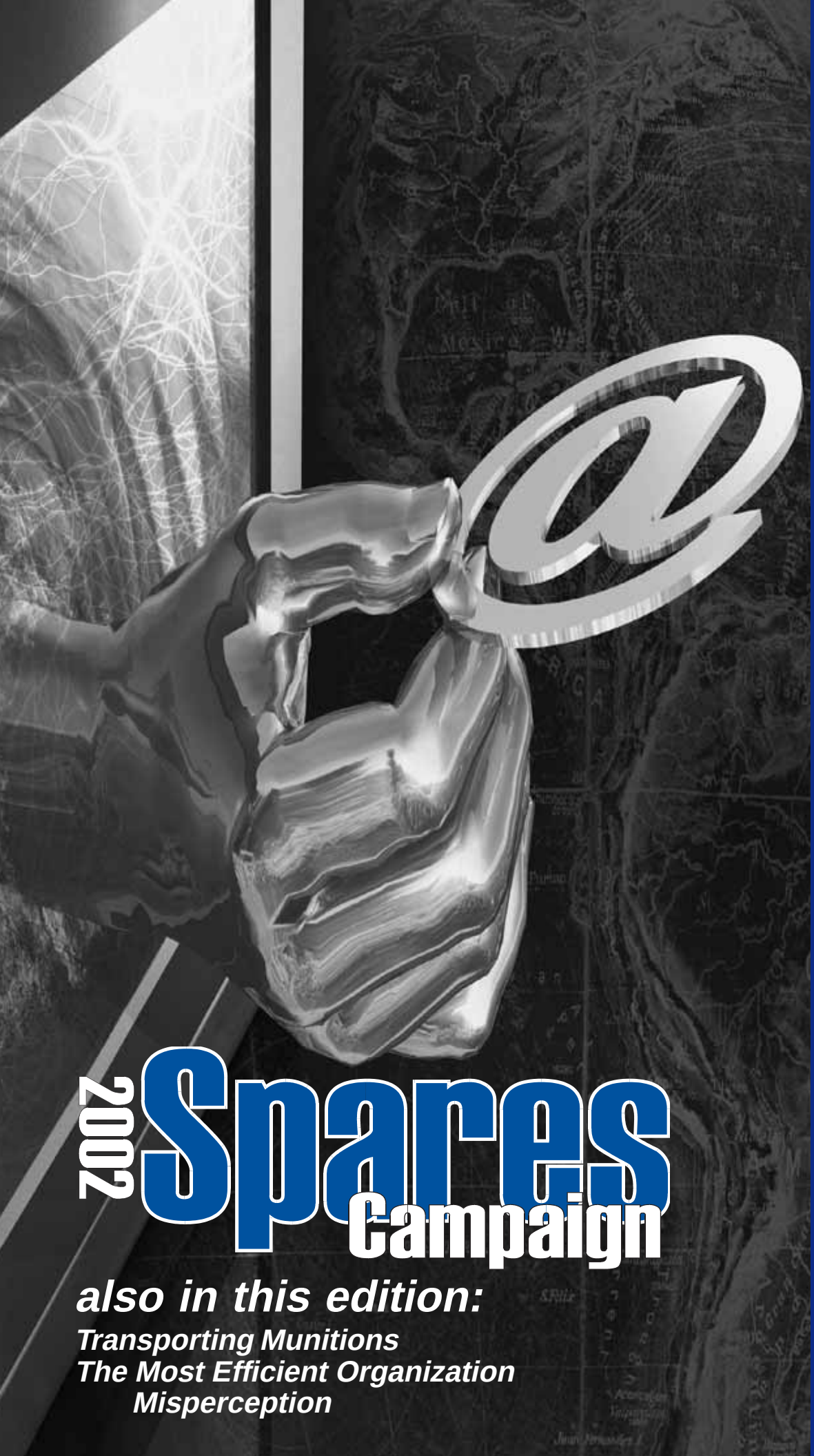

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Volume XXVI,
Number 3
Fall 2002

2002 Spares Campaign

also in this edition:

Transporting Munitions
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Volume XXVI, Number 3 **Fall 2002** **AFRP 25-1**

FEATURES—Spares Campaign

3 Improving Spares Campaign Support
Brigadier General Robert E. Mansfield, Jr, USAF

10 Supply Chain Command and Control
Debbie Alexander; John Gunselman; Major Jody Cox, USAF; Jonathan Mathews; Gregory Grehawick; Major Christopher Brockway, USAF; Captain Jondavid DuVall, USAF; Lieutenant Colonel Joseph Codispoti, USAF; Charles Masters

18 Demand Planning in a Demanding Environment
Maryann Kaczmarek, Bobbi LaRue, Duane Anderson, Robert Owen, William Warren, Larry Waite, Tina Womack

23 Advanced Planning and Scheduling
Maryann Kaczmarek, Bobbi LaRue, Duane Anderson, Robert Owen, William Warren, Larry Waite, Tina Womack

27 Financial Issues Overview
Jon Newsome; Lieutenant Colonel Verdis Redmon, USAF; Mark Terry

30 Purchasing and Supply Chain Management
Wing Commander Margaret Staib, RAAF, Lori Michaelson

CANDID VOICES

39 The Most Efficient Organization Misperception
Captain Jonathan L. Wright, USAF

ARTICLES

40 Transporting Munitions
Major Kirk L. Kehrley, USAF

BACK COVER AFJL Awards
Most Significant Article to Appear in the *Air Force Journal of Logistics* Volume XXVI, Number 2

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Brigadier General Robert E. Mansfield, Jr

improving spares CAMPAIGN support

The genesis of spares and repair parts problems began in the early 1990s with aggressive inventory reductions deemed necessary to size inventories to match a post-Cold War national security environment and force reductions following the Persian Gulf War.

