JIT in services: a review of current practices and future directions for research

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Introduction
Just-in-time (JIT), as an operational philosophy, has been of great interest to manufacturers and researchers alike over the past decade. Toyota Motor Company is credited with developing and operating the approach. During the early 1970s, the application of this philosophy strengthened their competitiveness in the automobile industry. Other Japanese companies adopted the policy and US firms found they had lost much of their edge in manufacturing. The 1980s was catch-up time for western manufacturers. They looked closer at importing the just-in-time philosophy and researchers studied both eastern and western implementations.

The literature contains a variety of definitions for the term “just-in-time”. These range from Schonberger’s (1982) “[to] produce and deliver finished goods just in time to be sold, sub-assemblies just in time to be assembled into finished goods, and purchased materials just in time to be transformed into fabricated parts”, to Hall’s (1983) “the elimination of waste in all areas of the manufacturing firm”. The American Production and Inventory Control Society defines JIT as:

A philosophy of manufacturing excellence based on pursuit of the planned elimination of all waste and consistent improvement of productivity. It encompasses the successful execution of all manufacturing activities required to produce a final product from design engineering to delivery and including all stages from conversion of raw material onward (APICS, 1992).

The most common element in all the JIT definitions is the description of JIT as a philosophy for manufacturing operations. Simply removing the word “manufacturing” from the APICS definition opens new possibilities for applying the techniques commonly associated with JIT to both service functions in manufacturing firms and service sector firms. Research-oriented
journals have been slow to consider moving JIT from the factory floor to non-manufacturing environments.

McClachlin (1990) examines the service aspects inherent in JIT operations. He argues that:

- the inherent service aspects of JIT operations have much in common with the operations of service firms. Consequently, JIT firms will respond to operational problems in ways characteristic of service firms.

Droy (1986) noted that highly successful practitioners of JIT look beyond the manufacturing function of the firm for applications of the JIT methodology. JIT is applied to the total business in these firms. Droy proposed that improving the manufacturing firm's information flow alone through application of JIT techniques can decrease a ten to 12 week lead time to two weeks.

Chase and Aquilano (1992) further simplify the definition of JIT as essentially a process-oriented waste-elimination philosophy. Because both service firms and manufacturing firms employ processes to create an end product or service, JIT techniques should be applicable to both environments. The JIT concepts adopted by many manufacturing organizations are process-oriented and can be summarized, following Benson (1986), as:

- total visibility - of equipment, people, material and processes;
- synchronization and balance - of production to sales and supply to production;
- respect for people - line operators are responsible for production, problem solving and improvement;
- flexibility - adapt production to customer needs;
- continuous improvement - never satisfied with the process;
- responsibility for the operation's environment - those who design, manage and operate the processes are responsible for the outcome;
- holistic approach - company-wide philosophy of elimination of waste.

Each of these JIT themes may be applicable to service organizations. Benson (1986) argues that, in fact, service operations are "organized systems of production processes" with the same potential for improvement through implementation of JIT precepts as manufacturing operations. Distinct differences do however exist.

First, manufacturing firms produce "an object, a device, a thing" (Berry, 1980), while a service firm produces "a deed, a performance, or an effort". The service is basically intangible. Second, customers are often, but not always, involved in the production of a service, as can be seen in hotels, air transportation and universities. This involvement puts the customer in contact with the personnel providing the service and with other customers receiving the service. Third, because the service is provided as needed by the customer, the quality of the service cannot be checked prior to its delivery, as it can with a
manufactured good. However, customers often have expectations as to what the service should consist of, influencing their perception of delivery quality. Fourth, services cannot be inventoried. This fact, combined with the consideration that the customer is often part of the service process, increases the importance of timely delivery. There are limits to how long a customer is willing to wait for the service, especially if alternatives are available. These differences, however, may increase the importance of applying JIT techniques in service sector firms. (For a more thorough discussion of these differences, see Albrecht and Zemke, 1985.)

