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Lieutenant Colonel Joseph L. Walden, USA

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School of Advanced Military Studies
Fort Leavenworth, Kansas 66027-6900

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ABSTRACT

APPLYING JUST-IN-TIME TO ARMY OPERATIONS

By Lieutenant Colonel Joseph L. Walden, Quartermaster Corps, 52 pages

In spite of the Army's "draw down," the requirements on the logistics community have increased. These requirements include Stability and Support Operations in locations such as Somalia and Rwanda, disaster support for Hurricane Andrew and the Northridge earthquake, and support to forces in Bosnia and Kosovo. The common thread in all of these actions was the requirement to get supplies and repair parts to the soldier in a more efficient and expeditious manner. The Just-in-Time management philosophy is one of the possible methods to accomplish this requirement.

The foundation for analyzing the application of Just-in-Time to Army operations includes a look at the history of Supply Chain Management and the history and development of Just-in-Time as an element of Supply Chain Management. The examination of Just-in-Time and its critical elements includes an analysis of commercial applications of JIT and actions within the Department of Defense and the Army to become more efficient. The missions of the 21st Century logistics system include getting supplies to soldiers in more locations, with a smaller logistics footprint, and in a more expeditious manner.

There are numerous lessons learned from the applications of Velocity Management and from commercial applications of JIT and JIT-like programs that have applications across the spectrum of support requirements for the 21st Century. The application of these lessons learned will enhance the support to the soldier, sailor, airman, and marine without creating additional risks to lives or readiness.

Just-in-Time applications have benefits for the Army and the Department of Defense. The application of the principles of Just-in-Time management to the Army's logistics system is beneficial in reducing customer wait times and eliminating the inefficiencies in the current logistics system. However, the most prevalent purpose for holding extra or just-in-case inventory, according to the American Productivity and Inventory Control Society, is to buffer against demand variation. The nature of military operations across the spectrum of Offense, Defense, Stability, and Support is extremely variable. This variability creates uneven demand and uncertainty. Buffer stocks at multiple locations remain necessary to buffer against this variation. Therefore, moving to a point of "zero inventories" is not feasible in a military environment.

Applying Just-In-Time To Army Operations

MONOGRAPH
BY

Lieutenant Colonel Joseph L. Walden
United States Army

SCHOOL OF ADVANCED MILITARY STUDIES
UNITED STATES ARMY COMMAND AND GENERAL STAFF COLLEGE
FORT LEAVENWORTH, KANSAS

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Approved by:

_______________________ Monograph Director
William J. Gregor, Ph.D.

_______________________ Professor and Director Academic Affairs, School of Advanced Military Studies
Robert H. Berlin, Ph.D.

_______________________ Director, Graduate Degree Program
Philip J. Brookes, Ph.D.

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List of Acronyms

APICS: American Productivity and Inventory Control Society

ASL: Authorized Stockage List

DOS: Days of Supply

DLA: Defense Logistics Agency

EDI: Electronic Data Interchange

ERP: Enterprise Resource Planning

FEDEX: Federal Express

JIT: Just-in-Time

LIF: Logistics Intelligence File

NTC: National Training Center

ODSS: Offensive, Defensive, Stability and Support Operations

OST: Order Ship Time

PIT: Process Improvement Team

SCI: Supply Chain Integration

SCM: Supply Chain Management

SCOR: Supply Chain Operations Reference Model

SIT: Site Improvement Team

SSA: Supply Support Activity

TISA: Troop Issue Subsistence Activity

VM: Velocity Management

Introduction

The Challenge

Throughout history, armies have struggled to provide the right amount of supplies, in the right location, at the proper time. The early history of the US Army is punctuated by periods of dire need within the army. The winter at Valley Forge during the American Revolution has entered American lore as an example of the Army and General Washington's perseverance in the face of extreme military need. Until recently efforts to avoid shortages in war have been directed towards establishing stockpiles of materiel and supplies across the combat zone, near the fighting force. Within the United States Army this practice has become an unofficial policy and is known as "Just-in-Case" logistics. "Just-in-Case" logistics is an inventory management methodology that ensures supplies are available regardless of the cost or the need for an item of supply.

The practice of "Just-in-Case" logistics has produced excess inventories in every major deployment of soldiers since World War I. There were over 27,000 containers on the ground and unopened after Desert Storm combat operations were completed and soldiers were redeploying to home stations. Additionally, there was more than two years of ammunition supplies stored in theater at the completion of the ground war. [1]

The surplus in Desert Storm was similar to the waste during the Vietnam War two decades earlier. During the initial deployment phase of Operation Joint Endeavor into Bosnia in 1996 "Just-in-Case" supplies created excess and excesses surfaced again in support of Task Force Hawk's deployment into Albania in 1999. Within three weeks of arriving in Albania, Task Force Hawk supply personnel started sending "excess" items back to Germany. Excess supplies may partly be explained by the absence of a joint supply management concept. Part of the blame could be a lack of faith in the Department of Defense Supply Systems to provide the right item, in the right amount, to the right place, and at the right time.

The system is not the only reason for excess supplies. Logisticians have historically applied the "Just-in-Case" principle to ensure responsive, sustainable, and survivable Combat Service Support. "Just-in-Case" supplies help logisticians by creating a buffer that enables them to improvise logistic plans when faced with changes in operational plans and unforeseen mission requirements.

In an attempt to gain control of their logistics processes and improve efficiency, all four Military Services have established cycle time[2] reduction and process improvement programs. However, these Service initiatives are not linked to the Joint Chiefs of Staff's Focused Logistics concept. Focused Logistics is the Joint Vision 2010 concept for supporting future operations. The Service initiatives and the Department of Defense logistics improvement initiative are working on separate but parallel lines. The result is redundancy and the consumption of scarce resources. Without coordination between the programs, it is likely that service unique programs will be unable to support joint operations adequately.

While the Department of Defense has grappled with ways to prevent supply waste, commercial industry has successfully improved customer support and reduced expenses through the application of Supply Chain Management and Enterprise Resource Planning methodologies. Commercial industry envisions the supply chain as stretching from the raw material to the final consumer or user of the product. Supply Chain Management (SCM) has several components. The components of SCM include procurement, manufacturing, distribution, storage, and inventory management. Just-in-Time is one method of inventory management and is quite a departure from the "Just-in-Case" method. Just-in-Time has become a popular concept in commercial industry because its use reduced the costs of Japanese car manufacturers. Just-in-Time (JIT) inventory management has been implemented in numerous businesses during the past twenty years. Commercial industry has benefited from Just-in-Time management because keeping smaller quantities of supplies on the shelf and on the shop floors is less expensive than maintaining inventories.

Many people believe that these commercial supply techniques can be applied directly to military logistics operations. However, military operations and military logistics operations are in many ways different from commercial retail and manufacturing operations. Those differences do not preclude implementing "Just-In-Time" supply practices but they dictate important changes to the methodology to achieve improvements in military logistics efficiency and successful military performance.

Unlike some commercial enterprises, efficiency did not become a primary military goal until the most recent DoD Strategic Logistics Plan. Changes in logistics operations must improve support for military operations while seeking efficiency. To understand both the limitations and the promise of these new inventory management techniques it is necessary to explore the contemporary commercial concept of supply chain management and its applications within the military. That examination establishes the basic elements of the JIT method and provides a benchmark for comparing proposed innovations later in the paper. To make the comparison between commercial practices and military innovations it then becomes necessary to examine examples of commercial practices and recent changes in military practices to see how the commercial experience is being applied in the military. From that comparison and a review of several studies of efforts to use JIT procedures in foreign militaries as well as the US, the direction and utility of military JIT is easily discerned. There are applications for JIT for the Army in reducing the lead time from ordering until receipt of the necessary supplies and in eliminating unnecessary inventory.

JIT procedures can significantly reduce inventory levels across the logistics force structure. The reduced inventory levels in a theater of operations will produce a smaller logistics footprint of supplies and personnel. This reduced footprint presents fewer, smaller targets for the enemy target acquisition systems and thereby improves survivability and sustainability. Implementation of JIT procedures and principles will improve readiness by providing more of the right items. JIT applications benefit deployments by reducing the quantity of sustainment supplies shipped in the initial deployment phase, which, thus eliminates the need to divert combat power to defend stockpiles and supply sites and increases the amount of lift available for deploying combat units.

JIT is not a complete solution to military needs because unlike commercial industry where the focus is customer support and profits, the Army must ensure that all critical parts are available to improve the survivability of the soldier during operations. Where commercial industry can afford a zero balance or stock out, the Army does not have that luxury during offensive or defensive operations where a stock out cost a life.

The challenge for the Army is to apply the principles of Just-in-Time to reform its current "Just-in-Case" practices to produce a system that has just enough. This system will have the ability to support operations across the full spectrum. This application of JIT techniques will enable the Army to reduce its reliance on multiple levels of supplies, reduce unnecessary inventory, and improve the quality of support to the soldier.