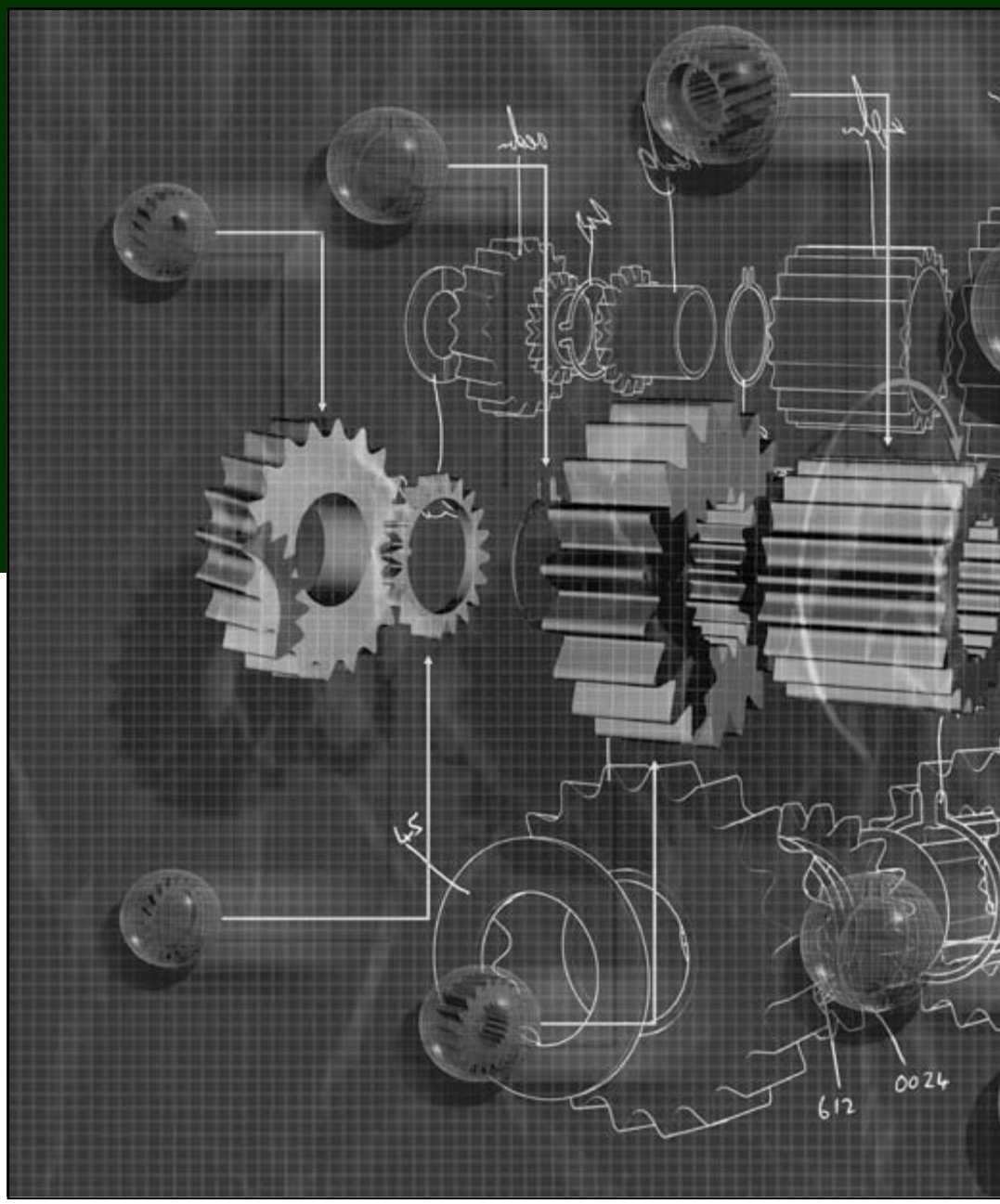
Logistics Transformation Through Supply Chain Integration

If we don't change the direction we are going, we will end up where we are going.

Chinese Proverb

The purpose of these articles is to present the basics of transformation and supply chain integration and discuss in some detail the Spares Campaign—how it came to be, its organization, and the initiatives.

Transformation refers to fundamental change in the way an organization achieves its purpose. It means change in the way we work, interact, participate, and even think about how we get things done. It means bringing new methods and technology to bear, as well as changing our processes. While the mission remains the same, the implementation steps that transform an organization are different and can be difficult as compared to the old ways.[1] Transformation means dramatic change in how we accomplish our logistics missions.

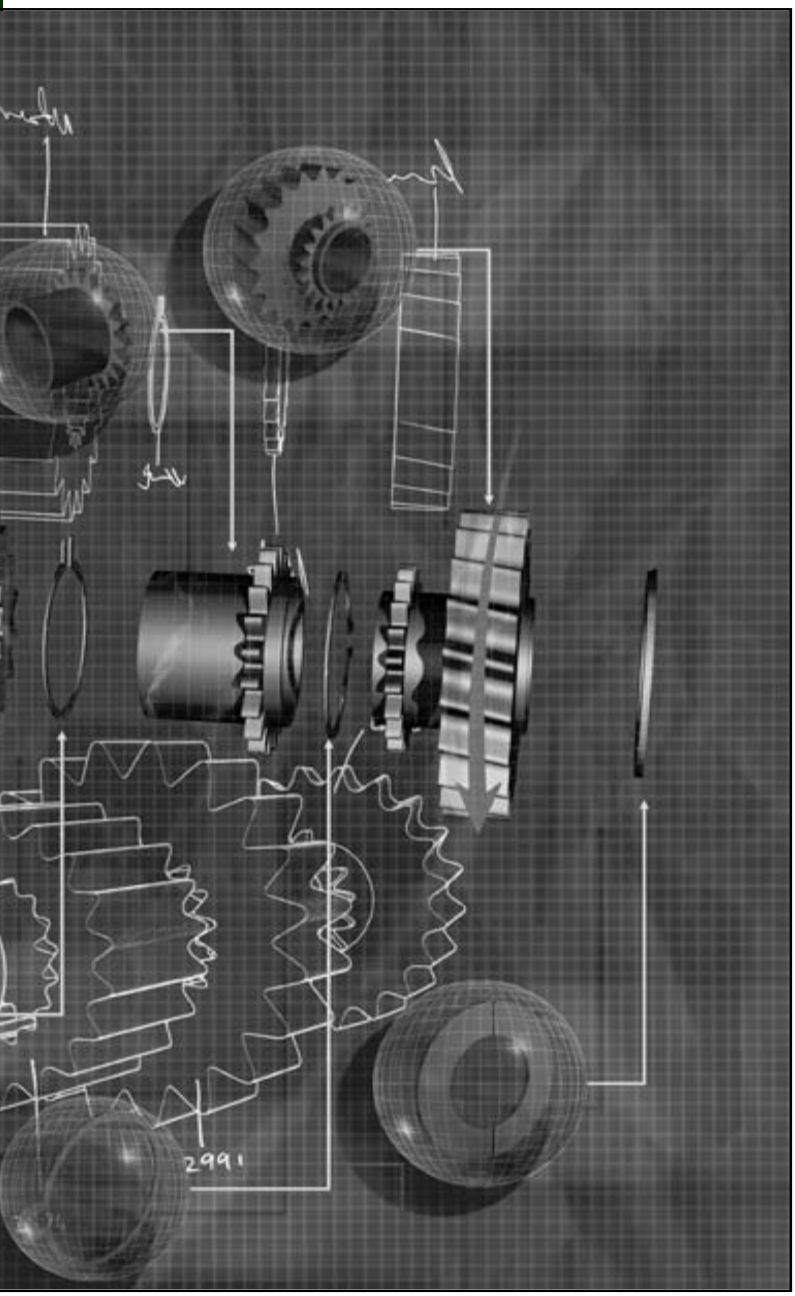


Supply chain management and integration of the supply chain are concepts that have been growing in importance. The commercial sector has embraced them. An integrated supply chain network offers the Air Force a path to logistics transformation. Like many ideas, it seems easy in concept, but realization is the hard part. Supply chain management is complex like the Air Force logistics system. And like any complex system, supply chain management has limited value if it is used in an ad hoc fashion. To employ a concept like supply chain management for transformational purposes, it must first be defined. There are many definitions, all having the same general components. For instance, commercially, a supply chain is: "An association of customers and suppliers who, working together yet in their own best interests, buy, convert, distribute, and sell goods and services among themselves, resulting in the creation of a specific product."[2] The Department of Defense has proposed a definition of supply chain management for the military environment:

