

# Just-in-Time (JIT) Production in Service Operations - Document Automation: A Case Study

*Track: JIT Lean Production Sessions*

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## ABSTRACT

The application of JIT (Just-In-Time) production system\* in service operations has attracted many research interests. This paper presents a case study about the application of JIT - “*document automation*” - in a specific service sector – the printing industry. The “*document automation*” process (also called “print-on-demand”), with the aid of new communication technology, starts from the customer-side and completes with the service delivery, including: project planning, cost estimation, job composition, graphic design, digital file conversion, disk creation, engineering drawing, publishing, hardcopy printing, binding, and lamination. This case study demonstrates that such a “*document automation*” can improve printing service operations significantly and represents the future for the printing service industry.

## *Introduction*

The introduction of Just-In-Time (JIT) production system to U.S. manufacturing operations started in 1970s (Hall, 1983; Zipkin, 1991). Successful applications of JIT in the U.S. manufacturing firms have been reported thereafter (Blackburn, 1991; White, 1993). While research addressing the impact of setup time, lotsize reduction, and leadtime performance in JIT production systems has been continuously emerging and the need for JIT in large repetitive manufacturing firms has been well justified, the merits of JIT in continuous process manufacturing firms or in small-sized manufacturing firms have also been examined in recent literature (Cook & Rogowski, 1996; Finch & Cox, 1986, Inman & Mehra, 1990). Addressing a more closer relationship with suppliers, JIT II system (also called “Partnering” or “Concurrent Engineering”) was first introduced by *Bose Corporation* in 1987 and widely implemented recently (Dixon, 1997). If JIT can be characterized as to **eliminates inventory**, then JIT II can be characterized as to **eliminates salesman**. In a JIT II system - focusing on extremely close interaction with suppliers - the suppliers are brought onto the plant of the buyer and be an active member of the purchasing office (called in-plant representative) (Dixon, 1997). To build a partnership, the duties of such an in-plant representative include: issuing purchasing orders to his/her own firms, working together on design ideas to cut costs for buyers, and control scheduling for suppliers, materials contractors, and other subcontractors (McClenahan, 1991). It has been reported proven that the JIT II system will provide the benefits of (1) improved communication between supplier and buyers, (2) continuing saving on material costs, (3) valuable input from suppliers to product design, and (4) building a natural foundation for electronic data interchange (EDI) (Dixon & Porter, 1994).

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Like other advanced innovative managerial approaches (e.g., *TQM*, *Benchmarking*) the Just-In-Time principles has also been introduced to service operations recently - especially for those service industries - which are repetitive in nature, have reasonably high volumes, and deal with tangible items such as: sandwiches, mail, and printed materials (Yasin & etc., 1999). The effectiveness of JIT in the public service sector has been empirically examined where the success of JIT is measured by 10 operational performance criteria – such as: the reduction in inventory, reduced service delivery leadtime, improvement in on-time service delivery, customer satisfactory, and overall operating efficiency (Yasin & etc., 1999). The major benefits gained from implementing JIT in service operations include: consistently high quality, uniform work load, close tie with suppliers, flexible work force, and opportunity for automation (Helms, 1990). Recent reported examples of JIT applications in service operations include: a concurrent training for a large number of employees in multiple locations for a larger service company (Rubin-Berman, 1997), the office operational procedures of general administration to achieve cost and time effectiveness (Billesbach & Schniederjans, 1989), and more recently on administrative aspect of the health care industry (Pierce, 1997; Whitson, 1997).