Chapter 2
Background

An analysis of Just-in-Time for the Army and the Department of Defense must start with an examination of Supply Chain Management. Supply Chain Management is the basic system and Just-in-Time is a component of that system. JIT, distribution management, material management, production planning, and material requirements planning are the components of Supply Chain Management. The development of Supply Chain Management and its applications in commercial industry explains how JIT fits as a component.

The Supply Chain

The American Production and Inventory Control Society (APICS), a professional organization for resource managers, defines the Supply Chain as: "1. The process from the initial raw materials to the ultimate consumption of the finished product linking across supplier-user companies; 2. The functions within and outside a company that enable the value chain to make product and provide services to the customer." [3] Understanding the concept of a Supply Chain is critical to understanding commercial best business practices and an understanding of best business practices is necessary to analyze future logistics support requirements adequately. The Supply Chain takes on a different look depending on the level of the person that is viewing it. Consequently, the ability to impact the supply chain is more or less difficult depending on where a person is along the chain. The most common commercial view is to look at the impacts on the ultimate consumer, as well as impacts on the other links in the chain.

Supply Chain Management has been defined as a "connected series of activities concerned with planning, coordinating, and controlling material parts and finished goods from the supplier to the customer. The two distinct flows in which the supply chain is concerned are material and information."[4] Managing the items within the supply chain has become more important as companies have recognized the need to reduce logistics costs to keep consumer prices down.

The term Supply Chain has been in military writings since the 1920's.[5] However, the term has come into vogue in the past four years with the establishment of the Supply Chain Council and the Supply Chain Operations Reference (SCOR) Model. The Supply Chain Council is a business consortium founded to develop a commonly accepted model of the supply chain. The SCOR model has become the commercially accepted model of the Supply Chain. SCOR provides a supply chain framework that links performance measures, best practices, and software requirements to a detailed business process model. SCOR's depiction of the supply chain is shown in Figure 1:[6]

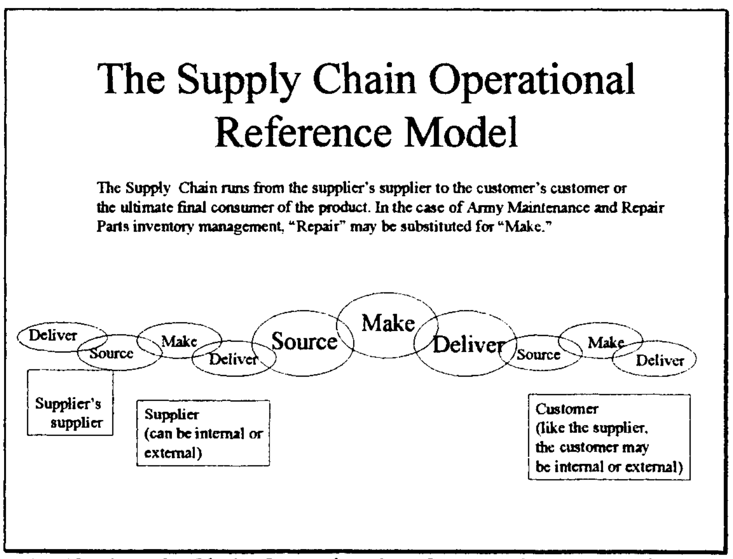

Figure 1. The Supply Chain Operational Reference (SCOR) Model

The elements of the SCOR model are: Plan – Source – Make (maintain) – Deliver. Rick Blasgen, Vice President of Supply Chain Management for Nabisco has defined SCOR as "a business practice that begins with the customer, integrating systems and business processes from forecasting through demand planning, resulting in an effective integration of purchasing, order management, manufacturing and transportation to the customer."[7] This comprehensive system of management is missing in the current Department of Defense logistics systems and programs. For the military to develop a logical supply chain, it will have to eliminate the unprofitable links in the chain. For example, if a part is handled at a Central Receiving Point only to be shipped to another warehouse, why deliver it to the Central Receiving Point?

Supply Chain Management evolved from previous supply management practices. Initially, managers focused strictly on the flow of raw materials into and finished goods out of a firm. Focusing on the flow of raw materials and finished goods is commonly referred to as materials management. Management thought changed when the distribution of raw and finished goods was added to the concern for material management. The new management focus was termed logistics management. Further inquiry led to the realization that there is a supply chain with that links the customer's customer to the supplier's supplier.

The evolution in management theories shifted the focus of logistics from controlling internal flow operations to an integrated management concept concerned with external flow management and "pull techniques," or only shipping what has been requested. Pull systems differ from push systems. A push system automatically replenishes an item based on forecasted demand and not on actual usage as is the case in a pull system. The evolution of logistics theory caused commercial industry to focus more on the ultimate user in designing distribution and manufacturing systems.

One of the earliest recorded instances of Supply Chain Management in the United States was at the Ford Motor Company's River Rouge plant. Henry Ford designed the plant to receive the raw iron ore at one end of the plant. The ore was converted into steel within the plant and used to make the automobiles that rolled out the other end of the plant. In addition, Ford required his suppliers to provide the necessary parts for the automobiles in specially designed crates with holes in closely defined positions. The workers at the plant carefully disassembled the crates and the crates then became the floorboards of the automobiles.[8]

Modern Supply Chain Management has its roots in the Quick Response concept of the early 1980s. Quick Response called for retailers to collect data on the goods being sold and to pass that data on to manufacturers. This practice enabled the manufacturers to produce only what was being sold and forced the retailers to work with their suppliers. That practice reduced or eliminated processing times. It also reduced costs because less production was directed solely for inventory, and it decreased waste because obsolete items were not produced.

Quick Response produced a shift toward pull systems and away from the waste producing push techniques. The shift away from producing waste also helped start the JIT revolution in America because manufacturers began to realize greater profits from the reduction of inventories. The focus on managing inventories in a supply chain management system now know as Just-in-Time production and supply.

Just-in-Time – a definition and historical background

To provide a proper analysis of the military utility of Just-in-Time, it is necessary to define exactly what JIT is and what it is not. There are as many definitions of JIT as there are books on the subject. JIT definitions and theories shift attention between production applications and supply based applications. The following definitions demonstrate the diversity of thought on JIT. The National Aeronautics and Space Administration (NASA) defines JIT as "a means of market pull inventory management imbedded in the humanistic environment of continuing improvement."[9] The APICS dictionary defines Just-in-Time as: "A philosophy of manufacturing based on planned elimination of all waste and continuous improvement of productivity. The primary elements of Just-in-Time are to have only the required inventory when needed; to reduce lead times by reducing setup times, queue lengths, and lot sizes; to incrementally revise the operations themselves. Synonymous with zero inventories."[10] The 1983 APICS seminar series on Zero Inventories defined JIT as "the idea of reducing inventory to its lowest possible level."[11] Henry Jordan, a noted business author defines JIT as, "striving for zero inventories; producing items at a rate required by the customer; eliminating all unnecessary lead times; optimizing the material flow from suppliers to the point of sale, so that inventories are minimized; ensuring high quality and dependable JIT suppliers; and minimizing safety stocks."[12] The APICS linking of JIT to the concept of zero inventories has provided critics of JIT the area of most concern and has led critics to misinterpret JIT concepts.

Modern Just-in-Time methodologies date back to the 1960s. Modern JIT started as a Japanese automobile-manufacturing concept and was a major factor in the transformation of the commercial market's opinion of Japanese goods, JIT helped change the public's understanding of "made in Japan" from meaning poor quality to meaning "exceptional value." In America, some firms have adopted JIT based on the desire to get goods to the consumer faster and to speed the flow of information through the supply chain. However, in Japan JIT started out of necessity. According to Malcolm Wheatley in his book on JIT, three factors spawned JIT in Japan: a lack of space, the implementation of new quality control techniques, and the development and refinement of the Toyota Production System. Because Japan lacks natural resources, most raw materials are imported. The need to import and store raw materials combined with the high cost of land and building space in Japan, produced pressure to free up precious manufacturing space in the factories. Japanese factories were generally small because construction and real estate were very high costs, and managers realized that some factories dedicated more space to raw goods and "work in process" than they did to manufacturing. To compete in the global market the cramped and antiquated Japanese factories needed to deliver high quality products reliably at lower cost. This requirement prompted manufacturers to negotiate with suppliers to provide raw materials directly to the factory floor only when needed to enable the factories to free up space for more manufacturing. Manufacturers that supplied these "Just-in-Time" consumers were able to reduce their finished goods inventories by producing only what their customers needed when they needed it. Decreasing stockage levels and the traditional buffer stocks meant products needed to be of higher quality products to compensate for the absence of replacement buffer stocks.

Based on the teachings of an American, Dr. W. Edwards Deming, Toyota engineer Taiichi Ohno developed the Kanban or pull system for the assembly lines at Toyota. This system eliminated the buffer stocks on the production line, thereby freeing up space on the floor. At the same time, the employees were empowered to stop the line if they perceived that there was a problem. Shigeo Shingo refined the process by defining guiding precepts to the Toyota Production System. These precepts included the elimination of:

1. The waste of over production;
2. The waste of waiting;
3. The waste of transportation;
4. The waste of stocks;
5. The waste of motion;
6. The waste of making defects; and
7. The waste of processing.