> . . . an integrated process that begins with planning the acquisition of customer-driven requirements for material and services and ends with the delivery of material to the operational customer, including the material returns segment of the process, and the flow of required information in both directions among suppliers, logistics managers, and customers.[3]

Regardless of the specific definition, there are standard features of supply chain management. Essentially, it comes down to integrating the activities of all members of the supply chain network to optimize their collective performance to minimize cost, as well as the time between order and delivery of a product. It is the coordination and consistency of activities among the members of the supply chain network that matter. Coordination and consistency require purposeful design and engineering of supply chain networks. Synchronization of all members' activities is key. "Synchronization includes matching the goals of the interdependent parts and linking their priorities with other parts of the organization. When conditions

change, synchronization realigns the multiple priorities and reallocates resources."[4] Supply chain management—with its emphasis on product, process, customers, and synchronization



of all parties' activities—can transform Air Force logistics, specifically, spares management.

The Air Force Spares Campaign was born of the need to change fundamentally the way the Air Force manages its spares and the parts used to repair them. For the support of fielded weapon systems and major end items, the Air Force relies on the repair of a large inventory of spares, sometimes called depot-level reparables. These spares are the lifeblood of *keeping 'em flying*. Over most of the 1990s, the Air Force saw its weapon systems' mission-capable (MC) rates drop to unacceptable levels (Figure 1). A significant reason for this drop was spares management process breakdowns. The Spares Campaign was the result of a concentrated effort to reshape spares and parts management to reverse the MC rate decline. What follows is a summary of the development of the campaign and a description of the initiatives selected to return spare parts, along with parts management, to acceptable levels.

The genesis of spares and repair parts problems began in the early 1990s with aggressive inventory reductions deemed necessary to size inventories to match a post-Cold War national security environment and force reductions following the Persian Gulf War. In short, the supply processes in place at the time were not designed for quick reaction to changes in inventory size. There was no efficient way, given the massive quantity of inventory stocks and capability of information systems, to determine which items and in what quantities should be disposed of, particularly in the timeframes demanded. These inventory reductions, coupled with significant personnel reductions—particularly in materiel management—and a mandated change in the management of most consumable repair parts further complicated the situation. Pressure to reduce inventories was unrelenting. However, to most experienced inventory managers and logisticians, absent the information systems and experienced personnel to quickly reduce the inventory holdings, these actions held a risk. Important weapon system items would likely be disposed of along with excess items. To cope with this pressure and risk, decisions were made to change the spares and repair parts computation formulas to lower the number of spares and repair parts computed as required by the supply inventory system. In this way, stocks could be drawn down at a fairly rapid rate and not be replaced, and very important weapon system items were less likely to be unwittingly discarded.

Virtually every supply inventory computation was changed. The outcome was achieved: inventory levels fell. Unfortunately, as with most complex systems, other things also changed. The level of operations increased, and weapon systems continued to age. Several years of budget constraints resulted in underfunding of the now truncated spares and repair parts inventory replacement requirements. The need to better understand the cost per flying hour resulted in a new spares requirement based on annual projected consumption of spares and repair parts by individual weapon systems. Money that had once been centrally controlled was budgeted by cost per flying hour and provided to the major commands (MAJCOM), which employ weapon systems, to *buy* spares and repair parts from the central logistics system. The processes used by the central logistics system for determining spares and repair parts needed to maintain and replace inventory in response to orders to reduce weapon system downtime became disconnected from the programming and budgeting process. So did the process for determining additive levels for readiness spares packages used by deployed units until supply lines were established.

A working capital fund was established in the early 1990s, which added additional complexity. The fund was expected to stay solvent by accurately forecasting *sales* several years in advance. The *prices* paid for the forecasted sales included the repair cost (a relatively stable variable cost), a full cost-recovery allocation for business operations, and the cost of