Differences exist not only between manufacturing and service operations, but between various service operations as well. Silvestro et al. (1993) proposed a framework for classifying service processes. Three service processes were proposed: professional, service shop and mass. These three types are characterized in terms of six different dimensions. As the number of customers processed by the service increases, the focus changes for each of the six dimensions. These six dimensions were defined as follows:

1. Equipment/people focus: the core element in the service delivery is provided primarily by equipment or people;
2. Customer contact time per transaction: the amount of time the customer is involved in the transaction;
3. Degree of customization: the amount of customization available or required in the delivery of the service to the customer;
4. Degree of discretion: the amount of discretion available to the person delivering the service to alter the service package or process;
5. Location of value added processes: the proportion of customer contact staff (frontline staff) to the total staff requirements;
6. Product/process focus: the degree of emphasis on “what” is purchased versus “how” it is provided.

In each of these dimensions, the value and appropriateness of JIT techniques may be different.

The use of JIT in services

A review of the major academic research journals found most articles focused on JIT in manufacturing firms. Non-manufacturing environments have been given little emphasis in the research literature. However, a review of recent applied journals revealed articles describing JIT precepts migrating to non-manufacturing environments. These non-manufacturing environments include typical service businesses such as insurance firms, retailers and mail-order firms.

In addition, articles highlighting implementation of JIT in the internal service components associated with a manufacturing firm, such as order entry and invoicing, were available. These articles reveal JIT techniques successfully
moving from the factory floor to the office environment. We have summarized these current applications of JIT techniques in services using a slightly modified form of Benson's (1986) guidelines for applying JIT in service:

- synchronization and balance of information and work flow;
- total visibility of all components of the process;
- continuous improvement of the process;
- holistic approach to elimination of waste;
- flexibility in the use of resources;
- respect for people.

Further, in each of these sections many of the differences between service and manufacturing operations are noted. JIT applications discussed in the literature are briefly summarized under one of these categories. In many cases, an article provided examples for several of the categories because of the wide variety of JIT techniques discussed.

This summary is not intended to provide a complete list of all articles in applied journals where JIT is discussed. Instead, it highlights current applications of JIT in either service sector firms or service operations and through these examples builds a case for further research of JIT in service industries.

Synchronization and balance of information and work flow
While synchronization – matching output with customer demand – is important in manufacturing to help minimize inventory levels, it is more important for services. Output from the service firm must match customer demand as, frequently, the customer is directly involved in the process, waiting for the results, and may have other alternatives available. For many companies, this emphasis on timing may be the competitive weapon for keeping and increasing their presence in their chosen market (Stalk, 1988). JIT also emphasizes balance at every process stage to avoid excess inventory and resource use. Service operations often cannot inventory the output of their processes making balance even more vital. Further, as in manufacturing, resources required to produce the service can be costly. For example, airlines must balance the size of the aeroplane with passenger demand. An unfilled seat is a lost seat: it cannot be saved for later use, yet the cost of providing the service is virtually the same whether the seat is filled or not.

Feather and Cross (1988) reported the implementation of a “product” versus “process” orientation for processing paperwork associated with managing contracts. To improve the work flow, JIT and optimized production technology techniques were applied to this non-manufacturing environment. One-at-a-time processing of contracts was implemented. Bottleneck operations were studied, work flow balanced with regard to bottlenecks and unnecessary buffers eliminated. The results of this implementation included not only a 60 per cent
reduction in throughput time (the time between entry of a contract into the system and its exit), but also an 80 per cent reduction in the number of backlogged contracts.

Semantodontics, a direct marketing company selling nationwide by catalogue to dentists, also found JIT an appropriate approach for reducing the time to process paperwork (Conant, 1988) and, hence, the time required for a dentist to receive an order. The idea of making lot sizes as small as possible was implemented by decreasing the batch size in which telephone orders were aggregated. As a result, telephone orders were moved to the second stage of the process three times daily rather than once a day, as was the previous norm. Set-up time for entering new customer records was reduced by moving the process to the original telephone operation where the data were first gathered. The decrease in order batch size had a behavioural impact on employees as well. From the sense of satisfaction gained on completion of multiple small batches, employees tended to work faster and more efficiently.