Locating the suppliers close to the manufacturing facilities in Toyota City enhanced the success of Toyota's program. Manufacturers who implemented JIT practices realized the added benefit of larger profits. Many American and International firms have adopted JIT-like practices to increase their profits by reducing waste and, hence, costs.

The essential aspect of successful Just-in-Time management is the reduction and/or minimization of inventory throughout a supply chain. Commercial industry has started to learn from the refined Japanese methods to produce substantial efficiencies from the delivery of small quantities to meet immediate demands. The aim of a JIT program is to correct the inefficiencies that cause a problem, not just the symptoms and, thereby, permanently solve the problem.

Although JIT started as a method to improve production efficiency, embedded within the Just-in-Time concept are several requisite elements that enable the application of JIT to business environments other than production. These elements are communications/information, distribution, storage, inventory, transportation, and personnel. The JIT elements of communications/information, distribution, and inventory are directly related to military logistics operations. All too often, a discussion of JIT focuses only on inventory management, based on the APICS zero inventory definition. Focusing solely on inventory reduction comes at the expense of improvement in the overall program. The practice of focusing only on inventory management has caused confusion and misunderstanding.

JIT practices are based on three basic tenets from management theory. The first tenet states that anything that does not add value to the product or service should be eliminated. Anything that is does not add value to a process is considered waste in the JIT environment. The second, JIT is a process and as such seeks continual process improvements and is not content to stop at any prescribed level of improvement or quality. Lastly, JIT practices view inventory as a waste. Inventory is considered a waste because it covers up problems that should and could be resolved rather than concealed by piles of inventory. JIT theory hypothesized that removing small amounts of inventory from the system will identify and then gradually eliminate this waste. Once a problem is corrected, more inventories are removed from the system.

Traditionally, holding inventory was less costly than correcting the acquisition and distribution inefficiencies. The level of a stream is commonly used to illustrate this concept.

When the level of the stream (inventory level) is lowered rock (problems hidden by the inventory) appears that impedes the flow of the stream. By removing the rocks, the stream now flows more smoothly and the level may be lowered a little more to reveal additional rocks or inefficiencies. If the rocks are immovable, a course can be plotted around the rocks to avoid the problem areas.

Program managers and financial management personnel tend to focus solely on the inventory management aspect of JIT and ignore the other tenets. This focus causes the implementation phase of many JIT programs to bog down. Focusing only on inventory reductions often leads to smaller inventories and reduced customer support. Focusing only on the inventory management while disregarding the problems the inventory is hiding is analogous to a doctor treating the symptoms of a disease rather than the actual cause of an illness. Such practices often provide temporary relief from the problem but the actual problem remains masked.

The JIT practitioners at NASA state that "the use of Just-in-Time methods results in considerably reduced inventory and enhanced customer response."[13] They further explain that "Although JIT was developed for production environments, there seems to be no reason why the concept cannot be extended to all business environments. The basic concept is to receive what is needed just in time for it to be used."[14] Major corporations throughout the world have adopted this philosophy in production environments.

The Application of JIT in Commercial Industry

Using the Japanese model as a basis, many major commercial firms have enjoyed success with JIT applications in manufacturing. Harley Davidson used Just-in-Time techniques in 1982 at its North American plants to gain control of the manufacturing process and generate cash savings to prevent bankruptcy. During the transformation at Harley Davidson, their inventory levels declined by seventy-five percent. Their inventory turns, a measure of how often inventory actually turns over in the warehouse, increased from five turns per year (about seventy three days of supply on hand) to twenty (approximately 18 days of supply on hand), and their productivity improved by fifty percent.[15] Harley Davidson was one of the earliest companies to apply the Japanese JIT techniques to an American operation. Like the transformation to quality in Japanese product, Harley Davidson has become renown for its quality products.

Like Harley Davidson, The Boeing Aircraft Company applied a combination of traditional "Japanese" JIT practices with modern JIT theories. Boeing produces an average of one 747-model aircraft every four days at its Seattle plant. Each 747-model aircraft has over six million components supplied from 1500 suppliers from fifteen different countries. Like the Japanese, limited storage space requires that the parts arrive only as needed for production.[16] Boeing also applied the Just-in-Time philosophy in their parts distribution facility. They process over 227,000 parts requisitions per day from the Seattle parts facility alone. This facility is one of six worldwide that provides six-hour guaranteed parts delivery anywhere in the world.

Much like the operations at the Toyota plants in Japan, the OPEL automobile plant in Russelsheim, Germany, practices JIT parts deliveries from its suppliers. All parts used in the production of an automobile belong to the supplier until they cross a line painted on the shop floor. Every supplier knows that he is responsible for the costs of stopping the line if his parts do not arrive on time. This concept allows OPEL to carry only four hours of supplies inside the shop. To take the JIT concept a step farther, OPEL, unlike American automobile companies, does not start the manufacture of a vehicle until OPEL has a customer order for a vehicle. These JIT procedures allow the same line to produce right hand drive cars for Britain and left-hand drive cars for the rest of Europe. It also allows simultaneous assembly of different on the same line. Each vehicle has a Radio Frequency tag attached to the assembly as it starts the process. The tag identifies what type of vehicle it is, the particulars of the vehicle, and the owner. This tag transmits signals along the assembly line to alert workers to the specific requirements.[17] The workers are then ready to install the correct part.

When the JIT practices have been applied properly in commercial industry, there have been dramatic results. For example, the implementation of JIT permits Caterpillar to fill an average of two orders per second, seven days a week. This equates to more than 50,000,000 customer orders per year or approximately 4.3 million orders per month. 99.7% of these orders are shipped the same day. The parts at the Caterpillar depots are maintained and stored based on their usage velocity. For example, fast movers are parts with greater than 10 demands per month; medium movers are parts with 1-10 demands per month; and slow movers are parts that have less than one demand per month. The key to the success of Caterpillar is the concept of JIT coupled with measurements that focus on velocity driven processes.[18]

At The Home Depot and Walmart, the move towards JIT includes eliminating the wholesaler. Most vendors ship directly to the stores or to the company's regional distribution centers, thereby cutting out the wholesaler. This provides The Home Depot and Walmart a process that is one step closer to JIT and reduces workload and stockage requirements at the main offices. Both companies maintain some warehousing operations where it makes sense based on buying habits and forecasts.[19]

All of the above mentioned companies learned some important lessons implementing JIT practices and those lessons should be considered when applying JIT to military operations. These companies encountered several obstacles to implementing JIT practices. The most commonly encountered obstacles are:

1. Resistance to change. People get comfortable with the "old way" of doing business and become concerned that methods that are more efficient may result in job losses.
2. Information hoarding. Knowledge is power and some managers are reluctant to release their power. The transfer of information and knowledge is critical to the cooperation between suppliers and customers to achieve JIT like deliveries.
3. Parochialism. Parochialism is a problem in commercial industry. It is also a problem in the military as each service defines its own narrow interests as do the branches within a service.
4. Inventory retention. No one wants to run out of a critical part and the prevailing attitude seems to be "I may need that in the future." In the Army this causes excesses throughout the supply chain and ties up dollars in inventory that could be used for other training or quality of life improvements.

These obstacles and lessons learned from commercial JIT applications are important to adopting JIT practices within the military. The military can avoid delays and potential problems by addressing the obstacles early in the implementation phase.

Commercial industry is not alone in its efforts to streamline logistics processes to achieve JIT like results. Commercial industry has built on Japanese success and has applied JIT practices to increase their bottom line and improve profits. The Department of Defense is not concerned with improving profit margins. However, as budgets continue to tighten, the Department of Defense and the individual services have realized that they have to act fast to reduce costs or Congress will direct reductions.

Military Efforts to Reduce Process Cycle Times and Achieve JIT-like Results

Within the Department of Defense, there are six major logistics process improvement programs underway. The Army has Velocity Management. The Marines have Precision Logistics. The Air Force has Expeditionary Logistics, and the Navy has High Yield Logistics. The program of the Marines focuses primarily on improving support to deployed forces. Expeditionary Logistics is an installation-focused program. The Air Force is concerned with reducing the time to repair aircraft components. The concern of the Navy is reducing the time to resupply ships at sea. At the joint level, the Defense Logistics Agency has Premium Service with a goal of delivering parts worldwide within forty-eight hours. The Director of Logistics for the Joint Chiefs of Staff has the Focused Logistics concept to support 21st century operations.

Premium Service is a cooperative contracted operation in Memphis, Tennessee operated by Federal Express. Approximately 3400 lines of supplies are stored in the contractor-operated facility and shipped via Federal Express to locations in CONUS within 24 hours and OCONUS within 48 hours of the requisition. The key to Premium Service is that if the unit is willing to pay the price for immediate shipment, DLA is willing to ship it via FEDEX. Responsible use of this concept could allow units to forego the cost of stocking essential items in Supply Support Activities' (SSAs) Authorized Stockage Lists (ASLs) and instead only order the items when they are needed. This type of service also allows units to avoid stocking critical but slow moving parts and frees funds to invest on providing stocks of faster moving items.