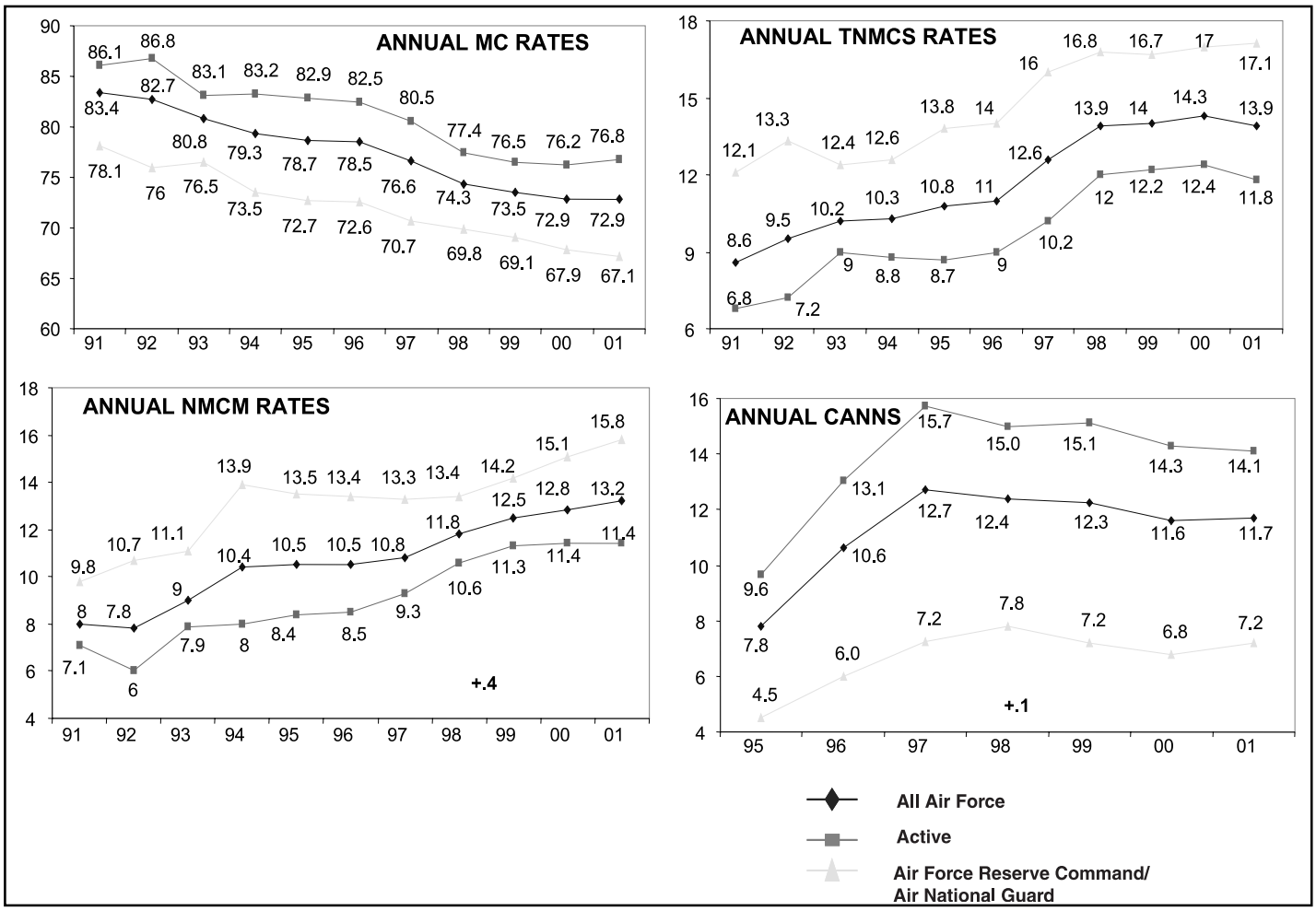


Figure 1. MC Rates

replacement materiel (a relatively volatile fixed cost when allocated based on a long-range sales forecast). The MAJCOM units would replenish the fund with *buys* made in the year they needed the spares and repair parts. Given the changes in operations from the time the forecasts were made to the day the spares and repair parts were needed, rarely did *sales* forecasts match *buys*. Adding a full cost recovery for business operations and the cost of replacement materiel to the sales forecast created large price swings during the years units bought the items. This confounded the spares and repair parts financial processes. And it confused field units and their financial planning. Costs seemed out of control.

The collective impact of these changes created a situation where too few spares and repair parts were available to support Air Force weapon systems at appropriate mission-capability levels. This became clear in combat operations. The great achievements of the Air Force over the skies of Bosnia, and later Kosovo, were really made on the backs of the maintainers through longer hours and a practice called *cannibalization* (taking working parts from one weapon system to repair another). The supply system itself was in need of repair. By 1998, the Air Staff and Air Force Materiel Command (AFMC) recognized the underfunding of the spares and repair parts requirement and were able to gain increases. In 1999, a complete review of spares and repair parts processes was initiated, and by 2000, the need to fix spares and repair parts processes hit high gear. In February 2001, the Chief of Staff of the Air Force was briefed on launching a Spares Campaign to fix the process disconnects that had occurred over the previous 10 years.

The Chief of Staff gave his permission to conduct comprehensive planning to correct spares and repair parts deficiencies. Of considerable importance as well was capability to support the new operating style of the expeditionary air force (EAF). Cold War supply processes were not up to the light, lean, and lethal capabilities the EAF demanded. From 23 March to 18 June 2001, teams met to determine the best ways to improve the Air Force spares and repair parts posture. There were several key considerations. Spares and repair parts policies and processes must focus on maximizing mission capability given fiscal realities. Processes must be synchronized with those of suppliers, and all actions must result in a universal commitment of corporate Air Force solutions.

Five teams were established and organized based on processes needed to produce spares. They focused their attention on outcomes to improve mission capability and manage cost. The Programming and Financial Management Team looked at how spares budgets are determined, funding obtained, and cost managed. The Requirements Determination

Team reviewed processes for identifying spares requirements. The Requirements Allocation, Execution, and Distribution Team analyzed the processes and policies involved in getting spares and repair parts to the depot repair lines and field. The Spares Command and Control Team studied management control of the spares processes. Given that suppliers outside the immediate control of the Air Force were playing an ever-increasing role, the Supplier Relationships Team explored options for improvement. The key roles suppliers have in the availability of spares and repair parts underscored the need for supply chain management and integration.

A planning management organization was put in place in early March 2001. The five teams had Air Force subject-matter experts, representation from industry and the Defense Logistics Agency, and consultants. More than 70 people ultimately participated on the teams, and a senior uniformed or Air Force civilian expert led each team. To ensure these Spares Campaign teams received full support, the Air Force Deputy Chief of Staff, Installations and Logistics assigned the Air Force Director of Supply full time to manage it. An experienced logistician (GS-15) and a uniformed officer were detailed to assist him in forming a small management team. With the assistance of RAND Corporation and KPMG Consulting, Spares Campaign planning proceeded. The Review (Red) Team was also used to provide an independent look at the solutions and associated initiatives. It consisted of senior Air Force military and civilian logistics leaders and a retired Air Force general officer. The Deputy Director of Maintenance led the Red Team.

A concept of operations was developed to guide the work of the five teams. Each team was to develop a high-level, strategic process map that depicted the way the team believed the area it was investigating should be managed to meet the objectives of improving its contribution to weapon systems availability (WSA) and cost management. In conjunction with these functional process maps, an overall spares management strategic process diagram was produced. Each team then identified *disconnects* or barriers to the processes functioning as desired. Once this was done, the next step was developing solutions to correct the deficiencies. Twelve major deficiencies were noted, and more than 190 corrective actions identified (Table 1). Through a reconciliation process among the teams (the Integration Team made up of the team leads and the Management Team) and Red Team review, a set of 20 initiatives resulted as solutions to the disconnects and barriers.

In mid-June 2001, the Spares Campaign planning results were briefed to the Deputy Chief of Staff, Installations and Logistics. On 13 July 2001, the MAJCOM Directors of Logistics (LG) were briefed via video-teleconference. At that time, the directors were asked to provide their comments and concurrence and to prioritize the 20 initiatives in the order they believed would provide the most impact for improving spares management and contribute to improved weapon systems availability and cost management. The LGs concurred with all the recommendations, with some minor clarification, and ranked the initiatives as shown in Table 2. Interestingly, the LG rank order had the same initiatives in the top six, each in a slightly different order, and all ranked as number one, Improve Depot Throughput. However, this initiative was deferred due to the creation of the Depot Maintenance Review Team (DMRT) in June 2001.[5]

Implementation of Spares Campaign Plan initiatives would take more than ad hoc study teams and a small management team. The Deputy Chief of Staff, Installations and Logistics sought permission from the Chief of Staff to temporarily assign a general officer to lead implementation. The Chief of Staff approved the request, and in late August 2001, the position of Special Assistant, Supply Chain Integration and Logistics Transformation was temporarily established. The Logistics Transformation Office,[6] which had been exploring transformational pathfinders, became the Spares Campaign

Major Problem Area	Disconnects
Nonresponsive execution process	• No process to allocate and execute limited funds to maximize weapon system goals. • Lack of a process to manage and reduce demands. • No corporate process for identifying, resolving, and preventing constraints on depot repair.
Disconnected requirements, determination, and financial processes	• Total spares requirement not computed and considered in planning, programming, and budgeting (PPBS) deliberations. • No ability to identify the effects of limited funding on WSA, perform weapon system tradeoffs, or provide corporate view of overall impacts. • Operations and Maintenance, Supply Maintenance Activity Group, Depot Maintenance Activity Group, and PPBS processes proceed independently.
Disjointed command and control	• Lack of authority and accountability to balance supply chain priorities.
Underdeveloped supplier relationships	• Suppliers and supply base not strategically viewed or managed for effective and efficient cradle-to-grave weapon system support.
Ineffective enablers	• Lack of proper metrics drives suboptimized behavior in supply chain. • Lack of training and education for supply chain management inhibits system performance. • Lack of common operating view and data inaccuracies in automated systems limit capability to manage the supply chain. • Lack of an accepted definition of core supply functions may result in misalignment of functions between Air Force and private sector.