One JIT technique which has been investigated for use in service companies is kanban-controlled movement. Kanban in manufacturing is a simple method of notifying preceding work centres that material is required downstream. Buffers of material between workstations are eliminated. Schonberger (1993) describes the benefits of using kanban for document processing. Atlantic Envelope Company uses kanban trays at its Atlanta facility to move documents within the order entry department. Order entry time fell to under a day from a previous uncertain number of days.

Total visibility of all components of the process

JIT emphasizes that all components of the processes employed to produce a good or service should be visible to those participating in the process. This allows process participants an opportunity to learn, inspect and improve those processes. Because customers are often part of the service process, they may define the value and quality of the service by what they see in the process.

Northern Telecom Inc.'s (NTI) Customer Service Center borders the traditional manufacturing environment (Savage-Moore, 1988) and the implementation is a good example of providing visibility through the use of work cells. This unit of NTI has the labour-intensive responsibility of repairing printed circuit packs (PCPs). For an individual PCP, it is difficult to predefined the specific repair process required, not unlike a job shop environment. The work cell concept was applied to keep all work on a PCP performed within a single cell and by one team of employees. This provided all employees repairing a PCP with visibility as to the repair needs and processes used to repair the product. Additionally, employees were cross-trained to staff the cells and jobs were redefined to recognize employee training efforts. Over a two-year period, NTI saw customer service levels increase from 85 per cent to 100 per cent and quality levels significantly improved. Work-in-progress inventory was reduced by 75 per cent and repair cycle times reduced from one week to less than 48 hours.
Harvey (1989) proposed a set of untested recommendations for the implementation of JIT techniques to increase the efficiency of the health and human services settings. He emphasizes improving the processes (work flow) required to meet client needs. Again, applications of group technology and the cellular manufacturing approach are used to improve the efficiency of meeting client needs as clients are “processed” through the system. This is an example of high customer involvement during service delivery.

Continuous improvement of the process

As part of JIT implementation, organizations must instil the habit of expecting continuous small improvements in the process. The operators must never be satisfied with the current environment, but always be moving closer to the ideal situation. Service operations are ripe for significant productivity gains that can be achieved through process improvements. However, recognizing processes that can be improved through the implementation of JIT techniques has been difficult.

While improving the speed and efficiency of administrative processes has remained an enigma for many organizations, Billesbach and Schniederjans (1989) provided an example of the use of JIT in administrative processes. They compared the target areas for wasteful activities in manufacturing with the corresponding processes in administration settings (see Table I). This Table illustrates an initial effort towards identifying the potential areas for implementation of JIT techniques in non-manufacturing environments, especially with regard to workflow.

Billesbach and Schniederjans (1989) were specific about the techniques used in JIT programmes that should be considered transferable to the administrative system. These techniques include under-capacity scheduling, re-layout or merger of operations, quality control through processing consistency, education of employees involved, the use of multifunctional workers, worker-centred quality control, stressing an operation and cellular organization.

Through a case study of a finance company, Lee (1990) emphasized improving work flow in an administrative setting with a focus on value-added elements and continuous improvement. Through these JIT techniques, the

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<th>Manufacturing setting</th>
<th>Administrative setting</th>
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Source: Billesbach and Schniederjans (1989)
The Manufacturing Quality Assurance Organization at Kodak in Rochester, New York provides specialized services in the form of sample testing of photographic film, chemical and environmental testing, equipment development and calibration control. JIT precepts were introduced to provide a framework for involving the entire organization in continuous improvement (Wasco et al., 1991). Fifty JIT cells were established to start the JIT delivery of products or services based on functional precepts. JIT activities were used to reduce work-handling steps and run times. Improvements through JIT techniques saved an average of $33,000 per month in 1990.

