Factory to Foxhole: Improving the Army's Supply Chain

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On the surface, the end-to-end supply chain that procures and moves repair parts to support U.S. Army troops worldwide may seem similar to commercial supply chains: both have suppliers, wholesale distribution centers, retail supply activities, customers, and transportation carriers which move parts from point to point. The main differences between military and commercial supply chains not surprisingly stem from the challenges the military must face and how it must respond.

In 1999, a team of RAND analysts were awarded Al Gore's "Hammer Award" for support of the Army's Velocity Management initiative, which dramatically improved order and ship times (OST) for repair parts. Current efforts to improve the Army's purchasing and supply management (PSM) are further upstream, integrating supplier management to achieve higher stock availability at lower total cost. As shown in figure 1, these initiatives span the end-to-end Army supply chain, from factory to foxhole.

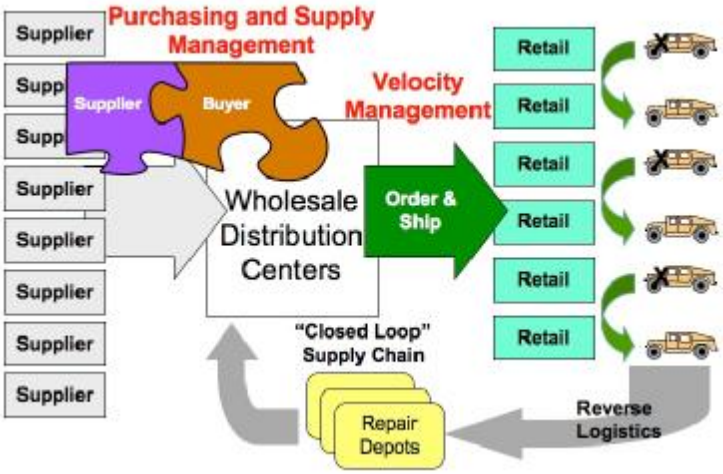

Figure 1: The Army's factory to foxhole supply chain, and how velocity management (VM) and purchasing and supply management (PSM) work to improve support the warfighter.

Military versus Traditional Supply Chains

Traditional commercial supply chains focus on physical efficiency, with a particular emphasis on operating at the lowest possible cost, minimizing inventory investments, and maximizing capacity utilization. In particular, supply chains that support just-in-time manufacturing smooth the flow of material from supplier to manufacturing line, e.g., the Toyota production system (TPS).[i] Management of physically efficient supply chains may include actively managing demands, such as with "everyday low prices" to mitigate surges, spikes, or forecasting inaccuracies from the supply system.

Military supply chains in contrast are focused on responsiveness and surge capabilities. The Army must be able to deploy quickly anywhere in the world, with a

supply chain that can adapt and respond to unpredictable demands and a potentially rapidly changing environment. Support for Operation Iraqi Freedom (OIF) moved the equivalent of "over 150 Wal-Mart superstores" to Kuwait to support 250,000 soldiers, sailors, airmen, and marines scheduled for deployment.[ii] Fischer (1994) wrote that the nature of commodities, functional or innovative, dictated whether supply chains needed to be physically efficient, or demand-responsive.[iii] Some industries that produce products with great forecast uncertainty also rely upon demand-responsive supply chains, e.g., high-tech, high-fashion, or even toy/entertainment industries.[iv] It is the nature of the military's *mission* that dictates a demand-responsive supply chain.

The characteristics of Army repair parts is also a challenge, i.e., highly specialized and weapon system-specific, frequently produced by sole-source suppliers with no commercial market to draw upon. Many parts, such as engines and transmissions, are "reparable" and must be overhauled as a source of future supply.[v] Thus the military not only has to manage a forward logistics pipeline, it must also manage a nearly equal size reverse logistics or "retrograde" pipeline within a "closed loop" supply chain.[vi] For every engine, transmission, or rotor blade replaced in the field, a carcass must be moved back to Army repair depots or national maintenance programs. All these commodity characteristics, combined with a mission that must respond to unpredictable surges and demand spike, highlight differences between the Army's supply chain and those of commercial companies.

Velocity Management for Speeding the Flow

Begun in 1995, the Army's Velocity Management (VM) initiative sought to improve the responsiveness, reliability, and efficiency of a logistics system based on massive stockpiles of supplies and weapon systems, many of them prepositioned "just in case."[vii] While this system was world-class for supporting a Cold War army, it became increasingly less effective and unaffordable for the current force projection army.

To measure the Army's logistics performance properly, the VM team developed a percentile bar-chart presentation of order and ship times to portray not only times for the peak, but also for the tail of the distribution. Figure 2 shows the time distribution of OST for moving in-stock materiel from the wholesale defense distribution centers to the Army's retail supply activities. The horizontal axis shows OST measured in days, and the vertical axis displays the percentage of total requisitions with that OST. On the lower horizontal bar, the black region represents the time required to receive half the requisitions for repair parts (17 days during the VM baseline period). The intermediate yellow and final gray regions shows the additional times required to receive 75 percent and 95 percent of the requisitions, respectively. A red marker is also placed at the mean (22.4 days during the baseline). Because the average time and 95th percentile variability differed by a factor of two or three, soldiers waiting for repair parts had no ability to plan repair schedules or to maintain the combat readiness of their weapon systems. They simply waited and waited as frustrated customers of an unreliable and unresponsive distribution system.

Figure 2: In 1994-95, Army order and ship times were lengthy with a long, variable distribution.