### *The Printing Industry - Background*

The printing industry has been one of the typical service operations – increasingly competitive and easily affected by the advancement of new technology and management approach (Beach etc., 1986). For example, over the last two decades, with the emerging of new technologies - from computer word processor, advanced fast-speed coping machines, laser printer techniques, three-dimensional graphical design module, fax machine, e-mail, and more recently Internet Web and FTP delivery system, the printing industry has changed its image from old fashioned hand- typewriting to today's real-time on-line graphical design, data communication, and document printing. A related development is the introduction of the concept of “*virtual enterprise*” – evolving to include everything that touches the products/services a firm provides from the suppliers to final customers. The concept quickly attracted many Web-based applications as e-commerce becoming a new trend in the supply-chain development (Bechler, 1997). A parallel trend is the change in new resource management for those *virtual companies* – consisting of multiple organizations teaming for shared opportunity, strength, and convenience and staying abreast of customer needs and ahead of their competition (Haupt, 1997). A key element of such a new resource management is the use of *Internet* – which will eventually replace many currently used high cost VANs (*Value-Added Networks*) to make modernized EDI (*Electronic Data Interchange*) more practical in developing the security, encryption, notification, and messaging mechanisms to make the Internet EDI secure and reliable (Haupt, 1997). As a logic step, research addressing the risk management in e-commerce has also been emerging in the recent literature (Miller & Engemann, 1999). Current focus has been placed on the three major issues: (1) what types of risks present in e-commerce? (2) What are similarities and differences between e-commerce risks and risks in other business environments? And (3) What are available tools that can be used to control e-commerce risks? Also, all e-commerce risks have been categorized into three primary areas: *information risks*, *technology risks*, and *business risks* (Miller & Engemann, 1999).

An application example has been reported on the using of company intranet to automatically print and deliver project status reports for many divisional project managers (who may be located at distant sites over a considerable geographical area) in a real-time manner

(Schwartz, 2000). In this application, the on-line printing helped the company to eliminate thousands of dollars involved in organizing, coping, and distributing those old-fashioned paper reports – while assisted those remote project managers to access the important timely information for immediate viewing. In the past, it took weeks for such reports to reach those remote project managers after the reports were printed out. Now it only needs a few seconds - so those remote project managers can correct any undesired deviations in a timely manner - to keep their project activities on the right track (Schwartz, 2000). The use of internet information delivery and on-line document printing have provided the backbone for the current hot stream of e-commerce – as it can overcome many traditional business obstacles and operational size barriers by delivering access to global markets and providing new leverage with old large powerful suppliers and by staying current in technology (Westerlund, 2000). In the new suggested performance criteria for service operations, fast service delivery and prompt and reliable service have been identified as two key competitive priorities for the future Web-based service delivery operations (Verma & Young, 1997), while time-based competition through better customer service has been re-emerging as a major tool of delivering high-quality services to customers through a total operation cycle – including planning, design, processing, marketing, and distribution (Sue, 2000).

This paper presents a case study about a new trend in the printing industry - “*document automation*”. The “*document automation*” can be viewed as an application of JIT (Just-In-Time) in printing service operations – also called as “*print-on-demand*”. With the aid of new communication technology, this automation process starts from the customer-side and completes with the service delivery, including: printing project planning, cost estimation, job composition, graphic design, digital file conversion, disk creation, engineering drawing, publishing, hardcopy printing, binding, and lamination. This case study demonstrates that such a “*document automation*” - a JIT application, can improve the performance of printing service operations significantly, and in fact representing the future for the printing service industry.

### *Document Automation at DAPS: A Case Study*

The *Document Automation and Production Service* (DAPS) is a printing service center located in **Warner Robins, Georgia** – a large Air Force Base. The printing center was originally managed by the Air Force, but transferred to a contractor agency - *Defense Logistics Agency* in 1992 (DAPS, 1998). The center is serving for all consolidated printing, duplicating and document production orders in the base from the *Department of Defense*. The center was used to be known as “*Defense Printing Service*”, but in 1998, the words of “*Document Automation*” were added to the name to reflect the change of its printing operations – from old-fashioned hardcopy duplication to today’s Internet-based JIT type on-line document management.

Under the current system, today all of its printing orders will be operated with a *print-on-demand* procedure. The procedure of *print-on-demand* can be explained in a simple sentence – all printing works will wait - until a print request comes in, and only then the center will begin to print it digitally - in exactly the quantity the customer needs and in the format they request – followed by delivering the related technical manual with a just-in-time manner to the customer. The new JIT procedure is based on its commitment to provide the best printing services – termed as “*document management*” for their customers. More specifically, its “*document management*” service includes: project planning, cost estimation, composition, graphic design, digital file

conversion, CD-Rom production, engineering drawing production, scanning, publishing, hardcopy printing, binding, and lamination.