Holistic approach to elimination of waste
The JIT philosophy must be adopted throughout all levels and in all functions of the organization. Chase (1991) provides an excellent argument for and examples of the need to consider the service aspects of the manufacturing firm as potential areas for competitive advantage. He argues further that service innovations typically cut across departmental boundaries and cross-functional support is required for a successful implementation. From a non-manufacturing perspective, inventory and purchasing are the most obvious areas for implementing JIT techniques because of the common vocabulary, of which many examples can be found. According to Schonberger and Gilbert (1983), “the just-in-time concept as applied to purchasing translates into frequent releases and deliveries”. They developed a list of characteristics describing a JIT purchasing environment. As can be seen from the items listed below, these characteristics could be descriptive of almost any purchasing operation, be it in a manufacturing or service environment:

1. **Suppliers:**
   - few suppliers;
   - nearby suppliers;
   - repeat business with same suppliers;
   - active use of analysis to enable desirable suppliers to become/stay price-competitive;
   - clusters of remote suppliers, competitive bidding mostly limited to new part numbers;
   - buyer plant resists vertical integration and subsequent wipeout of supplier business;
   - suppliers are encouraged to extend JIT buying to their suppliers;

2. **Quantities:**
   - steady output rate (a desirable prerequisite);
   - frequent delivery in small quantities;
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(3) quality:
- minimal product specifications imposed on supplier;
- help suppliers to meet quality requirements;
- close relationships between buyers' and suppliers' quality assurance people;
- suppliers encouraged to use process control charts instead of lot sampling inspection;

(4) shipping:
- scheduling of inbound freight;
- gain control by use of company-owned or contract shipping, contract warehousing, and trailers for freight consolidation/storage where possible - instead of using common carriers.

Carlson (1989) presented three case studies illustrating the application of JIT to the warehousing operations of three companies. Under the philosophy of continuous improvement, these companies strove to:
- reduce errors and complaints;
- reduce picking route distance;
- decrease storage space;
- increase the frequency of replenishment;
- increase employee involvement; and
- encourage team identity and teamwork.

The results were higher productivity and improved customer service.

Both JIT and stockless inventory systems have been introduced for materials management in hospitals (Berling and Geppi, 1989; Cassak, 1988; Pettus, 1990; Wagner, 1990). When JIT is used, inventories at central stores are lowered, orders are placed and received on a daily basis and closer ties are established with vendors of medical supplies. Stockless systems extend the JIT approach and seek to eliminate the need for central stores. Distributors perform the
breakdown of bulk supplies and materials are moved directly from receiving to the point of use. In both systems, inventory at the point of use is also lowered. Monthly or weekly inventory levels are decreased to weekly or daily use levels.

Smith et al. (1989) report using JIT principles to analyse the operation of Ecuador’s medical supply system which serves rural community health workers (CHWs). JIT principles were used to identify an alternative solution for supplying CHWs which would improve supply availability without raising health care costs.

Inman and Mehra (1991) examined the potential for JIT in service industries through three purchasing-oriented case studies. These cases highlight the application of JIT to three areas identified as: the purchase of sub-components/services; maintenance, repair and operations (MRO) goods; and quasi-MRO goods. They concluded that the utilization of JIT in a service industry is more than justifiable. They also offered suggestions for implementing JIT in service industries that strongly resembled those offered to manufacturing firms contemplating adoption of JIT.

Rzepka et al. (1990) developed a multi-period dynamic simulation model to study the effects of the deterministic and probabilistic estimation of interest rates. The experiment conducted was designed to determine the applicability of the JIT philosophy to bank portfolio adjustment decisions. The authors drew a parallel between JIT philosophy and banking operations. In banking, excess cash (inventory) is unprofitable.

Flint (1993) reports the use of vendor alliance programmes in the airline industry. Known for its classic service qualities, examples of JIT in this industry are discussed together with the benefits experienced. Emphasis in this industry is again focused on purchasing relationships.

Flexibility in the use of resources

Firms should have the ability to change processes rapidly to meet customer demands without wasting resources. Because the output from service processes is often highly customized, flexibility is a key element for many successful service organizations. Improving the timing and quantity of resource allocations for performing a process to avoid employing human and material resources when they are not needed is another facet of JIT.