The DLA Premium Service program was a product of efforts to support the initiatives of the Army's Velocity Management Program. The Velocity Management Program started in 1995 as the result of a RAND Arroyo Center study on ways to improve the Army's logistics processes. One of the basic charters of the Velocity Management Program is to eliminate "non-value-adding processes."[20] The goal of the Velocity Management Program is to put parts in the hands of the soldiers "better, faster, cheaper." The program also seeks to identify areas of improvement that will enable soldiers to work more efficiently. Areas of waste include unnecessary tasks (revealed using process maps and current reality trees), unnecessary parts of tasks, and overly complex tasks. The best method for identifying unnecessary tasks is to ask, "Why is this being done?" while constructing the process map. The process map lets the soldiers that actually perform the tasks on a daily basis define what it is they are doing at each step.

The Velocity Management program initially looked only at the Order-Ship Time (OST) processes for Class IX (repair parts). OST was chosen because the Army Materiel Command has measured and recorded data on OST for over twenty years. The data is stored in the Logistics Intelligence Files (LIF) and more recently the Logistics Integrated Database maintained by the Army Materiel Command's Logistics Support Activity (LOGSA). The data in the LIF provides the Army baseline from which to measure results achieved by process improvements. The twelve-month period from July 1994 to June 1995 serves as the baseline period. The initial process diagram for the repair parts process is diagrammed below:[21]

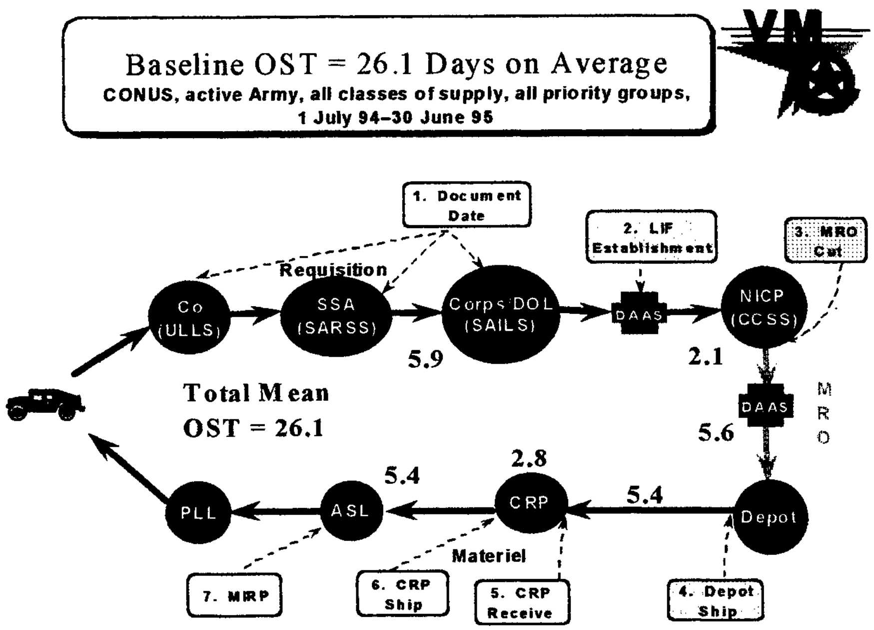

Figure 2. The Velocity Management Baseline Order-Ship Time Process Flow Map

A process flow analysis of the above data revealed that it took as long to move the electronic requisition, 13.6 days, as it did to physically move the actual supplies. Additional work by the RAND Corporation at the National Training Center revealed that it took up to five additional days to install the part on the vehicle or piece of equipment after the part was received at the unit.[22] Factoring in this additional time, the average customer wait time[23] during the baseline period was more than 30 days.

To map and identify the problems in the process, RAND developed a methodology designated as D-M-I. The Velocity Management Program adopted the methodology of Define-Measure-Improve (D-M-I). The D-M-I methodology seeks to define the process, to measure progress against baseline data and measures of program effectiveness, and to improve the process. The D-M-I methodology is very similar in nature to the Six Sigma Methodologies developed by Motorola to improve quality and service.[24] D-M-I is also similar to Dr. Deming's Plan-Do-Check-Action methodology for implementing change. Velocity Management also uses benchmarking as a method to identify best business practices in the commercial arena that may be applicable for implementation by the Army.[25]

Using Process Improvement Teams (PITs) and Site Improvement Teams (SITs), the Velocity Management (VM) Program branched out from a strictly Class IX OST focus. Based on the successes in the OST arena, VM started looking at Repair Cycle Times, Stockage Determination factors, and financial management issues that influence the ability of the logistics system to support the Army. The staff of the Department of the Army, Deputy Chief of Staff, Logistics manages the operations of the multi-functional PITs. The Commander of the Combined Arms Support Command serves as the Executive Agent for the day to day management and staffs of the PITs. Based on a directive from the Army Vice Chief of Staff, Site Improvement Teams now operate at every Army Installation. The use of the multi-functional PITs combined with the SITs has enabled the Velocity Management Program to successfully reduce the average CONUS OST from the baseline of 26.1 days to a CONUS wide average of 9 days. The OCONUS OST now averages less than 14 days, down from an average of 35+ days during the baseline period. Over the same period, the Repair Cycle Time for the Army decreased by over 35% because of reduced shipment times and improved installation stockage levels.

Some of the more successful examples of the Velocity Management Program are found at Fort Campbell, KY, Fort Irwin, CA, and in the US Army, Europe (USAREUR). At Fort Campbell, the OST has fallen from 20.4 days during the baseline period (Jul 94-Jun 95) to 7.4 days in 1999. During the same period the Repair Cycle time decreased from an average of 16+ days to just over 12 days. The Actual Customer wait time has also decreased as a result of the decreased OST and the increased fill rates. The cumulative result is an increase in unit readiness. When the VM process started at Fort Campbell the focus at the monthly Maintenance Management Reviews was on the maintenance work orders that were over thirty days old. Because of OST improvements, the focus at Fort Campbell is now on maintenance work orders that are older than fifteen days because there are no jobs over thirty days old.

By early 1996, the National Training Center at Fort Irwin, CA, achieved almost a fifty-percent reduction in the Order Ship Time of repair parts through close cooperation with the depots and other suppliers. The reduced OST enabled the installation to reduce the levels of stocks in the Supply Support Activities supporting the training fleets and rotational units. These reductions produced a "windfall" of over $20 million. The "windfall" was used to increase the number of different items stocked at the NTC by fifty four percent. The increase in the number of lines stocked in the SSAs significantly shortened the time rotational soldiers and contract mechanics waited to receive parts to repair home station equipment and the equipment on loan from Fort Irwin. The reduced order ship times coupled with the greater availability of different parts at the NTC resulted in a thirteen percent increase in the operational readiness rate for the M1A1 fleet when it was returned from the rotational brigade to the NTC.

The successful efforts in the US Army, Europe (USAREUR) produced reductions in OST from a baseline average of 23.1 days to an average of 13.3 days in 1999. Given the reduction in OST, USAREUR was able to recalculate its ASLs for its ongoing operations. USAREUR reduced the value of the parts stocked by $147 million and increased the number of different parts stocked. These reductions freed up funds that enabled the Supply Support Activities to add more parts to their ASLs. The increase in the variety of parts stocked allowed the SSAs to provide better, more responsive support the soldiers.

Reductions in Order-Ship Times and Repair Cycle Times enabled Army units to reduce their on-the-shelf stocks significantly by identifying processes throughout the logistics system that did not add value. The initial work done by the RAND Corporation revealed that there were plenty of areas for improvement in the Army's logistics system. RAND's later work at the NTC revealed that regardless of how responsive the parts delivery system was, if the part was not used for an additional 5 days after delivery there was still waste in the system. The Velocity Management Program's success over the past five years validates RAND's initial and subsequent follow-on findings. The Velocity Management Program provides the Army with a systems approach for looking at logistics problems and eliminating waste from the system.

Chapter 3

21st Century Logistics Requirements and Commercial Industry JIT

Given a firm understanding of Just-in-Time procedures and their history, it is possible to assess contemporary applications of non-manufacturing JIT concepts and to establish the requirements of a 21st Century logistics system. The National Security Strategy, the National Military Strategy, and Joint Vision 2010 set the military logistics requirements for the 21st Century. Additional military logistics requirements are generated by the Army's Revolution in Military Logistics and guidance from the office of the Deputy Under Secretary of Defense, Supply Chain Integration (SCI). The National Partnership for Reinventing Government has also established inventory goals for the Department of Defense.

According to the Under Secretary of Defense for Logistics, Mr. Roger Kallock, the Department of Defense logistics system is obsolete, expensive, and slow. The Department of Defense logistics system is an $80 Billion a year operation. The DoD logistics system requires an average of twenty-two days to deliver an item once it is ordered. The system does not have the trust of its. The system consists of over 1,000 different information systems, some of which are obsolete.[26] The complexity of the logistics information systems can be illustrated by the following description of the Marine Corps' logistics communications infrastructure. Figure 3 shows approximately 120 of the over 1,000 DoD logistics systems that a requisition must pass through from the time it is submitted until the part is received by the requester.

