Military Supply Chains: Five Principles for Managing Uncertainty

Military logistics is inseparable from combat. Moving forces to hotspots around the world, providing for their needs while deployed, and bringing them home as tensions subside are all part of the complex process of military logistics. Meeting the challenges of coming decades will require substantial logistics capability, and the nature of that capability will differ from what it has been in the past.

Current and future military needs require our forces to have a smaller logistics train (more teeth; less tail). The logistics supply chain must be flexible and able to be deployed quickly to meet these needs. Enhanced logistics processes can help the Department of Defense (DoD) produce more combat capability. Successful implementation of this change is essential, and will have far-reaching impact on the people, business processes and technology infrastructure of the U.S. military and its partners.

Military logistics is expensive. Moving large numbers of people and considerable heavy equipment and cargo drives cost in an obvious way. Other factors also drive cost. One such factor is the uncertainty of future requirements, and the impact of this uncertainty on readiness. To prepare for uncertain events, military planners budget for “stockpiles”, “war reserve materials”, and reserve transportation capacity. These reserve or excess capacities provide the means for combat commanders to react very quickly to events that would otherwise overwhelm their normal garrison logistics support.

At the present time, the DoD is engaged in a great debate. The focus of the debate is how to transform the United States military to better respond to new threats. This transformation initiative has many fronts; one is military logistics. Transformed military logistics must be far more effective and less costly than it is presently. But, we believe, it must also be more robust. Military logistics, like military forces, must be able to react to the unexpected quickly, appropriately, and effectively.

Hedges against uncertainty are used regularly in financial and currency markets, in supply chain management and in manufacturing. In fact, one could argue that “military readiness” has always been the art of hedging against an uncertain threat. Since we don’t know the location of the next attack, we must be able to move quickly to meet it. We don’t know the timing of the attack, so we must be vigilant. We don’t know the nature of the attack, so we must be able to respond in a variety of ways.

Traditionally, managing risk involved the use of “rules-of-thumb”. Military logisticians specified the number of days of supply to be stockpiled for various commodities like munitions, fuel and repair parts. Transportation managers specified the number of ton-miles-per-day of lift capacity that could quickly be brought to bear. Until recently these “rules-of-thumb” were the best tools available since more sophisticated planning tools were data intensive and too computationally demanding.
But just as technology has transformed the battlefield, it can also transform military logistics. New approaches can revolutionize the way military supply chains are planned and executed—performance can be dramatically improved and resources can be used more efficiently and effectively, even when great uncertainty prevails.

**Identifying and managing factors that contribute to uncertainty**

The DoD has made many improvements to military logistics over the last decade and a half. Organizations have been realigned to consolidate similar functions. Processes have been improved, transaction level information systems have been upgraded, and competition has been introduced by outsourcing activities to commercial providers. Yet, despite 15 years of progress, many challenges persist and truly effective supply chain management has not been attained.

Demand uncertainty exists and always will, given the nature of combat operations. While this is clearly the case, logistics plans continue to be developed with little explicit consideration of uncertainty. The frequent result is disappointing performance.

Response times are long and variable. As a result, recovery is difficult when demand differs from plan. The temptation is to increase inventories leading to large excesses that still don't meet critical demand. But, high levels of readiness cannot be achieved by solely increasing inventories. Once a certain level of investment in inventory has been made, further improvements to readiness will be minimal by increasing investments in inventories.

Information infrastructure remains inadequate, especially once deployment begins. Military logistics in all Services lacks connectivity for “the last mile”. Even though the bandwidth available to combat units has expanded greatly in the last 15 years, demand for intelligence and command & control has expanded even more rapidly.

Unfortunately, little capacity remains available for logistics. This lack of an adequate information infrastructure greatly reduces the ability to improve readiness, responsiveness and flexibility of the logistics functions. While new platforms like the F22 have advanced integrated avionics, weapons systems and real-time information displays that give pilots decisive advantages over the enemy, the military I/T infrastructure has lagged far behind. The logistician of the future must be supported by systems that provide a holistic, real-time view of mission-critical supply chain management decisions.

Business processes, especially inter-organizationally, are poorly designed. Each Service and the DoD have invested in improved business processes, with financial, human capital, and logistics processes having led the way. But little effort has been expended on business processes that cross enterprise boundaries. This is not simply a matter of exchanging data. Supply chain partners (combat units, central logistics agencies, transportation agencies, and contractors) must be joined together in ways that allow money, material and information to flow smoothly across organizational boundaries.

The imperative of improving inter-organizational processes cannot be overstated. Our military supply chain systems cannot and will not be able to respond as quickly as they must to the myriad of uncertain conditions that they will face unless significant improvements are made to inter-organizational processes.

Decision support systems are inadequate, especially in how they treat uncertainty. Most logistics analysis is based on averages: average demand rate, average transportation time, average repair rate, average manufacturing rate. But averages never happen in real combat. Decision support should accept the variability of demand and search for strategies that help military logistics respond. Collaborative relationships aimed at reducing uncertainty in the logistics process are needed to make supply chains more efficient. Decision makers need to focus on how best to use available capacities to meet actual need.
Efforts to date have largely failed to adequately consider and treat the many sources of uncertainty inherent in military supply chain management, and the impact can be significant. Decision support systems and the tools embedded within them that will provide real-time guidance in the presence of uncertainty must be developed and deployed.