Decreasing the cost of maintaining patient accounts was the purpose of applying JIT techniques in a hospital as reported by Groenevelt (1990). While this implementation also could have fallen under the improving work flow emphasis, many of the JIT techniques discussed in this article reflect employee-centred techniques increasing the flexibility of the workforce. Workers were involved in decisions; training and education programmes were established to create a pool of multi-skilled workers; standardized procedures were established; performance standards were created and monitored; and a special emphasis was placed on fostering co-operation and commitment to the JIT philosophy.
Hung (1991) reports the implementation of an algorithm for scheduling nurses which was designed to improve the timing and quantity of nursing resources. The algorithm presented uses permanent shift scheduling, 10-hour-a-day shifts and downward substitutions. Nursing schedules was just one of many targets for implementing JIT precepts in the hospital cited.

Duclos and Spencer (1994) report the use of an improved information system to support scheduling of maintenance resources that support processes in a JIT manufacturing environment. Maintenance operations are often viewed as a service component of a manufacturing system. In this presentation, the effects on the manufacturing component of improving the use of service resources through better quality and timely information were discussed.

Wal-Mart retail stores have concentrated on resource flexibility, and the result has been strong market share and strong profits in an extremely competitive environment (Ballou, 1994; Halverson, 1994; Stalk, 1992). Wal-Mart’s use of an automatic replenishment system allows for frequent shipments and smaller quantities of goods to be carried in each store. With the re-order occurring at the time of customer purchase, this is essentially a pull-type system. Further, Wal-Mart’s emphasis on technology and providing information to aid inventory decision making allows vendors to review sales of their products store by store. Quick response to the changing demands of customers is the result of such systems, decreasing the likelihood of inventory obsolescence.

Few quantitative-oriented publications were found examining the use of JIT in services. However, two articles describing distribution and inventory models were found, and these qualify as “resource” oriented. Bookbinder and Locke (1986) present a model to determine if JIT distribution methodology is a feasible alternative to traditional distribution methods. They investigated the behaviour of two different distribution models for JIT organizations. In the first, a factory-warehouse-retailer distribution system, the warehouse holds stock. In the second, stock moves from factory directly to retailers. The models were compared using statistical tests, and the second model was determined to be the superior distribution system because it furnished essentially the same service level to retailers while carrying one less echelon of stock.

Another mathematical model is offered by Ramasesh (1990) for the implementation of JIT techniques in purchasing systems that have not yet advanced to the ultimate level of JIT purchasing (lot size of one). He treated the fixed costs associated with the adoption of JIT as investment, and justified it based on the savings generated using any of the techniques of investment analysis. He modified the traditional economic order quantity model to include explicitly the costs of small-lot shipments. He also provided guidelines and formulae for determining the order quantity and the optimal number of shipments.

Respect for people
Because customers are directly involved in the service delivery process, service employees play a crucial role in affecting the customer's perception of
the quality and value of the service. Employees must respect customer requirements and provide service in a timely and efficient manner. Those same employees deserve the respect of the company's management. This means helping employees work smarter, not harder, through training and supervisory assistance, and involving all employees in problem solving and process improvements.

Many of the articles discussed in other categories mentioned the need to implement various techniques for helping employees work smarter, not harder (Billesbach and Schneiderjans, 1989; Carlson, 1989; Groenevelt, 1990; Savage-Moore, 1988; to name a few). Most of these articles focused primarily on operational changes. However, they also recognized the vital role employees have in service industries and emphasized methods for improving their performance.

Service firms working for JIT manufacturing firms must be aware of the impact of the customers’ JIT emphasis on their own companies. Bagchi et al. (1987) investigated the importance of various service factors considered by both JIT and non-JIT firms when selecting a transportation carrier. A questionnaire was developed to measure the value of certain carrier selection variables from the perspective of the executive responsible for carrier selection. They concluded that executives in JIT firms regard customer service-related factors as more important than others. JIT firms place significantly more emphasis on service-related determinants, such as frequency of service, delivery predictability, transit time, service schedule changes and service flexibility. Carriers and other service providers must design effective service offerings which include the customer service requirements of their JIT customers.