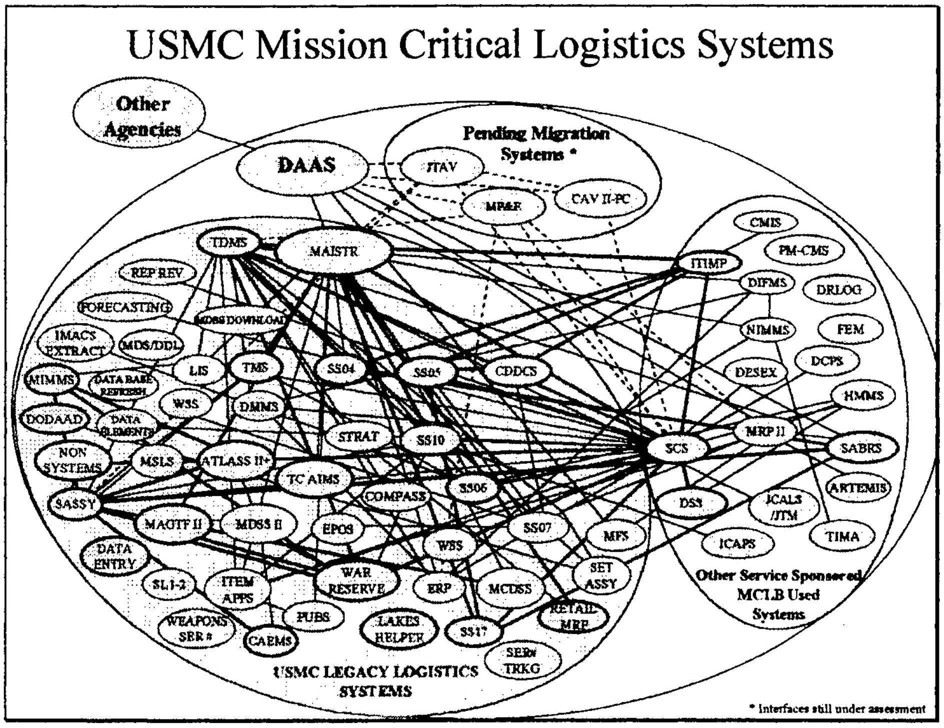

Figure 3. US Marine Corps Critical Logistics Systems

Each of the over 1,000 systems require operators and equipment. These systems operators and their equipment contribute to the size of the logistics support force. The Army plans to reduce its share of the DoD logistics force structure by twenty percent between now and FY2004, another twenty percent by FY2006, and another ten percent by FY2008.[27] The size of the Army's logistics force will shrink, despite plans in the National Defense Strategy for a New Millennium for continued engagements around the world. The Fiscal Year 2000 DoD Logistics Strategic Plan states clearly the logistics mission of the future, "To provide responsive and cost-effective support to ensure readiness and sustainability for the total force across the spectrum of military operations."[28] The draft FM 3-0 (100-5) defines the spectrum of operations as consisting of Offense, Defense, Stability, and Support (ODSS) operations. The Army's vision for the logistics support for these operations is a joint logistics process that is a "highly efficient, integrated system that ensures required support to the Warfighter."[29] To support the plan the

Army is posturing itself to move from a mass based, supply point logistics system to a distribution based logistics system.

The value of the inventory currently stocked at DLA depots under the mass-based logistics support concept approximately $63 Billion.[30] The mass-based supplies and logistics systems supported a variety of ODSS operations over the past ten years. These operations included offensive operations in Desert Shield/Storm, peacekeeping operations in the Balkans, humanitarian assistance in Nicaragua, catastrophic disaster assistance in Florida and California, and major disaster assistance in Oklahoma City. Under the engagement policy of the National Military Strategy, the logistics system will support similar operations in the 21st Century as well.

Joint Vision 2010 establishes the missions for the logistics systems of the 21st Century. The missions are readiness; support to the engagement policy; and international assistance. The 1998 National Military Strategy states that the logistics mission will be to support strategic agility, power projection, and peacetime military engagement.[31] Joint Vision 2010 foresees the end of the "days of multiple requisitioning of an item in hopes that at least one will arrive when needed."[32] The future logistics force structure will be a more precise balance between "Just-In-Case" and "Just-In-Time" with a goal of just enough.

The Department of Defense Strategic Logistics Plan for FY1996/1997 states that "the focus shift from global to highly diverse, regional conflicts – for peacekeeping, humanitarian, or combat missions – demands agile logistics support."[33] "Focused Logistics" calls for creating the ability to tailor logistics quickly to meet operational and tactical requirements. "US Forces must have the ability to link information, logistics, and transportation technologies."[34] "Focused Logistics" embraces the Just-in-Time requirement for delivery quickly and only when needed.

GEN Shinseki identified a similar logistic concept during a recent visit to the National Training Center, he asked, "Can we accept an order ship time of six days...is it right...will it work in combat? Six days does not make me comfortable..."[35] His concern about determining the right amount of time to fill a requisition is closely related to GEN Shinseki's commitment to deploying anywhere in the world within ninety-six hours. One of the elements of the Army's deployment concept is the reduction of the logistics support force. To deploy a credible force into an area in ninety-six hours will require a combat unit to deploy with a small amount of unit supplies and the confidence that the logistics system will provide resupply on time when needed. This vision appears to require some adaptation of Just-in-Time procedures to military support requirements. Without a shift in procedures, rapid deployment will be impossible.

However, to date, the focus of the initiatives within the Department of Defense has been strictly on reducing inventory levels as mandated by the National Performance Review.[36] As was stated earlier, programs that focus only on the inventory reductions usually do not produce the desired long-term results. There have been some efforts to apply other aspects of JIT. The Subsistence Prime Vendor program enables Dining Facility Managers to order their required rations today and receive the rations two days later. The Subsistence Prime Vendor Program has virtually eliminated the requirement for every installation to have a Troop Issue Subsistence Activity (TISA) warehouse and has eliminated the double handling of subsistence supplies. Before the Prime Vendor program, multiple vendors delivered subsistence supplies to the TISA for storage and subsequent issue to the Dining Facilities.

Another successful attempt to reduce inventory and improve responsiveness is the Prime Vendor program for pharmaceuticals. That program allows medical clinics and pharmacies to order the required pharmaceuticals and have them delivered within 24 hours. Rapid order and delivery precludes the need for every pharmacy in the Department of Defense to stock a large number of medications. The direct delivery of the pharmaceuticals eliminates the extra handling of the supplies at installation Central Receiving Points. Bypassing the Central Receiving Points insures that pharmaceuticals remain solely in the medical system, which reduces the possibility of loss or pilferage.

The Department of Defense has studied and tested the concept of using Vendor Managed Inventory[37] (VMI) to supply parts directly to units instead of through the Defense Depots. VMI simply shifts the location of the storage and reduces the need to deliver the part to the depot, to unpack it, and to place it on a shelf only to be later picked, packed, and shipped to the customer. Although any reduction in the time necessary to process the request and get the part to the using unit should be considered a step in the right direction changing the location of inventory piles is not JIT.

The improvements in streamlining logistics processes while improving customer support in commercial industry provide incentives for the Army and the Department of Defense to reduce their logistics force structure. The Honorable Jacques Gansler, Undersecretary of Defense, Acquisition and Technology, told the US Army War College Center for Strategic Leadership that the DoD logistics system does not provide the services with adequate support. He further stated, "What's worse, world-class companies, over the last few years, have demonstrated that similar tasks can be done at significantly lower costs, with significantly fewer people, and with dramatically better performance."[38] These "world-class" companies offer valuable lessons for the Army and DoD.

The best example of a corporation using non-manufacturing JIT practices is Federal Express. Federal Express (FEDEX) was founded on the principle that people are willing to pay extra for guaranteed premium service. FEDEX operates it primary hub in Memphis, Tennessee. The hub is equipped to handle approximately one million packages each night. The operation runs with precision. The planes start arriving in Memphis at ten o'clock in the evening and continue arriving until around two o'clock the next morning. All packages are sorted between two and four o'clock using bar code scanners and conveyers and moved to the appropriate location for loading. FEDEX flies empty planes on four dedicated routes, prepared to land anywhere along the route to cross load packages in case of a break down. The built in redundancy of the empty planes ensures minimal interruption in the package flow. Using Electronic Data Interchange (EDI) with the US Customs Office and the Customs Offices of the countries that it services, FEDEX is able to clear approximately 85% of its shipments through customs while the plane is still in the air. The extensive FEDEX communications system, monitored and controlled in their Worldwide Operations Center in Memphis, provides them with worldwide shipment visibility twenty-four hours a day. This level of visibility is the goal of the Joint Total Asset Visibility program.