Table 1. Supply Process Disconnects

Implementation Team, under the direction of the former Director of Supply.

The need to raise mission capability and weapon systems availability and understand costs better was urgent. Near-immediate impact from the Spares Campaign initiatives was required. Implementing all 20 initiatives would take time and many resources—something not readily available. To gain maximum advantage from the initiatives in the shortest time, a decision was made to focus implementation resources on a subset of the initiatives that would likely result in near-term improvements. As the Implementation Team was organizing itself, the 20 initiatives were closely reviewed to select the first set for implementation. The criteria for this selection were MAJCOM priorities, contribution of weapon systems availability and cost management, time to implement or achieve an initial operational capability, consideration of initiatives currently underway, contribution to spares process improvement and transformation, and the greatest impact and return to the Air Force as a whole.

By late August, the set of initiatives was identified (Table 3), and MAJCOM LGs were briefed on the selection of this smaller set of initiatives via telephone conference on 24 October 2001. They gave their concurrence, and these initiatives were then presented to the senior leadership of the Air Force by the Deputy Chief of Staff, Installations and Logistics on 31 October 2001 at the Corona Fall meeting. They endorsed the entire set of initiatives for implementation.

The first set of initiatives falls into three categories: command and control, financial management, and transformational. There are also information technology components to some of them. Good command and control requires a common operating picture. To take full advantage of demand and workload planning, best practices software systems, like advanced planning and scheduling, are needed. To better manage costs, activity-based cost management models are key. New capability to track execution of weapon systems spares support against an approved plan and budget is required. Such a tool would allow monitoring of the performance of the supply chain, identifying constraints and potential tradeoffs for resolution. The RAND Corporation took on the task of creating such a tool.

Any of these initiatives taken individually would result in some incremental improvement. However, taken together, they begin to provide a significant contribution to improving weapon systems availability and cost management. Implementation, however, is paramount.

The key to any implementation in an organization is to transfer the actual doing of the new processes as quickly as possible to those responsible for the work in order to get the expected outcomes. In other words, ownership and accountability must move to the process owners for oversight of the implementation and action as quickly as possible. The implementation structure for the Spares Campaign was developed to facilitate transfer of ownership and implementation responsibility to process owners.

Raw Score	Priority	Solution
35	1	Improve depot-level repair (DLR) throughout
37	2	Centrally prioritize spares and funds allocation
58	3	Restructure PPBS spares determination process
62	4	Improve item demand and repair workload
77	5	Develop alternative stockage polices to support EAF
78	6	Ensure a competent and skilled workforce
85	7	Implement multipart pricing for DLRs
88	8	Track execution versus plan adjust and feedback to PPBS
88	9	Create common operation view and improve data
90	10	Designate a single authority for spares management
101	11	Implement integrated supply chain management
102	12	Develop process to manage and reduce demands
105	13	Align supply chain managers' roles with a WSA/MCS focus
108	14	Improve and restructure working capital fund
116	15	Develop appropriate metrics
118	16	Actively manage suppliers and supply base
120	17	Enable single logistics proponent
124	18	Expand regional supply squadron responsibilities
131	19	Adopt purchasing and supply management
150	20	Develop an e-business strategy

Table 2. Spares Management Initiatives

Solutions	
Purchasing and supply chain management	Adopt PSCM best practices in working with Air Force suppliers
Demand and repair workload forecasting	Improve demand forecasts; enhance workload planning
Virtual inventory control point	Centralize buy-and-repair priorities to meet mission capability
Weapon system supply chain manager	Focus supply chain manager on meeting weapon-system MC goals
Regional supply squadrons	Extend centralized supply Air Force wide and expand responsibilities.
DLR pricing structure	Set stable prices and manage costs
Spares forecast	Forecast and budget spares requirements (integrated models)
Financial management	Track execution of weapon system support to approved plan and budget

Table 3. Spares Management Initiatives Subset

The Spares Campaign implementation is a top-down-directed activity. Each initiative has an Air Staff team leader, and a project manager from the Spares Campaign Implementation Team supports the team leader. The project manager's role is to help the team leader keep the implementation project schedule up to date and the initiative on schedule.

The team leader is responsible and accountable for bringing together the subordinate activities to work the details of implementation. Many of the implementation actions fall to AFMC. For this reason, the AFMC Directors of Logistics, Financial Management, and Contracting are actively engaged in detailed implementation actions.

Implementation has begun. The air logistics centers (ALC), where much of supply chain management occurs, have a vital role. Purchasing and supply chain management (PSCM) best practice implementations are underway at each of the three air logistics centers, and an APS demonstration is underway at Oklahoma City ALC. The common operating picture's initial operating capability is fielded to the KC-135, F-15, and F-16 supply chain managers. The initial map and performance metrics of the F100 engine supply chain, using the Supply Chain Operational Reference model, has been produced.

The need for supply chain thinking and integration became clear early in the Spares Campaign planning. The importance of commercial suppliers must be explicitly recognized in the Air Force supply chain. This extended enterprise is essential to the success of the air and space expeditionary force. Synchronizing activities and managing materiel, information, funds, and knowledge flows among members of the supply chain network leads to optimization—the ability to get the best mission capability possible, given fiscal realities. This optimization will maximize mission capability, minimize costs, and reduce inventory "locked up in the logistics pipeline."[7]

Also, in the course of the planning phase of the Spares Campaign, the need to differentiate among customers became clear. In general, the customers of the spares processes are the warfighter's weapon systems and related major assemblies. These customers fall into three customer lines of business—the flight line, programmed depot maintenance and overhaul line, and component repair line. Each of these customer lines has distinguishing characteristics, and the supply chains that support them must recognize them. O*ne size fits all* does not serve these lines of business well.[8]

The Spares Campaign embeds the supply chain integration and customer-centric thinking in the initiatives currently being implemented. Bringing supply chain integration to reality will transform Air Force supply management.