Future directions for research

The 1990 census reported that seven-out-of-ten US workers were employed by service sector firms and that continued growth in service employment is expected. Academicians and researchers cannot continue to ignore the evidence from practitioner publications suggesting that service industries could benefit significantly from the introduction of JIT. Productivity improvements in non-manufacturing environments offer the greatest potential for improved productivity and competitive growth of US firms. We suggest the following actions for increasing the speed of adoption of JIT techniques within the service sector:

- modify JIT terminology;
- include service sector examples in operations management courses;
- develop a framework for research;
- apply current JIT research to service operations;
- develop models for evaluating JIT success.
Modify JIT terminology

JIT terminology should be modified, where appropriate, to reflect service operations. As previously discussed, Billesbach and Schniederjans (1989) initiated this process by comparing targets for wasteful activities in manufacturing with corresponding processes in an administrative setting. Broader definitions of such manufacturing terminology as “work-in-progress”, “inventory”, “waste”, “group technology”, and “cellular manufacturing” need to be developed to adapt JIT techniques to service operations. Continuing the work of Silvestro et al. (1993), JIT terminology should be modified to include these service processes. Further, the distinct differences between various service sector firms should be considered with regard to JIT techniques. Silvestro et al. (1993) recognized major differences between service sector firms along six different measures of service activities. Because service activities vary widely between service firms, so too may the applicability of various JIT techniques.

While developing this common terminology, techniques currently used in JIT operations must be analysed and compared with other service techniques. For example, quick response techniques used in retailing and distribution could be considered analogous to quick set-up techniques in JIT manufacturing firms. Chase and Stewart (1994) started this process with their discussion of the use of poka-yokes (fail-safe devices to assure quality). They developed a framework for considering where poka-yokes may be used in service operations. Many fail-safe devices are in use throughout the service sector; however, the terminology gap may inhibit recognition of the tool. For example, the development of an input screen (or template) used in an information system is essentially the development of a poka-yoke for data entry. Systems design textbooks or information systems literature do not refer to it as such.

Include service sector examples in OM courses

Classroom discussions of JIT techniques should include not only manufacturing examples, but examples of service processes as well. Academicians must see that the education and training which college students receive in operations management and industrial engineering techniques includes more emphasis on service sector industries. Service organizations, such as hospitals, banks, hotels, and insurance companies, require operations management expertise. The typical operations management education, however, focuses more on manufacturing than on services contexts. For many students, this may be a large hurdle to overcome. Increasing the number of service sector examples, combined with an “improved” vocabulary encompassing both manufacturing and service operations, will make the application of JIT techniques more naturally obvious to the student of operations management.

Develop a research framework for service sector JIT operations

Research of JIT in services needs to grow beyond the current case study orientation. Most of the reported publications of JIT in services are case
study-based and may lack transferability to different organizational environments. Few simulation or quantitative models are evident in service sector studies, and they too may be difficult to develop and generalize. A large-scale empirical study should be conducted to survey a number and variety of organizations to determine the frequency, depth and breadth of JIT implementations in service operations. The results of this research could provide a framework for successful implementation of JIT techniques in service operations and provide a research agenda for the study of JIT in service operations.

As a starting point, it is suggested that surveys which address the following issues be administered to service operations managers:

- What kinds of firm are most active in implementing JIT practices?
- What are the benefits expected from implementation?
- What types of JIT practice are most widely adopted by service firms?
- What impact does the adoption of JIT practices have on existing systems?
- How have service firms reorganized their processes to implement JIT?
- What methods are used to implement JIT methods in service firms?

Research is also needed to study the performance differences between service firms that have implemented JIT techniques and those that have not. A study of those that have been successful will shed new light on the effectiveness of their respective methods. Cross-sectional studies are needed which will examine JIT issues in a wider variety of service firms and industries.

Research must be conducted which examines the most appropriate way to compensate service firm employees as the performance emphasis changes towards teamwork in a JIT environment. Employee involvement is essential in a JIT operation. Employees become responsible for service improvements and must be rewarded for initiative, leadership skills, communication skills and improved problem-solving skills. In addition to compensation systems, all performance measurement systems in JIT service environments must be evaluated to determine the performance criteria that should be selected.