Much of the FEDEX logistics business transformation focused on improving JIT practices. That focus allowed FEDEX to branch out into contract maintenance operations for Apple Computers and the DLA Premium Service operation. FEDEX works on the premise that customers are able to reduce their inventory and increase inventory turns[39] by replacing their physical inventory with better information. Newer operations allow customers to reduce their cycle times and increase their speed to the market using FEDEX's time definite delivery services.[40] For example, in working with National Semi-conductor (NSC), NSC was able to reduce product delivery to two days, close nine distribution centers, reduce the NSC personnel by five hundred people and produce real savings of approximately $8 million for NSC.[41]

Xerox has also been successful implementing JIT supply practices. Using JIT, Xerox reduced the time needed to obtain spare parts. That enabled Xerox to minimize the customers' downtimes. Xerox developed an order fulfillment tool to chart usage based a part's usage. At the same time, they altered their accounting system for parts. Xerox determined that in many cases the accounting, inventory, and receiving procedures for low dollar parts exceeded the value of the part.[42] The Xerox system is very similar to the Dollar Cost Banding procedures that the Army is testing now under the Velocity Management program.[43] Xerox realized that stocking low cost parts in all of its eighty parts centers in the US would provide a higher level of service at lower cost.

Cummins-Diesel, a supplier of parts for Army trucks, processes over 200,000 orders per month using JIT supply procedures. The Cummins goal is to achieve a "100% fill rate" off the shelf by the next morning after an order is received. Cummins seeks to achieve faster response times by moving stockage locations closer to their customers and using faster transit modes. The Cummins Diesel resupply philosophy assumes that the customer's cost of being down is higher than the cost of next day shipment. Even without the use of next day shipments, the goal is 100% resupply within three days and the next day if the part is on the shelf. Since the cost of inventory obviously increases as service levels increase, the items stocked must be based on demand. With this in mind, Cummins refocused their stockage determination policies to maximize the breadth of stocks instead the depth of the stocks.[44] Cummins bases their stockage criteria on how often a part is ordered and in what quantity (Demand Velocity); how long it has been since the last time the part was ordered (Demand Age); and the actual cost of stocking the item. The goal of the program is to carry a variety of critical parts with less depth. The new stockage philosophy is similar to the Dollar Cost Banding test that the Army is conducting through the Velocity Management Program.

Many companies are moving to fewer, more centralized distribution centers to streamline the flow of material to customers. At the 1998 Warehousing Education and Research Council Annual Convention, Dr. Ed Frazelle stated that "logistics is the flow of material, information, and money between consumers and suppliers."[45] The best way to streamline that is to eliminate and combine operations when possible. The Defense Logistics Agency started on this road in the mid-1990s when it assumed control of the Army Materiel Command's supply depots. Distribution was further centralized in 1998 when Defense Distribution Region, East (DDRE) merged with Defense Distribution Region, West (DDRW) and became the Defense Distribution Command. The Disney Stores® and Toys R Us® have accomplished this type of consolidation very successfully in the Memphis, Tennessee area. By locating in the general vicinity of the FEDEX hub and close to a UPS hub, both companies are now able to service the entire country from one distribution center.

Another way to minimize the logistics flow is to place items that are ordered most frequently together. L.L. Bean did a Demand Velocity analysis of their orders and realized that shirts of the same size but different colors or designs were most frequently ordered together. The solution was to place all shirts of the same size in the same location to reduce travel time within the warehouse to process an order.[46] The military could apply this warehouse in a warehouse concept by organizing the Supply Support Activity or Depots into sub-areas based on weapon systems. For example, within a depot there would be an M1A1 area in which all M1A1 unique parts are stored; an M2/3 area for Bradley parts, and an M113 family area. The warehouse in a warehouse concept reduces parts handling and reduces the travel time necessary to locate and pull the part off the shelf.

To measure improvements in the logistics flow achieved through JIT practices the Army needs to abandon the performance measures developed in the 1960's and 1970's. In a presentation entitled "Seven Principles of World Class Warehousing," Dr. Frazelle discussed world-class performance measures.[47] The following chart compares what is considered world class in a JIT environment with the AR 710-2 standards and the processing times found in the Logistics Integrated Database.

	World Class[48]	Army[49]
Inventory Accuracy	99.97%	95%
Shipping Accuracy	99.998%	Not measured
Dock to Stock	2 hours	2 days
Warehouse order cycle	3 hours	2 days

Figure 4. Benchmarking Army Performance to World Class Performance Measures

The world-class levels of performance reflected in Figure 4 provide the Army a level of support to set as the goal with the adoption of JIT procedures for military operations. The difference between the Army's two-day dock to stock time and world-class could prove to be the difference between success and failure in a future operation.

Commercial industry bases their essential business drivers or goals on the customer's needs. The Army's performance measures are based on the performance within distinct segments of the supply chain, not the customer. However, to improve overall performance DoD must define measures that create agility and measures that are not more bureaucratic. As Dr. T.C. Bond has pointed out in a recent edition of the *International Journal of Operations and Production Management*, "dysfunctional behavior may result from inappropriate metrics."[50] Some of the metrics used by commercial industry that could be applied in the Department of Defense are: the percentage of orders filled; the percentage of items that are actually in stock; the percentage of deliveries that are on time; and actual dock to stock times. [51] Use of these measures would provide a customer centric view of the storage and distribution systems. A shift from internal measures to customer measures provides logistics managers with a feel for the impact of their actions on the customer.

Another trend in commercial practice is to integrate the acquisition personnel into the JIT process. According to Riggs and Robbins in *The Executive's Guide to Supply Chain Management Strategies* a major supply problem is the fact that procurement personnel do not understand how products are used during the various stages of manufacturing.[52] In the case of item managers and contracting personnel, this is very true in today's DoD. This problem is compounded because supply clerks lack an understanding of repair parts and their application when the part arrives at the SSA. To most soldiers working in the warehouse, 92A Military Occupational Skill (MOS), a part is a part. To the item manager at the NICP, the essentiality code assigned to part during the initial materiel development and acquisition process determines the value of the part. If a part is not coded as essential in the Federal Catalog (FEDLOG), then the part is assumed less important for the operation of the equipment. If the part is not essential, it falls back in the queue of items for replenishment. This misunderstanding of the essentiality code leads to critical shortages and down time for equipment and weapon systems. Yet, the Department of Defense continues to move acquisition personnel farther away from the Item Managers and the Item Managers farther from the actual location of the stocks.

Chapter 4

Analysis and Applications of JIT to 21st Century Logistics

In a speech to Army War College Center for Strategic Leadership in January 1998, the Honorable Jacques Gansler, Deputy Under Secretary of Defense, stated, "In very simple terms, it (the DoD Logistics System) costs far to much, takes far too many people, and does not provide the desired performance in terms of readiness, responsiveness, or sustainment. What's worse, world class companies, over the last few years, have demonstrated that similar tasks can be done at significantly lower costs, with significantly fewer people, and with dramatically better performance."[53] This leaves one wondering, if world class companies have improved performance and reduced costs while reducing lead times and inventories, why can't the Army and Department of Defense do the same? This chapter analyzes what the Army has done and what it can do to improve performance by applying JIT concepts.

The lack of a common operating logistics communications architecture is the biggest reason why the Army and the DoD maintain inefficient logistics systems. JP 4-07, Common User Logistics, acknowledges the problems facing the services in providing common support. The inability to communicate between services is a real drawback to implementing a JIT philosophy for future operations. It is currently very difficult to process requisitions between services. Although all of the services use the same catalog with the same National Stock Numbers, they all use different requisitioning procedures. Therefore, the using unit must manually fill out a paper form, which states all the required information in detail. The manual requisition is physically passed in the standard eighty-card column format to the supporting service. The unit with the supplies checks the National Stock Number (NSN) to ensure it is correct and then determines if it is in stock. This presents a problem because there may be as many as eight different NSNs for the same item. A separate NSN is assigned depending on the end item application or how an item is packaged. For example, a battery in a twelve pack has a different NSN than the same battery in a four pack and an engine with a slight modification has a different NSN than the unmodified engine. The inability to communicate between services reduces the entire cross service support process to manual transactions in the age of automation.