Ninety-nine percent of all the work they take in is for the printing of Air Force Technical Manuals (TOs). They also provide services to every organization located on the base such as the Chapel, History Office, Environmental Department, Public Affairs, Hospital, Base Schools and the Travel Office.

If a customer has a specific requirement for a printing service (such as: foil stamping, refrigerator magnets, thermograph with raised-ink, embossing, and reflective vehicle decals) that the center cannot provide in-house, the request will be submitted to outside commercial contractors. The printing specialists in the center will prepare the job specifications and then forward those special printing orders to the contacted outside provider (e.g., the Government Printing Office, located in Atlanta, Georgia) with the objective of getting the jobs procured at the lowest price and best value to its customers. In the past, there will be a 5.5% surcharge on these out-going jobs to cover the cost for its employees to process the paperwork. But recently the center has dropped this surcharge so customer will receive this particular service at no cost.

The center has a slogan - "*ALWAYS CAN DO RIGHT NOW*" - by being dedicated to providing a wide range of high quality products and services with an outstanding customer service level. For example, to be **printing-on-demand**, the center places two employees (titled pricer/schedulers) to work with the customers for getting all the printing jobs priced and scheduled according to delivery date. The total number of **print-on-demand** requests has increased more than 200% since 1999 and expected to continuously increase at a higher rate. As manual pricing is totally out-of-date for the **printing-on-demand** operations, printing order pricing process at the center has been automated with advanced computer software based on its pricing manual for a consistent pricing practice. For the best service quality, the center has a quality assurance team in place - which was created to maintain the best quality and provide a high level of printing. This team is not only in place during day-time, but also be required to be on call after hours and during weekends. The use of new technology has played a key role in transforming the center from a traditional paper-based printing service facility into a totally new automated **printing-on-demand** printing facility. A good example is the comparison that a few years ago their employees had to stand on cement floor and stepped over big cumbersome wires and cords all day long - now their technicians sitting in front of the computer terminal to control all printing job orders through a well-designed colorful screen with the state-of-the-art equipment. It is believed that the center is leading in the industry for the effort to substantially reduce paper-based bulk printing and warehousing while update its printing technology toward providing easy multiple-channel network access and paperless digital printing with digital information warehouses and libraries. That is, **printing-on-demand** requires for converting paper documents into digital form and providing for quick, economical, and secure digital distribution of the desired output.

In the following sections, the operations of the center under the old technology and the operations currently with the new technology are briefly compared with the discussion on the benefits from the new system – a **printing-on-demand** (JIT type) printing facility.

“Old” Operating Systems:

The center was established dating back to 1943 - a small printing plant operating out of the headquarters building on the Robins Air Force Base – with only one press and one operator (Zdrakas, 1988). The center was relocated to an old warehouse in 1956 – by then employing 15

people with much large printing operations. In 1998 the center was expanded to have 21,000 square feet, 56 employees, and 10 times higher printing workload - an average of 5 million printing pages a month at a monthly cost more than \$1.78 million (DAPS, 1998). The center had used old traditional presses to reproduce all their printing requirements before then (Smith, 2000).

One of the main pitfalls associated with traditional printing technology is usually a very lengthy printing process – often including: prior camera work, negatives preparation, special graphical design, printing operations setup, step-by-step duplication, plates binding and collating, and the likes – with a very long printing leadtime. Starting from 1992, many customers began to request to print their entire hardcopy technical manuals into digital formats and Just-In-Time printing procedures for their end users. The center realized then that the new process of **printing-on-demand** operations could not be accomplished with existing technology and equipment. For example, for many of their small customer printing orders, it had been very difficult (if not economically possible or impractical) to print short runs of a few copies on the traditional presses. That is, to transition from traditional printing to **printing-on-demand** operations, the center needed new technology, new software, new computer servers and all other related equipment (Brzozowski, 2000).