Notes

1. Joyce Wycoff, *Transformation Thinking*, New York: Berkley Books, 1995, 3.
2. National Research Council, *Surviving Supply Chain Integration*, Washington DC: National Academy Press, 22.
3. Logistics Management Institute, *DoD Supply Chain Management Implementation Guide*, Logistics Management Institute, McLean, Virginia, 14.
4. Larry Bossidy and Ram Charan, *Execution: The Discipline of Getting Things Done*, New York: Crown Business, 2002, 234.
5. The DMRT reviewed deport maintenance processes and organization from June to November 2001, which resulted in initiatives in eight focus areas: Workload and Production, Financial, Workforce, Materiel Support, Infrastructure, Organizational Structure, Information Technology, and Metrics. Materiel Support borrowed heavily from the Spares Campaign work. Two additional Spares Campaign initiatives were added, Improve Air Force Materiel Support Policies and Improve Stock Level Process, to fully implement the DMRT Materiel Support action items as part of the Spares Campaign.
6. The Logistics Transformation Office was established in March 1999. Its purpose was to develop transformation initiatives to fundamentally reshape Air Force logistics. Many of the pathfinder initiatives underway at the time of the Spares Campaign planning were spares related and showed great promise. These were reviewed by the Spares Campaign planning teams, and some were incorporated. Given this, changing the focus of the pathfinders to implementation and using the team personnel was logical.
7. Martin Christopher, *Logistics and Supply Chain Management*, 2d ed, London: Financial Times/Prentice Hall, 1998, 217.
8. Charles Fine of the MIT Sloan School of Management expresses this well in his book *Clock Speed*. He makes two very important points (among many) related to supporting customers and supply chain management. His notion of *clock speed*—that products, process, and organizations operate at different speeds—is very germane. These speeds are influenced by technology and the characteristics of customers and their expectations. Second, Fine discusses the integration of supply chain thinking and design as a core competency. The design and engineering of supply chain networks should be considered as a future core competency of Air Force supply chain managers.

General Mansfield is Special Assistant for Supply Chain Integration and Logistics Transformation, Air Force Deputy Chief of Staff, Installations and Logistics.

notable quotes

It is not only necessary to collect large quantities of supplies, but it is indispensable to have the means of conveying them with or after the army.

—Jomini

Debbie Alexander, John Gunselman, Jody Cox, Jonathan Mathews, Gregory Grehawick, Christopher Brockway, Jondavid DuVall, Joseph Codispoti, Charles Masters

Air Force Spares Campaign

Supply Chain Command and Control

Over the years, the critical need for improving the supply chain command and control (SC C2) process for weapon system spares supportability has become more and more apparent. While many improvements have occurred as a result of lessons learned in the Gulf War, Somalia, Kosovo, and other contingencies, no one has used an integrated approach that specifically linked all elements of the spares supply chain. The Air Force Spares Campaign identified three initiatives aimed at providing that linkage to form the SC C2 process for spares. This article addresses the three SC C2 initiatives:

- Establish a virtual inventory control point (VICP)
- Align supply chain management focus
- Standardize use of and expand role of the regional supply squadrons (RSS)

Supply chain C2 is important to the spares world. It is achieved when a designated authority is provided the resources, responsibility, and accountability to manage and direct all spares supply chain activity required to achieve assigned weapon systems availability (WSA) goals. No single organization controls the process from the base level through the transportation system to the air logistics centers (ALC), and this effort does not establish one. It attempts to more closely tie together the efforts of all these elements so spares support to the warfighter can be improved. Several new enablers will help make this happen.

First is development of a new supply chain common operating picture (SC COP) tool to provide *everyone* the same picture of worldwide requirements and the asset posture available to meet those requirements. Second is establishment of VICP to provide better buy-and-repair budget guidance and execution tracking by weapon system. Third, the Air Force Materiel Command (AFMC) is establishing a new weapon system supply chain manager (WS SCM), for most weapon systems, with responsibility for orchestrating the efforts of all members of the supply chain to meet WSA targets from a spares perspective. Fourth, six new regional supply squadrons will be established to provide standard supply support for operational units across the Air Force. Fifth is designation of five lead command regional supply squadrons (LCRSS) to serve as a single voice for operational units on distribution of selected critical spares. Finally, new operating rules, roles, and responsibilities have been established for each of these key players to help make the supply chain run more smoothly.

Figure 1 is a graphical representation of the SC C2 framework. The new elements described have established a new structure or framework for a formal spares SC C2 process. Phase I of the process began 1 October 2002 with the issuance of weapon system-specific buy lists for the F-15, F-16, and KC-135 and establishment of the LCRSS for the F-15 and F-16 at the Air Combat Command (ACC) RSS and the LCRSS for the KC-135 at the Air Mobility Command (AMC) RSS. Further, incremental capabilities, including standup of the WS SCMs and fielding of several VICP tools, will occur over the next several months with all elements expected to be in place by April 2003. Current plans call for a phased introduction of additional weapon systems starting in October 2003, with integration of most weapon systems by July 2004. The overall success of this process will be determined by the collective efforts of everyone, using the new tools and exercising their respective new rules and responsibilities.

Supply Support

Virtual Inventory Control Point

VICP is a combination of centralized processes, systems, and business rules that focus on achieving optimum weapon systems availability through spares support based on available funding. VICP is not an organizational structure; associated processes, systems, and business rules will continue to be managed by the AFMC Logistics Directorate. What has changed, however, is that VICP will focus these efforts on:

- Projecting unconstrained and constrained spare parts requirements for the program objective memorandum (POM) and budget inputs,
- Allocating and reallocating buy-and-repair cost authority to achieve desired availability targets for specific weapon systems,
- Tracking the execution of cost authority to the plan and maintaining the effects on weapon systems availability, and
- Providing a data environment that facilitates distribution and redistribution decisions.

VICP is designed to correct gaps in the processes used to improve weapon systems availability. In today's environment, focus is on the weapon system only when determining an unconstrained buy requirement to achieve aircraft availability targets. The process begins to deteriorate during execution if the cost authority for buy-and-repair actions does not meet the unconstrained requirement level. The Air Force does not have a method to allocate constrained cost authority across weapon systems and identify the reduction in availability that will occur because of the reduced funding. Finally, there is no feedback loop to measure how cost authority was actually executed by weapon system and the resulting decline in availability that could be expected. As a result, it is extremely difficult for leaders to make decisions on where to focus logistics support resources.

The goal of VICP is to correct the deficiencies in the process by establishing business rules, enhancing current systems, and developing the tools to identify constraints and provide feedback to measure the effectiveness of the centrally developed plans to meet WSA targets.

This goal is being met hrough focused improvement efforts in the following core processes:

- Weapon system prioritization
- Computing the full fequirement
- Allocating and reallocating limited cost authority
- Centralized buy
- Centralized repair
- Distribution and redistribution
- Weapon system prioritization

As noted earlier, allocating cost authority to achieve WSA targets would not be a problem if all requirements were funded. However, when funding is constrained, decisions must be made to ensure that logistics support and associated funding are focused on Air Force operational priorities. This tradeoff decisionmaking process begins with the operations community's developing a weapon system prioritization scheme. Air Staff logisticians will apply this prioritization scheme through a PC-based tool that allocates funds and identifies the impact of these allocations. They will also have the capability to run various allocation scenarios to identify the optimum mix of funding to various weapon systems to achieve operational requirements. Alternatively, if weapon systems have equal priority, the tool can effectively allocate cost authority to allow each weapon system to attain a defined percentage of its targets.

