inventory cost savings. These examples show that the application of JIT in service companies can improve overall operations.

Conclusions and future directions

The basic philosophy behind JIT in manufacturing and service operations represents a uniquely organized set of activities which can be utilized to produce low cost and high quality products and services. The discussion presented in this paper highlights the importance of the service sector to developed and developing economies. Global competition is forcing companies to improve the quality of their products and their customer service while reducing the cost of their operations. This is a

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critical requirement for maintaining competitiveness. It is postulated that the implementation of JIT concepts in the service sector will facilitate the achievement of benefits long realized by the manufacturing sector. A comparison of manufacturing and service operations was conducted in an attempt to show the transferability and applicability of these concepts to the service sector. The activities that would most likely show the greatest potential for the improvement of services through the use of JIT concepts were analyzed and discussed. The philosophy of JIT can bring impressive advances in productivity and quality to the increasingly service-dominated economies of the future (Levitt, 1976).

JIT as a strategic weapon for process improvement has been subjected to numerous studies in the literature. Transferring this body of knowledge in the manufacturing sector to service industries requires further research in various areas. One of these is an analysis of how the philosophy of JIT relates to services where the factors under consideration are customer contact/interaction, labor intensity, and customization, as outlined by Haywood-Farmer (1988). Each of these factors is present in all services at various levels. Research has shown that advances in productivity and efficiency in services are directly related to the design of the service system (Rosen, 1990). Further research needs to explore the applicability of JIT in services that offer a tangible output as opposed to those services whose primary output is an act or performance (i.e. consulting services).

Other research avenues could entail the investigation of the supplier's role in the implementation of JIT concepts in services. Can we assume that the supplier's role in services will be the same as in a manufacturing environment, or will there be a different set of roles to analyze? Finally, the problems of measuring service quality and productivity need to be addressed. The problems may be caused by the measurement technique in use and not by the process employed. This is an important area for future research. The service industry will not be able to document any true gains in productivity and quality without a valid measurement methodology.

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