**The essential foundation: Integrated systems**

Military supply chains require five interconnected systems: engineering, manufacturing, repair, logistics, and management. Opportunities for improved supply chain efficiency tend to be at the boundaries of these systems. The greatest advantages will come from focusing on (1) integrating the five systems intra-organizationally and (2) integrating the supply chain processes with collaborating supply chain partners. But integration alone will not achieve successful combat support. Leadership must learn to deal explicitly with the impact of uncertainty on the supply chain decisions they make. While sharing data is essential, simply passing data will not be sufficient to substantially reduce the impact of uncertainty.

**Supply chain operational excellence: The five fundamental principles**

1. **Know the Customer:** Without a clear understanding and definition of combat unit requirements, no military supply chain can be effectively constructed. To gain that understanding requires constant research and collaboration, the construction of an information infrastructure to capture unit transaction data, and the storage and analysis of these data from a strategic, tactical, and operational perspective. Supply chain requirements vary greatly by type of combat unit, commodity, and operating location. Further, the needs of the operating unit must be understood within the context of the missions it is asked to perform, which vary considerably over time. All of these requirements must be thoroughly understood to establish the foundation for constructing responsive, efficient, and effective supply chains.

2. **Adopt Lean Philosophies:** Over the last decade DoD, the Services, and supporting contractors have focused on creating lean organizations. Internal lead times have been shortened and made more predictable. Set up times and work-in-process inventories have been reduced. But for maximum supply chain efficiency, all partners must engineer, align, and execute their jointly designed and operated processes so that the entire chain has the desired attributes: response times must be short, predictable, and repeatable. Thus lean supply chains must be designed as a system that responds quickly and predictably to fluctuations in military need. Therefore, lean philosophies must be extended beyond the boundaries of individual DoD or Service logistics organizations to include all supply chain partners. No combination of software systems can compensate for a poor physical operating environment.

**Know the Customer; application:** Supply chains supporting ships at sea differ from supply chains supporting Air Force units at a fixed location. Supply chains designed for low cost, high demand material (e.g., rations) differ from those designed for high cost, low demand items (e.g., complex equipment repair items). Supply chains that exist for repairable items must include planning for and allocating repair capacity and providing adequate transportation links to and from repair locations. Weapon system repair parts are related to one another by their common application and the unique configuration of the equipment being supported. This interconnectedness must be considered when designing supply chains. Failure to take these differences, and many others, into account when planning inventory and capacity requirements will significantly degrade performance.

**Adopt Lean Philosophies; application:** Many defense contractor and DoD manufacturing and repair facilities have been able to reduce their flow times and make them more predictable. As set up times have improved, planners have found they can respond better to changing demand, even with less inventory. Furthermore, lean supply chains cannot exist if procurement...
policy is inconsistent with the basic principles. Responsiveness, as well as cost, must be a key element of procurement policy.

3. Create A Supply Chain Information Infrastructure: The DoD has made great strides improving its information infrastructure. Although actual performance frequently falls short of the desired level of performance, it is possible now for all partners in military supply chains to share demand information, inventory status, and logistics requirements. But true collaboration requires more than just data exchange between successive supply chain partners. Rather, it requires joint planning of inventory, production and repair strategies, and executing the resulting plans quickly and reliably on a continuing basis. How various capacities (inventory, transportation, production, repair) are used daily must be considered from a systems perspective and not just a local viewpoint. The DoD’s supply chain information infrastructure must be capable of responding effectively to frequent changes in combat and logistics requirements. Re-planning the use of capacities may need to be done daily and in some cases even more frequently.

Create A Supply Chain Information Infrastructure; application: Support of a major weapon system assigned to multiple combat units deployed around the world is a daunting task. Knowledge of inventory levels and unit demands will not be sufficient to maximize equipment availability. Part repair requires careful planning and allocation. Transportation to and from units and repair locations is critical to effective support. The ability to re-plan transportation routes as combat units deploy and relocate, is essential. Component stocks must exist at the repair sites for repairs to be accomplished. Positioning of these stocks to meet changing requirements is essential to executing combat operations.

4. Integrate Business Processes: Business processes must be established both intra and inter organizationally. These processes, coupled with the information infrastructure, support the efficient flow of material through the supply chain. While much attention has been placed on understanding business processes within DoD organizations, it is essential to understand what processes must be built inter-organizationally to leverage and enhance partner capabilities.

Integrate Business Processes; application: Business processes are the negotiated rules that govern how organizations inside and outside of the DoD deal with one another. Effective business processes allow events to trigger actions automatically throughout the entire supply chain by all partners. Business processes control the sharing of information, accountability and movement of material, and financial compensation. Too often, in DoD supply chains, business processes do not effectively tie partners together. Events that should automatically trigger follow-on actions do not and therefore responsiveness and effectiveness become seriously degraded.