Computing the Full Requirement

Another aspect of VICP involves ensuring the full requirement is computed. It is extremely important that VICP support development of the total unconstrained spare parts requirement to support the peacetime and wartime missions for Air Force-managed items. In years past, a number of elements (repair cycle times and order and ship times) used to compute buy-and-repair requirements were constrained to keep the overall requirement at a level commensurate with anticipated funding. This, of course, masked the real requirement. The objective of the VICP is to identify the real requirement needed to support the warfighter and then make adjustments based on the level of funding received. In this way, the full requirement to support established availability targets is known, as is the constrained requirement and achievable targets. As a result fact-based decisions can be made on where to spend Air Force funds.

VICP, in concert with the Spares Requirements Review Board (another Spares Campaign initiative), will generate POM inputs based on aggregate estimated requirements by weapon system. For budget inputs and actual execution, requirements will be determined at the item level and rolled up to a weapon system requirement.

Once the requirements have gone through the corporate POM and budget process, a level of cost authority will be provided to the VICP from the Air Staff. If sufficient cost authority is not available to execute the full buy-and-repair

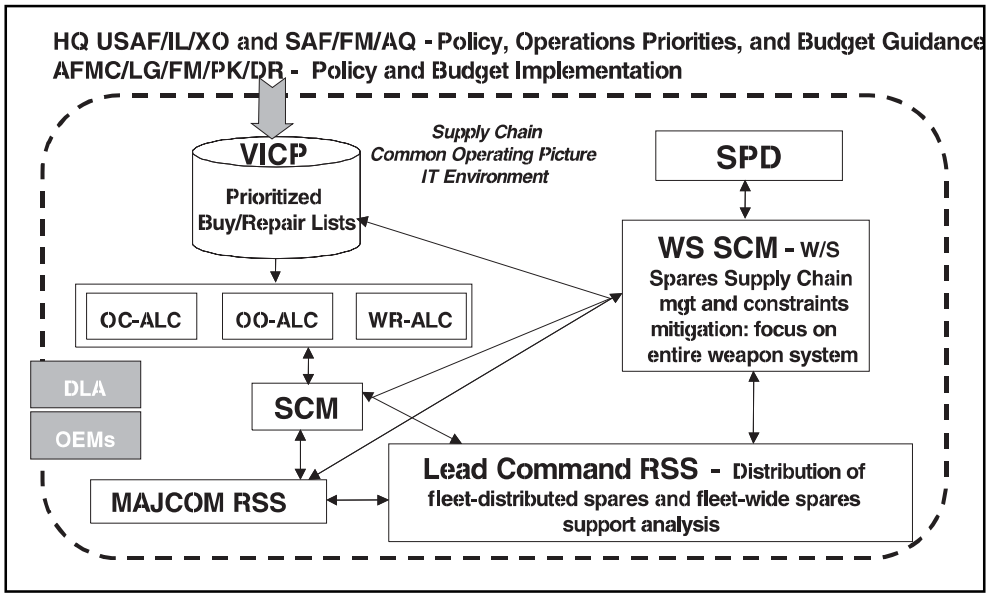


Figure 1. SC C2 Framework

requirement, VICP will determine how to allocate the limited cost authority to best meet Air Force weapon system prioritization and guidance issued by the Air Staff. This guidance could provide full funding to some weapon systems at the expense of other weapon systems with a lower operational need, or the shortfall could be shared equally across weapon systems.

Allocating and Reallocating Limited Cost Authority

VICP will also determine the most efficient allocation based on visibility of the entire weapon system requirement across all the air logistics centers instead of the single-ALC perspective used today. A funds allocation tool, using an operational priority matrix, will allocate (or when necessary reallocate) cost authority to prioritize weapon systems against various support-level targets. Once it is determined how much cost authority will be allocated to each weapon system for buy and repair, VICP will develop an execution plan for buy-and-repair actions needed to achieve funded targets. Cost authority will then be allocated through the air logistics centers to the commodity supply chain managers who perform the actual initiation of buy-and-repair actions. In addition, VICP will provide funds reallocation guidance whenever there is a significant change in the requirement (increased condemnations, technical surprises, increased usage because of contingencies), the capability to execute, or available funding. Finally, it will allocate execution-year cost authority to the air logistics centers by weapon system. Of note, the AFMC Logistics Directorate will be the VICP approval authority for reallocation of cost authority based on WS SCM evaluation. The weapon system priority matrix will be used to guide the allocation (and reallocation) of funds when full funding is not available.

Centralized Buy

The buy execution plan developed by VICP will reflect funded requirements for both common and weapon system peculiar items. Guidance will be provided to the ALC commodity supply chain manager responsible for execution and the WS SCM for weapon system visibility and management of constraints. This guidance will provide business rules to facilitate management decisions at the air logistics centers and across weapon systems. The combination of centralized guidance and decentralized execution will protect against inconsistent support of individual weapon systems across the air logistics centers.

Centralized Repair

In the case of repair execution, VICP allocation of cost authority will be based on previously computed requirements; however, to maximize effectiveness, repair execution of that cost authority will be done through the Execution and Prioritization of Repair Support System (EXPRESS). EXPRESS recognizes today's need and prioritizes repair based on actual operational requirements at that given time and will be a valuable tool within VICP. There will, however, be a change to the way EXPRESS prioritizes workload. Today, each air logistics center prioritizes internal repair activity, using the EXPRESS Prioritization Module. Although this prioritizes repair by weapon system within the air logistics center, it cannot determine the impact of repair to the weapon system fleet because it does not consider the repairs being done at other air logistics centers or at contractor repair locations. VICP weapon system focus will change this. By 30 January 2003, the Prioritization Module of EXPRESS will centrally compute a list that will prioritize repair for weapon systems across air logistics centers.

The EXPRESS Supportability Module will continue to be processed in a decentralized mode at each air logistics center, where they will identify repair constraints. Today, these constraints are not prioritized with a view to their impact on weapon systems availability. After EXPRESS is centralized, the Air Force will be able to prioritize constrained assets and see their impact to the weapon system lead time away. It will also be able to determine the urgency of mitigating the constraint and identifying the impact if it is not mitigated.

Finally, not all items are prioritized by EXPRESS. In fact, none of the contract or other service repair is prioritized or managed within EXPRESS. A long-range goal is to include these categories of items in EXPRESS.