Using a Define-Measure-Improve methodology, the VM team "walked the process," following both the flow of requisitions and materiel. The implementation and optimization of scheduled truck deliveries provides an excellent example of "win-win" solutions. By replacing a prior mix of delivery modes with a reliable, high-volume and high-performing distribution system utilizing scheduled trucks, the Army has a premium-level service that is faster, better, and cheaper. Other improvements included better coordination of requisition processing and financial reviews, simple rules to "clear the floor" daily, and establishing a high-level governance structure to measure performance and drive continuous improvement.

Through VM, the Army dramatically streamlined its supply process, cutting OST for repair parts by nearly two-thirds nationwide, shown in figure 3.[viii] The greatest improvements, cutting OST by over 75 percent, have been achieved at the major forces command (FORSCOM) installations and other installations in the Active Army, shown in figure 4. Today, Army customers nationwide and around the world routinely receive the quick and dependable level of service they have come to expect from a high-performing commercial supply chain.

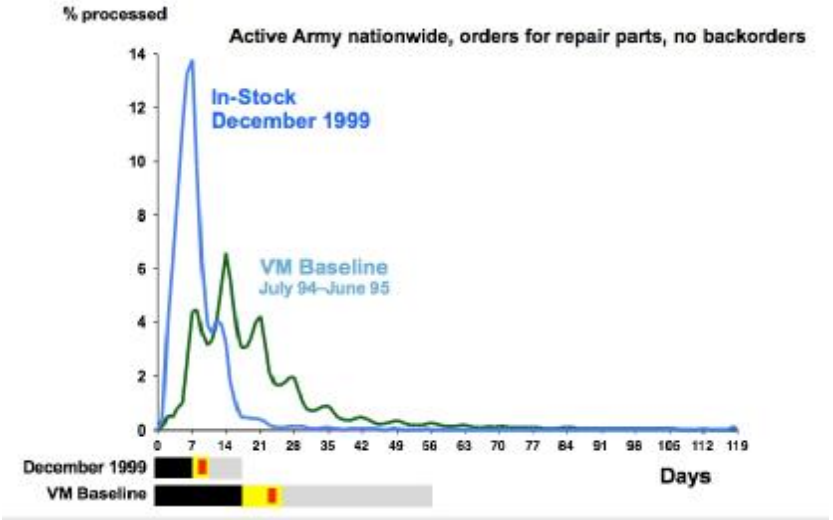

Figure 3: Army order and ship times dropped dramatically during the implementation of Velocity Management.

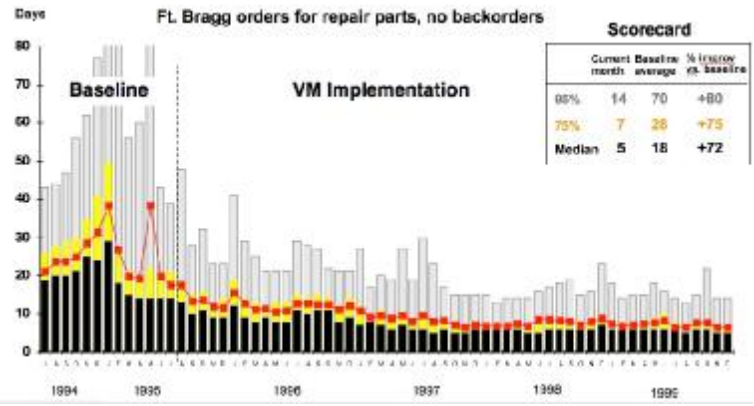

Figure 4: At major FORSCOM installations such as Ft. Bragg, the improvements in OST have been the greatest and most dramatic.

Improving Purchasing and Supply Management

While VM distribution improvements focused on *moving* parts that are in-stock, more recent efforts to improve the Army's PSM processes are aimed at *keeping* parts in-stock. During the high operating tempo and increased demand for repair parts in OIF, requisition backorder rates of Army-managed items at the national wholesale level skyrocketed, reaching 35 percent for the active Army.[ix] Backorder rates are a key performance metric because they contribute to longer customer waiting times for parts, longer repair cycle times, and ultimately impacted weapon system availability and unit readiness.[x]

Certainly, many factors have conspired to create stock availability challenges besides the contingency surge, such as financial delays and underfunding of war reserve inventory prior to the war. Implementing best PSM practices has the potential for improving future supply performance, such as reducing lead times and total costs. In the commercial world, there has been a paradigm shift from managing items and contracts, to managing suppliers and supplier capacity. This helps reduce the "bullwhip effect," where lack of coordination and information cause large, variable demand swings back through the supply chain.[xi] Best PSM practices call for increased collaborative, planning, forecasting, and replenishment (CPFR) between buyer and supplier and have led to better supplier management and more integrated supplier relationships. These are the PSM goals the Army is moving towards, as its supply chain becomes more demand-responsive.

RAND is currently performing high-level spend analyses of all the Army's purchased goods and services, over $300B in FY05, to identify opportunities for improved purchasing, e.g., opportunities for aggregating requirements where there are many contracts or many suppliers for the same commodity. Supply strategies must also be developed by the Army, an important step towards rationalizing its supply base. As long-term agreements are made with the best suppliers, overall supplier performance will increase, and the Army and suppliers can work towards integrating business processes. Several pilot efforts to test PSM principles are planned in the upcoming year by Army Materiel Command (AMC), the headquarters organization responsible for purchasing and supply management.

Summary

The Army's supply chain faces a unique mission, of having to operate in and to provide support for highly unpredictable contingencies. As a result, its design must be demand-responsive, able to surge and adapt as conditions change. Dramatic reductions in the Army's order and ship times have accelerated and streamlined the Army's supply chain. The current challenge is to leverage the distribution improvements made by velocity management with higher and more robust wholesale stock availability. Efforts are underway to improve the Army's purchasing and supply management to adopt best practices in commercial PSM, to achieve better management of suppliers and supplier capacity.

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