Within the Department of Defense, there are multiple retail service unique logistics communications systems. The Navy has the Shipboard Non-tactical Automated Data Processing Program, the Shipboard Uniform Automated Data Processing System, and the Uniform Automated Data Processing System. The Army has the Unit Level Logistics System – Ground (ULLS-G), the Unit Level Logistics System – Aviation (ULLS-A), the Unit Level Logistics System – S4 (ULLS-S4), and SARSS-O. The Army has an additional communications loop for property book items. Accountable items ordered by one of the other systems must also pass through the Standard Property Book System – Revised (SPBS-R). The Air Force uses the Air Force Standard Base Supply System and the Marines use the Supported Activities Supply System (SASSY). The retail supply communications picture is further complicated by the fact that none of the service systems can "talk" to each other. Joint Pub 4-07 states that the Army is the Common User Logistics provider for a number of items. The need for a common architecture is the reason that many large firms, such as Honeywell (formerly Allied-Signal) and The Home Depot, have implemented Enterprise Resource Planning (ERP) packages. An ERP program enables component work units to use the same computer language and removes the communication barriers evident in the DoD. Another approach to the communications problem is Federal Express' PowerShip® program. PowerShip® converts shipping information from customers' legacy systems, converts this into PowerShip® 's language and then sends back inventory and shipment information to the company in the customers' legacy languages. A program such as this may provide the Army and DoD with the interface necessary to operate jointly until a common architecture is developed. A system like PowerShip® also provides asset visibility and intransit visibility.[54] The Singapore Armed Forces solved their communications issues by adopting the Enterprise Resource Planning program SAP® for all of its logistics and financial operations. The Canadian Defense Forces solved their communications incompatibility problems years ago by consolidating into a one-service defense force. Their continuous process improvement programs have further streamlined logistics operations by adopting JIT practices in their supply chain operations.[55]

Commercial industry is moving towards mandatory use of Electronic Data Interchange for ordering, shipping, receiving. Some companies are moving towards dealing only with suppliers that can communicate via EDI. The use of EDI for DoD transactions was mandated on December 9, 1998 by DoD Reform Initiative Directive #48. Directive #48 mandated adoption of commercial EDI standards for all DoD Logistics and Business transactions. This advanced form of communications will work once all of the services have systems that can communicate with each other. In the meantime, the use of EDI will reduce some of the communications slow downs between the Defense Logistics Agency and suppliers, and should reduce the Administrative and Procurement Lead Times that delay DLA and AMC procurements. The use of EDI will also enable DLA to use and provide Advanced Shipping Notification and commercial Vendor Managed Inventory visibility to SSAs. This will in turn reduce shipping and receiving processing times at the wholesale level.

However, one of the arguments against implementing JIT for the armed forces involves communications capabilities. JIT is based on being able to order supplies as needed and have them immediately shipped to the customer or in the case of the military to the soldier, sailor, airman, or marine that is in need of the part. JIT ordering and receiving requires assured communications. If for some reason communications are interrupted by terrorist, military, or even cyber-attacks, deployed forces could not rely on parts available in theater which might reduce military effectiveness. The threat of communications breakdowns provides a strong argument against total reliance on JIT for Offensive and Defensive operations.

Reliable communications for critical, high integrity information can reduce uncertainty. Reducing uncertainty leads to the reduction or elimination of safety stocks. The reduction of safety stocks releases dollars to stock other critical items. The more items that are stocked in smaller quantities closer to the user, the shorter the processing time for the total order and the faster the organization moves toward JIT. Thus, communication is critical to inventory control.

Inventory is another critical piece of the JIT equation. According to the Department of Defense's Logistics Handbook for Fiscal Year 1999, the number of inventory turns at the wholesale level is atrocious. World-class commercial firms such as Motorola turn their inventory approximately 13-19 times every year. Exceptional firms such as Dell Computers average one inventory turn every week which approaches true Just-in-Time. The number of turns for Army managed items at the wholesale level is less than once per year. The inventory of Army managed items rotates out of the warehouse approximately once every 3 years. DLA managed items are only slightly better managed, averaging 1.2 turns per year.[56] The Department of Defense, as a whole, averages about .4 turns per year. These statistics indicate that either too much "stuff" is on the shelves at the wholesale level or the wrong items are stocked. The low number of inventory turns also suggests that what is stocked is so long in supply that the DoD could go for several years without replenishing. The current stock is approximately 490 days of supply to cover safety stock, Administrative and Procurement Lead Times (ALT/PLT), and repair cycle times at the wholesale level.[57]

Like the United States defense establishment, the Australian defense ministry found that they moved inventory very slowly. The Australian Defense Efficiency Review conducted in 1996 revealed that there was a need to improve inventory management. They also concluded that the inventory levels were too high. The inventory levels were based on a "just-in-case" mentality. Like DLA, the Australians realized that a large part of their inventory, sixty to seventy-six percent, was dormant. The large inventory indicated that many of the items were unnecessary or overstocked. The Australian reasons for holding stocks were much like the reasons the US Armed Forces continue to use for holding stocks. The Australian study listed insurance against stock-outs, ensuring life cycle support to weapon systems, reducing order costs, and buying in large quantities to gain discounts as the reason they maintained high levels of repair parts.[58] These are some of the same reasons given in arguments for maintaining "Iron Mountains" of stocks for the United States Army.

As noted earlier, companies that concentrate only on the inventory management and reducing stocks often fail to improve the overall process. Inventory reduction alone is not enough to categorize the program as Just-in-Time management. If inventory is used to buffer against variations in predictable requirements then the problems that the stocks hide will not be uncovered. The ill effects of over stockage can be illustrated by the efforts to reduce inventory (1995-1997) at the National Training Center (NTC). The reductions in processing cycle times at the NTC and at the depots allowed the NTC to reduce inventory levels by 45% while increasing the number of lines (items stocked) in the ASL by over 50%. The reductions in the buffer inventories at the NTC revealed serious maintenance shortcomings masked by the artificially high inventory levels. Instead of solving the maintenance problem, the NTC logistics community had focused on the symptom of the problem or the inventory levels. Believing the problems to be inventory related the Department of the Army purchased approximately $25 million in additional inventory for the NTC in 1999. Not only did the additional inventory not solve the maintenance and internal distribution problems, it created a new problem. The new problem is how to manage the increased levels of inventory with the same manpower and facility.

Opponents of JIT also focus on the inventory reduction aspects of JIT and point to it as a reason for not implementing JIT methods. These opponents argue that if the levels of inventory are reduced too low, the Army's ability to support two major theaters of war would be significantly reduced. However, the variety of items stocked is more important than the depth of the stocks. The argument against lowering inventory levels has more merit if the support provided to deployed forces was interrupted because items ere not available for shipment. However, the figures from the Logistics Intelligence File show that the support to recent operations was provided in less than half of the time required to support Operation Desert Shield/Storm. The initial support lead-time for Desert Shield was approximately 40 days. Figure 5 shows the lead-times for recent deployments.[59]

Operation Joint Endeavor (Bosnia) Feb 96 Average OST	Operation Joint Endeavor Apr 96 Average OST	Task Force Hawk (Albania) Apr 99 Average OST	Operation Joint Endeavor Feb 96 @ 95% fill	Task Force Hawk Apr 99 @ 95%
22 Days	18.6 Days	11.7 Days	30 Days	14 Days

Figure 5. Requisition Lead Times for Recent US Army Deployments

JIT inventory levels depend on a proper forecast of needs. The inventory and communications are interrelated. In 1999, the Hershey Company recognized the interrelationship. While implementing a new planning system in the early summer of 1999 Hershey Foods discovered a communications problem in the transfer of data between the planning software and the production software. Consequently, Hershey Foods failed to obtain the supplies needed for the critical Halloween and Christmas seasons. Reducing supplies depends on achieving the correct balance between communications, inventory, and distribution.

The third critical area of Just-in-Time management is distribution. Dr. Jim Tompkins, in a monograph entitled Inventory: the Unwanted Asset, states that distribution is the management of inventory to achieve customer satisfaction.[60] Distribution must be linked to both the communications and the inventory to make the JIT philosophy work. Proper communications/information as proposed under the Joint Total Asset Visibility (JTAV) Program enables inventory throughout the world to be visible to item managers and Materiel Management Centers. Total Asset Visibility enables managers to treat the inventory at storage sites and in transit into a virtual warehouse. Proper communication will enable the item manager to re-route the items in transit to users with critical requirements. A more critical requirement can be defined as a requisition for a Non-Mission Capable, Supply (NMCS) deadline as opposed to a routine requisition to replenish stockage. This virtual warehouse reduces the amount of inventory on the shelves at both the wholesale and the retail levels. To create a virtual warehouse, the distribution system has to be responsive and robust enough to move the supplies and reroute them if necessary. In addition, the distribution system must have the flexibility to ship parts and supplies from one location to another. TRADOC Pam 525-5 states "Once deployed, the distribution based system will be fully integrated into operational planning, complete situational awareness, and be able to anticipate and respond to customer requirements. .... The goal is 24 hour global delivery with 100% accuracy enabled by precision GPS air delivery."[61]

One obstacle to implementing JIT in the Department of Defense is its distribution system. The Defense Distribution network is currently not able to handle an increase in the number of shipments that will result from implementing Just-in-Time procedures. It may also be too expensive to increase the number of shipments. There is a price for DLA premium service. DoD organizations that choose to use the DLA Premium Service Program pay a surcharge to cover the cost of the next day delivery. However, it is possible to accomplish JIT deliveries while saving money. The best example of that is improved delivery times to the National Training Center from the DLA Depot at Stockton, CA. The consolidation of shipments into daily deliveries on scheduled trucks instead of using small parcel air (primarily FEDEX) and small parcel ground (primarily United Parcel Service and the US Postal System) resulted in significant reductions in in-transit times. The reduction from ten days to just over one day of in-transit times saved over $800,000 in the first eighteen months of the service.

Another obstacle to adopting JIT procedures in DoD is the prospect of increasing the number of shipments of smaller packages. Opponents of JIT note that the Japanese government is now offering incentives for companies to abandon JIT. The Japanese government is doing this to reduce the number of trucks clogging the roads and creating air pollution while making JIT deliveries with only partially filled vehicles. Opponents of JIT argue that smaller shipments by DLA will result in more shipments that will probably clog the distribution pipeline. To avoid this problem, DLA uses scheduled trucks dedicated to large customers instead of the using the more expensive small parcel carriers. The use of scheduled trucks to deliver all of a unit's supplies at one time results provides more full truckload deliveries and fewer, more frequent smaller deliveries.