#### Transition to New System:

By 1994, all “old” presses were replaced with pieces of new equipment (such as: Xerox 9400, Docutechs 135, Xerox 4135 and 4635) – which were all high-speed copiers and with certain on-line capabilities. That is, now customers can *e-mail* their printing job orders to the center’s computer server – which in turn routes the files to the automated equipment for just-in-time printing. With **printing-on-demand** dominating its daily operations, there was no longer a need to store customers printed document outputs in a central warehouse. In certain degree, **printing-on-demand** is a type of JIT application in the printing industry. For example, now when a customer needs to place a printing order, one just needs sending his/her request through an internet channel (i.e., an e-mail order), the center will then pull the digital file from the central repository system and then printing the order and mailing the printed documents directly to the customer. New software, servers and equipment necessary for digital printing were attained thus with moderate investment and market research. Additional efforts were made to explore and experiment methods of digitally downloading, file separating, and output documents distributing. Customers’ input and commitment were sought before such a magnitude investment being made. New research on testing and investing in new equipment and software has been undertaken in hope of improving and speeding up their **print-on-demand** projects. For this purpose, an OCE 9800 printer was purchased in 1998 – which can perform all printing, drilling, collating and folding jobs *on-line* and receiving digital data - in addition to normal scanning, storing, and copying from paper originals. In short, this new machine has the capability to reduce the printing costs and printing leadtime remarkably – compared to the “old fashion” traditional printing.

Currently the center can support all the **print-on-demand** job orders as well as traditional hardcopy output requirements – with 14 civil services employees and 18 contractors operating seven days per week by three shifts. The center is now able to keep a very short printing leadtime (called “job turn-around time” at the center) from 2 to 5 working days – which has attracted more and more customer demand in recent times. For example, in 1999, they produced a total of 100 million units of printing services. By the middle of April 2000, their output has

reached 53 million hardcopy printed pages and over 5 million **print-on-demand** pages. It has been shown that the demand for traditional hardcopy printing is decreasing while the demand for **printing-on-demand** type of electronic documents is increasing.

#### Current Technology and Future Systems

The center is constantly looking for the best technology available for further improvement. For instance, recently it purchased a **DocuJob Converter** station which has the capability of converting remote files. In order to accomplish the jobs that require spot color, it acquired a **Kodak ImageSource 70 CP** while for full color jobs, a **Docu-Color 40** was added. Projecting the potential requests to CD replication, the center purchased a **Rimage CD Duplicator** - which has on-line capabilities for its customers. Additional efforts to improve the quality of JIT printing services include - a customer interface (an on-line doc.access) which makes ordering printing services as easy as clicking on an icon right on the customer's computer screen. Customers enjoy the fact that they can submit their printing request electronically and attach any files to be printed without the need of delivery the original documents to the center by a traditional mean.

The center also has a marketing team consisting of individuals with a variety of background experience. Team members have pricing, computer technology, and contracting background to provide potential customers with a wealth of expertise. They use promotional packets that are sent from their headquarters, as well as flyers and posters they created, which advertises any new capabilities. They summarize the major benefits to the customers from their JIT type **printing-on-demand** printing operations as below: (1) cutting customer printing leadtime by 50%; (2) reducing inventory and storage space; (3) reducing printing costs (including the costs of production, materials, labor, and mailing costs); and (4) improving the quality of the printing services.

The center has developed a new strategy plan for their future direction – which has four major objectives:

- (1) **Building A Team 2000 for Future** - *Digital* becomes the **wave** of the future and the center plans to make it a reality by building a **Team 2000 for Future** with necessary knowledge, skills and abilities to meet challenges in the center's strategic direction. The management realizes that to be a technology leader in the industry – appropriate employee training on the latest and up-to-date IT technical advancement will be a key for this purpose. To build their future team, the center has outlined a detailed plan to integrate their professional development and leadership development into a day-to-day corporate business environment.
- (2) **Achieve Total Customer Loyalty** - The need for a digital printing facility comes from the customers' demand for variable and personalized documents creation and distribution. With this technological advantage, the center has been selected as the customers' preferred source for automated printing services for the best value – in terms of quality, service, delivery, and price. To achieve total customer loyalty, the center will further enforce employee professional training, customer partnership development, increasing personal contacts, and the use of feedback and follow-up procedures. To be cost effective is certainly a key to achieve customer loyalty – the center believes that its new technical advantage will provide its customers with significant cost savings – through reduced costs resulting from saved warehouse space, improved labor productivity, and decreased need for raw materials.