5. Unify Decision Support Systems: Researchers have designed supply chain Decision Support System environments for the military for decades. Much of the capability currently offered by commercial software providers began with research done for the DoD. Yet within the DoD there is little understanding of this capability.

Unify Decision Support Systems; application: Defense managers must calculate and defend the need for budgetary resources annually.

These environments are based on different philosophical models. Also, they differ in how they forecast demand, and how they drive production, repair and allocation decisions. Their goal is to generate plans that consider some of the elements of the supply chain. No matter which approach is taken, these systems and their embedded rules drive many daily supply chain activities. Therefore, they have a substantial impact on the operating behavior, and consequently on overall supply chain performance and operational effectiveness. How much they enhance military supply chain performance depends on both the accuracy of their input data and the modeling approaches employed. We believe that these decision support systems need to address uncertainty in an explicit manner – most do not.

Unify Decision Support Systems; application: Defense managers must calculate and defend the need for budgetary resources annually.
The data and underlying modeling approaches used for developing these estimates should be consistent with the methods used to allocate resources once they become available. Defense managers face daily challenges of how best to utilize available capacity for repair, manufacturing, and transportation. A consistent modeling environment is essential. Defense managers must be prepared to re-plan on short notice, since international tensions may require combat units to deploy to new parts of the world. Consequently, demand for resources moves to new locations, transportation links must be established and others eliminated, the location of intermediate repair activity may have to change, and inventory may need to be repositioned. These changes may have to happen very quickly; the impact of the existence of these resources affects a significant portion of all combat units. Defense managers facing these challenges require unified decision support systems.

A new decision modeling paradigm

While commercially available Advanced Planning & Scheduling (APS) systems as well as Inventory Optimization systems, such as AIO, have led to considerable improvements in supply chain efficiency, success in implementing these systems depends on the extent to which the Five Principles of Supply Chain Management are followed.

Strategic and tactical modeling paradigms employed in military supply chain decision support systems are inadequate. Hence, supply chain manufacturing, repair and distribution systems are often not appropriately designed and operated. Typical consequences of poor design are inventories concentrated in the wrong items and in the wrong locations. A fundamental cause of this failure is the environment’s uncertainty and the inability to construct accurate demand forecasts for most items.

Given that creating accurate forecasts is difficult, if not impossible, entirely new approaches are required to ensure responsiveness. An integrated supply chain needs to be created that quickly and repeatedly moves the right quantities of material to units for those items that experience highly uncertain demand. When designing supply chain planning systems, a clear process must be established that considers the operational dynamics that support successful execution. Planning model designs need to consider both combat unit requirements and the physical structure of the supply chain. Lead-time expectations must be understood. Flow times through facilities and, more importantly, through the entire supply chain, must be considered. Inventories must be maintained in critical locations to support the overall supply chain requirement.

A new operating philosophy

There is an axiom that should guide the design of effective supply chain management systems: Keep your assets in their most flexible form for as long as it is operationally and economically possible. Keeping your assets in a flexible form demands that one follows the principles that we have briefly discussed here. This then leads to thinking carefully about the design of the re-supply system. The resultant strategy must establish what types of maintenance and transport resources the DoD should have.

Specifically, the strategy must reflect the types of maintenance capabilities the Air Force depots should retain and what types of activities should be assigned to a commercial contractor. Such a strategy might say keep in the capacity needed to repair low demand critical weapon system parts and emphasize responsive turn-around within Air Force depots, and contract out repair for the high volume predictable demand items. Similarly, careful thought is needed to plan what should be repaired at local levels (for example bases or CIRFS) and what should be repaired at more distant and centralized facilities. Obviously the resources required differ greatly depending on the choice of the strategy. Correspondingly, the investment and operating costs do, too. But so does combat effectiveness, and our ability to meet threats in a timely manner.
Conclusion

Effective logistics strategy is essential to providing military capability that is needed to protect our self interests. That strategy should be based on the five principles that we have outlined. These principles, when followed, will result in a supply chain system that has the attributes that are required to achieve operational preparedness in a cost effective manner. Implementation will require a transformation in the way the United States military does business, and touches every aspect of operations. Sustained, top-down commitment accompanied by an effective change management strategy and program are needed to ensure success. Those who take on this vital task are wise to heed the following timeless advice:

5 Principles for managing uncertainty in military supply chains

1. Know the Customer.
2. Adopt Lean Philosophies.
3. Create a Supply Chain Information Infrastructure.

Learn more at: http://www.ptc.com/service-lifecycle-management/aerospace-and-defense

John A. Muckstadt

Acheson-Laibe Professor of Business Management and Leadership Studies School of Operations Research and Information Engineering

General George T. Babbitt

USAF Ret.

“There is nothing more difficult to plan, nor more dangerous to manage, nor more doubtful of success, than the creation of a new order of things. For the reformer has fierce enemies in all who would profit from the preservation of the old, and only lukewarm defenders in those who would gain from the new. This lukewarmness arises partly from the fear of their adversaries, who have law in their favor, and partly from the incredulity of mankind, who do not truly believe in anything new until they have had an actual experience of it.”

Niccolo Machiavelli
1513