Changes in employee responsibility in a JIT environment include measuring and controlling quality at the source. Research is required which will identify how those concepts can be implemented in service operations. The entire corporate culture of the organization may require changes to implement JIT successfully. These issues must be investigated if service firms are to reap the same benefits as have manufacturing firms from the implementation of JIT practices.

Finally, emphasis on business re-engineering and time as competitive weapons should support publication of research focusing on JIT techniques for process improvement and reducing time delays. This will build on operations management research on facilities layout, set-up time reductions, batch size issues and process planning.
Apply current JIT research to service environments

Studies of JIT in the manufacturing environment should be applied and tested in service environments. For example, much of the manufacturing research has focused on kanban size. A similar situation in service organizations requires administrators to determine appropriate lot sizes associated with work batches. Little direction has been provided to determine appropriate lot sizes. Variability of output was discussed in the manufacturing studies as a problem associated with JIT implementations. Variability has been shown to be potentially more of a problem in administrative settings (Feather and Cross, 1988). Methods for handling this variability, outside of adding wasteful processes and buffers, should be studied.

In addition to kanban size, the study of some types of service operation provides a unique opportunity to apply the “demand-pull” system used in JIT manufacturing applications. With a demand-pull system, nothing is produced by a supplier workstation until a signal arrives from a user station authorizing production. Some service processes, such as processing loans or contracts, use push rather than pull systems. Loans or contracts arrive for processing at the first desk and are pushed through the remaining steps of the process. Applying pull systems, similar to those used in manufacturing, becomes obvious in these settings.

Develop models for evaluating JIT success

As with manufacturing operations, managers of service operations must be provided with models for analysing the costs, benefits and overall performance success of JIT implementations. Weiters (1984) notes that service organizations will not find physical inventory reductions a major source of financial justification. Savings from more reliable delivery data quotations and better service time for customers may be harder to document. Productivity measures for service industries are more important than ever before as the service sector continues to gain an increasing share of the economy.

Conclusions

While a review of the major academic research journals revealed a focus on JIT in manufacturing firms, a review of applied journals shows that many of the components of JIT are migrating to non-manufacturing environments. Research journals, however, have been slow to recognize this trend. Current books discussing JIT provide, at most, a chapter on the application of the techniques to the service sector (see Chase and Aquilano, 1992, and Schniederjans, 1993, for examples.) However, little has been done to identify the major impediments to implementing JIT in service sector operations. By failing to research this trend, academicians and others conducting research in operations management have not recognized a unique developmental stage for service operations and industries.

In this article, we have reviewed the literature reporting many JIT applications in service operations and classified those articles using a modified
form of Benson's (1986) categories of JIT precepts. This provides evidence that JIT techniques are, in fact, migrating to service sector operations. Further, these articles suggest that service industries could benefit significantly from the introduction of JIT techniques. Five recommendations were proposed for increasing the speed of moving JIT techniques to service sector operations and increasing our understanding of JIT in this environment. These recommendations can be summarized as:

1. modifying JIT terminology to encompass service processes more naturally;
2. emphasizing the applicability to service operations of JIT techniques to students studying operations management;
3. developing a research framework for the study of JIT in services;
4. applying manufacturing-oriented studies to service processes; and
5. developing appropriate models for analysing costs and benefits to service operations of JIT implementations.

A continuing shift of workers away from manufacturing and into services, where more than 70 per cent of US jobs reside, is a significant feature of the new economy for many developed countries. Further, productivity gains in service economies will be crucial to maintaining standard-of-living levels in those countries. Using JIT methods to concentrate on decreasing the time required to provide a service, improving the quality of the service and, essentially, increasing the productivity of the economy are all potential advantages that may result from further research into and application of JIT techniques in service-oriented organizations.

References
APICS (1992), APICS Dictionary, American Production and Inventory Control Society, Inc., Falls Church, VA.
Hall, R.W. (1983), Zero Inventory, Irwin, Homewood, IL.