Chapter 5

Conclusions

JIT was originally defined in the United States as "zero inventories." Although reductions in order ship times, customer wait times, and maintenance repair cycle times did enable the Supply Support Activities and Depots to reduce stockage levels, the Army cannot afford to go to "zero inventories." Zero inventory levels are not feasible in the military because of the nature of the military operations. While commercial industry can risk being out of stock, the Department of Defense cannot risk soldiers' lives if critical stocks are not available at the right time. Therefore, some level of stockage will be maintained for military operations. The level of Just-in-Case supplies needed depends on the location and duration of each mission.

The Japanese developed JIT processes have improved the efficiency of manufacturing at both Boeing and OPEL. These same processes and philosophy if applied to the Army Materiel Command's depot work could reduce required depot storage space and supplies. AMC could forecast the annual requirements on a blanket purchase order and then tell the supplier each week the number of assemblies that are to be repaired and obtain the necessary parts on Friday for work scheduled the following Monday.

JIT applications used by Boeing and FEDEX to process requisitions and packages can be applied to the Army's logistics operations. Both companies base success on the management of inventory, good communications, and rapid distribution. During the largest military deployment since the Korean War, the number of requisitions for Desert Storm reached approximately 35,000 per day. The Army's logistics system was taxed but successful in Desert Storm. Using JIT management principles, FEDEX processes and delivers over 1,000,000 packages a day through its hub in Memphis, Tennessee and Boeing processes over 227,000 requisitions daily through its Distribution Center in Seattle, WA.

The most prevalent reason for holding extra inventory is to provide a buffer for variations in demand. Item demand at Boeing and FEDEX is relatively constant. Only one thing is constant in military operations; that constant is unpredictable rates of equipment failure. There are models to predict reliability and failure factor rates for all of the breakable parts on the Army's high tech equipment, but experience from the National Training Center proves that intense operations cause parts to fail at uncertain rates. A critical failure at the wrong time could result in the loss of the crew and the equipment. Because the nature of military operations is not predictable, the Army will never be able to move completely away from maintaining inventories close at hand. However, the application of the principles of Just-in-Time management to Army and DoD supply operations will eliminate some of the waste in the system. The elimination of the waste from the logistics systems will provide a smaller, more responsive support system for the 21st Century.

Although a total reliance on Just-in-Time is not feasible for military operations, adopting the JIT philosophy of eliminating waste from the system will provide some efficiency for the Army. For the Army to be able to support operations across the full spectrum envisioned in ODSS, it has to adopt the Just-in-Time management philosophy across the logistics spectrum. This philosophy includes the adoption of a world class communications system and a world class distribution system. The communications/information and distribution can be enhanced through the use of technology such as shirt-button sized radio frequency tags to track inventory and provide the soldier with real time visibility of inventory. Only through eliminating the non-value adding processes and excess inventory in the system while establishing a trust logistics system will the efficiencies be gained that are needed to successfully support the Army in the 21st Century.

[1] Velocity Management Brief, http://www.cascom.army.mil/vm

[2] Cycle time is the amount of time to complete all of the actions within a given process. An example is the time for a warehouse to receive a shipment, process the receiving paperwork, and put the item on the shelf or in the customer locations.

[3] APICS, *APICS Dictionary, 8th Ed.*, (Falls Church, VA, 1995), p.84.

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[5] The term supply chain appears in Jacob Kipp's translation of V.K Triandafillov's book, *The Nature of the Operations of Modern Armies.*

[6] Supply Chain Council website, http://www.scc.org

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[9] NASA Website, http://dfca.larc.nasa.gov/dfc/jit

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[12] Jordan, Henry, "Inventory Management in a JIT Environment," APICS website.

[13] NASA Website

[14] ibid.

[15] Goetze, Lisa A., "Harley-Davidson Improves Production Efficiency," *Modern Materials Handling Magazine*, October 1998, p. 45.

[16] Hutchins, Greg, *Taking Care of Business*, Oliver Wight Publications (Essex Junction, VT), 1994, p.51.

[17] Based on briefing received at the OPEL plant on 19 April 1995

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[21] Velocity Management brief, www.cascom.army.mil/vm

[22] Lewis, Matthew, Rick Eden, and Dave Oaks, "Velocity Management in Deployments: Insights from the National Training Center," RAND Arroyo Center, February 1996.

[23] Customer wait time can be defined as the total amount of time from the time that a fault is identified by the mechanic or operator until the fault is corrected and the equipment is Fully Mission Capable.

[24] Six Sigma. "Continuous improvement by measuring, analyzing, and controlling the improved process. The Six-Sigma methodology is important from the quality aspect – Six Sigma as a measurement (6δ) is literally less than three errors per million transactions. Six Sigma is more important for this research from the process perspective. The Six Sigma process is a continuous improvement process that has six distinct steps.

[25] Benchmarking is the process of improving performance by continuously identifying, understanding, and adopting outstanding practices and processes found inside and outside the organization.

[26] "Transforming Logistics for the 21st Century," Mr. Roger Kallock in a presentation to the Joint Total Asset Visibility Working Group, 4 Jun 99.

[27] Cannon, Charles C, Jr., MG, Presentation to Senior Service College Fellows, 24 Jul 99.

[28] FY2000 DoD Logistics Strategic Plan, Department of Defense, Washington, DC, p.10.

[29] ibid., page 10.

[30] Office of the Undersecretary of Defense, Supply Chain Integration, *1998 Logistics Handbook*, (Washington, DC, 1998), p.15.

[31] *National Military Strategy – August 1998*, p.4-6.

[32] *Joint Vision 2010*, p.iii.

[33] Office of the Under Secretary of Defense (Logistics), *Department of Defense Logistics Strategic Plan, Edition FY1996/1997*, (Washington, DC, 1997), p.6.

[34] *Focused Logistics*, p.16

[35] GEN Shinseki, CSA Trip Report, NTC Visit, 25 Nov 99.

[36] In 1998, the National Performance Review changed its name to the National Partnership for Reinventing Government.

[37] Vendor Managed Inventory can take on several forms. The supplies can be physically at a retail type location. A vendor is responsible for resupply. Another form of VMI requires the vendor to store items and to supply as needed.

[38] Gansler, Jacques S., Remarks to the US Army War College Center for Strategic Leadership, January 14, 1998, www.acq.osd.mil/ousda/speech/carlisle.html

[39] Inventory turns is the number of times the inventory completely turns over in a warehouse or distribution center.

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[41] Podwaski, Roger, "FEDEX, Airline of the Internet," presentation Warehouse of the Future, Phoenix, AZ, 1998.

[42] McCrossen, Mary, "Reducing the Lead Times of Spare Parts Distribution," Presentation to Interlog 98, Chicago, IL, July 1998.

[43] Dollar Cost Banding is a new project of the Velocity Management Program. Items qualify for stockage in an ASL based on dollar bands coupled with frequency of use. The current methodology for stockage determination treats all items of inventory the same regardless of dollar value.

[44] Haley, William & Norbert Nusterer – Cummins Diesel presentation to Interlog '98, July 14, 1998.

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[46] Harvard Business School case study on L.L. Bean, "Item Forecasting and Inventory Management," Boston, MA, September 1993.

[47] Frazelle, WERC presentation, May 4, 1998.

[48] ibid.

[49] AR 710-2

[50] Bond, T.C., "The Role of Performance Measurement in Continuous Improvement," *International Journal of Operations and Production Management*, vol. 19, no. 12, p. 1319.

[51] Dock to Stock time refers to the time necessary to get supplies from the receiving dock to the customer bin in the SSA or to a storage location.

[52] Riggs, David A. and Sharon L. Robbins, The *Executive's Guide to Supply Management Strategies,* AMACOM, (New York, 1998), p.74.

[53] Transforming DoD Logistics Hon. Jacques Gansler, January 14, 1998 speech to Army War College Center for Strategic Leadership

[54] For more on the PowerShip® program see *Transportation and Distribution Magazine*, December 1999.

[55] For more information on the Supply Chain Program the Canadian Defense Forces are pursuing see http://www.vcds.dnd.ca/dgmrs/scp

[56] FY99 DoD Logistics Handbook, p.24.

[57] ibid., p.24.

[58] For more on the Australian Defense Efficiency Review, similar to our QDR process, see the website, http://www.anao.gov.au/rptsfull_98/audrpt5/parttwo2.html

[59] Velocity Group Board of Directors proceedings May 1999, LIF data

[60] Tompkins, Jim, Ph.D., "Inventory the Unwanted Asset," Tompkins Press, (Raleigh, NC, 1997), p. 19.

[61] United States Army, TRADOC PAM 525-5, *Force XXI Operations,* (Fort Monroe, VA: US Army Training and Doctrine Command, 1 Aug 1994), p.6.

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