- (3) **Create A Total Document Automation Environment** - by providing a full range of automated printing services through in-house and commercial means, establishing electronic connectivity with customers throughout all the centers' facilities, serving customers with designed user-friendly approach, and optimizing business processes with the most effective way. In order to be competitive, the center will integrate document management, digital printing, and fulfillment services into their functional capabilities. Just-In-Time printing offers the center tremendous flexibility to distribute jobs where they are needed and the ability to process all printing job orders in a timely fashion.
- (4) **Integrate Technological Changes within the Organization** – the center believes that it is important to integrate those new technological changes within the organization, i.e., let their workforce get involved with all related technological changes and be informed about all administrative information. It is a fundamental principle for a JIT type operation to have a highly motivated, integrated, informed, and trained workforce.

The center has a *vision* for its future – to be a **leader** in the trend of **document automation** in the printing industry. It will compete within the industry to become customers' preferred provider of digital and **print-on-demand** type printing services with competitive price, the highest quality, and fast and on-time delivery. This vision will be achieved through the following organization cultural environment and managerial principles:

- (1) **People** - Value all employees and the diversity that they bring to the workforce.
- (2) **Service** - Listen to the customers, focus on their needs, and strive to exceed their expectations. Be aware of the diversity of the customers resources and prepared to assist regardless of the preparation stage.
- (3) **Excellence** – Keep doing things right at the first time on a high standard of quality.
- (4) **Integrity** – Always operating with the highest standards of conduct - abide by the law and operate within the authority.
- (5) **Innovation** – Creative ideas come from every member of the organization. New technology will allow *downsized* (or called "right-sized") workforce to do *more* with *less* resources. All employees need to be more innovative and knowledgeable in order to perform their duties. Leadership is very important for an innovative workforce. A leadership program is in place to identify candidates for future management positions with the following characteristics: initiative on motivation, teamwork oriented, honesty, integrity and ethics, strategic thinker, be business results and customer driven, a problems solver and effective communicator, and finally empowerment drive.

### *Summary*

With the success of converting their traditional printing service operations into a JIT type printing-on-demand printing service (with digital and on-line capabilities), the annual sales of the DAPS center has been grown steadily since 1994 – from \$4.4 million in 1994 to a projected \$22 million in 2000. While the cost to their customers for the same printing service has been reduced dramatically. For example, one copy of a 500-page manual printed today will cost about \$21, in comparison, the same manual had cost near \$450 in the past. In addition, automated digital document printing can provide two output services to customers which the traditional offset printing equipment could not. One is the mass amount of printed documents that are

stored in databases now can be retrieved electronically and printed as needed. Another is the capability to economically produce all small quantity printing orders (e.g., *just one or two copies*) for faster turnarounds on their high-speed copiers. Such a process would not have been practical with traditional offset presses - which was practical for *only large printing orders* (e.g., very large run lengths).

Another important benefit from the **printing-on-demand** type printing operations (described in this case study) is the significant improvement on the printing leadtime performance. Today, depending on customer's need, most **print-on-demand** jobs can be handled - from initial customer requests to out-the-door delivery in less than two days – compared with six to eight days in the past. For example, if a customer out in the field requiring a document, instead of going through a pick and pack operation in the past, now, the center can simply print them as needed – with the flexibility of clicking and pushing a couple of buttons and sending the digital files directly to the hi-tech equipment. Strong leadership and the commitment of their **Team 2000** will take them well into the future – to be recognized as the leader of **document automation** in the industry with a world-class service.

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