Distribution and Redistribution

Distribution is the shipment of assets from the ALC storage location to the customer to satisfy the customer's outstanding requisition. Redistribution is the shipment from a base (retail account) to a customer to satisfy the customer's requirement. This includes lateral support (the filling of high-priority requirements at one base with assets from another base) and the reallocation of stocks (the movement of shelf stock from one base to another to improve Air Force mission support).

The decision logic in the VICP data environment will provide an asset on receipt of a requisition, identify the source for the asset, and provide status to the customer immediately. Thus, the VICP data environment will identify, based on Air Force-approved business rules, whether to ship from depot stock, base excess stock, or nonexcess base stock or wait for repair. This will eliminate the need for bases to use lateral support procedures for Air Force-managed items. The VICP data environment will identify what item to distribute or redistribute (both the shipping and ship-to bases) based on weapon systems availability. Hence, items will be distributed from bases with the least mission impact rather than base where the first asset was found (as is the case with the current lateral support system).

The VICP data environment will have to provide *what if* reallocation analysis and direct reallocation actions for existing stock. The reallocation process will identify the impact on weapon systems availability of moving shelf stock from bases with lower needs to bases with greater needs. The lead command and major command (MAJCOM) regional supply squadrons can use this capability to improve fleet and supply support to high-priority contingency needs.

Feedback Tools

For all the processes to come together, the ability to compare actual execution to the plan is absolutely key to identifying constraints for timely resolution and adjusting future budget projects. VICP will compare actual buy-and-repair execution to the planned (VICP guidance) buy and repair. It is important to allow some execution flexibility to accommodate the dynamics in spare parts usage and in mission priorities. Nonetheless, the

execution tracking system will provide valuable feedback to determine the accuracy of the VICP forecast, ability of the WS SCM and the air logistics centers to execute to achieve the WSA targets, and constraints affecting the execution guidance.

Specifically, VICP will track the execution of the buy lists to analyze the accuracy of the computed requirement compared to execution. This analysis will help refine the requirements-determination process.

For the repair process, VICP will provide an EXPRESS *skip over* tool for the WS SCM to properly gauge the effectiveness of repair activities. If high-priority items are not being inducted, WSA targets cannot be achieved, and the WS SCM must take corrective actions to ensure the right things are being repaired. WS SCMs will be responsible for ensuring constraint mitigation plans are developed for constraints that adversely impact achieving the WSA target.

The last piece of the puzzle is the *future vision* of the VICP data environment. The vision provides for centralized guidance to retail repair sources and establishes business rules to allow for automatic distribution and redistribution of Air Force-managed items. For retail repair sources, notices will be sent to retail systems when repair actions are unnecessary because an asset is excess to both base and worldwide needs. VICP data systems will also prioritize and provide redistribution actions for repair of assets at one base to satisfy needs at other bases. The VICP repair execution system will also consider repairs made at centralized intermediate repair facilities when prioritizing depot-level repair and distribution requirements.

In a nutshell**,** VICP is not an organizational structure but is a combination of processes, systems, and business rules that require a collaborative effort to maintain weapon system focus, the key element of supply chain command and control. VICP will execute Air Force policy generated by many Air Staff offices. This includes financial, logistical, and operational policies. Execution of this policy will produce unconstrained requirements for POM and budget submissions, as well as the capability to execute constrained budgets to meet operational priorities. Centralized buy lists and priority repair lists will be produced based on the weapon system target, which will be sent to the air logistics centers for decentralized execution. Feedback to VICP allows adjustments to be made to the buy-and-repair requirement and reallocation of cost authority resources. Feedback to the WS SCM will provide insight to the performance of activities that execute the cost authority allocated to the weapon system and will identify major constraints that require mitigation.

Aligning Supply Chain Management Focus

In today's global marketplace, successful enterprises define supply chain management as the integration of key processes and information across the supply chain. One of the more difficult tasks associated with this process centers around identification, understanding, and standardization of those key processes. As noted in the *International Journal of Logistics Management:*

> While many have recognized the benefits of a process approach to managing the business and supply chain, most are vague about what processes are to be considered, what subprocesses and activities are contained in each process, and how the processes interact with each other and with the traditional functional silos.[1]

The following paragraphs address the Spares Campaign's Align Supply Chain Management Focus initiative, describe its objectives, and provide background related to the development of a weapon system supply chain manager. Also discussed is the importance of providing visibility across the supply chain through implementation of a supply chain common operating picture, to include how and when it will be phased into Air Force operations.

Today, supply chain managers at air logistics centers lead organizations that manage groups of specific national stock numbers (NSN). Supply chain managers can manage stock numbers applicable to a single weapon system or common to multiple weapon systems. These managers report to their respective ALC commanders and are responsible for managing the supply, repair, and overall management of these assets. Additionally, they are responsible for analysis of supply chain performance as it relates to their specific group of NSNs. However, looking only at a specific group of NSNs, today's supply chain managers are unable to see how their items impact overall weapon systems availability. The Air Force also requires management of assets at the weapon system level.

In conjunction with AFMC's efforts to improve supply chain manager performance, MAJCOMs have expressed concern that tomorrow's supply chain managers must focus on weapon systems. They must be responsible for fleet-wide supply chain integration for entire weapon systems. Their efforts must be focused on maintaining the highest possible mission capability and weapon systems availability given the resources allocated to that weapon system.

Within this charter, the visibility of information, product, and funds across the entire supply chain becomes a necessary enabler. With the aforementioned issues in mind, the Spares Campaign Integrated Process Team for Align Supply Chain Management Focus identified the need for a new position within the ALC organizational structure, the WS SCM, who would report directly to the system program director or program manager, depending on the assigned weapon system. The WS SCM will have responsibility and authority for analyzing and coordinating the integration of support actions necessary to ensure overall weapon system supply chain effectiveness and oversee the execution of spares buy-and-repair priorities to meet mission capability and WSA goals. Additionally, the WS SCM will coordinate supply chain activities to mitigate constraints in order to optimize mission capability and weapon systems availability given the resources allocated.

To be successful, the WS SCMs must identify and drive the integration of their supply chains, to include supply chain structure, business processes, and supply chain management components. These design efforts include identifying specific supply chain nodes and processes (the key processes that require integration) and where to focus available resources to maximize support to the customer.

While it is important that WS SCMs have visibility over the entire supply chain, it is equally important that the supply chain be mapped in this configuration to optimize collaboration and communication. Once members have been mapped in the supply chain, the WS SCM must identify the key supply chain processes that require integration among the critical members of the supply chain.

The key supply chain processes identified by members of the Global Supply Chain Forum are:

(1) Customer relationship management,
(2) Customer service management,
(3) Demand management,
(4) Order fulfillment,
(5) Manufacturing flow management,
(6) Procurement,
(7) Product development and commercialization, and
(8) Returns.[2]

Within each of these processes, the WS SCMs must build the proper service-level agreements with suppliers and customers. They must manage information flows among the members of their supply chain to allow better demand forecasting, improve asset visibility, and provide the necessary flexibility to meet demand variability. The WS SCM's objective is maximizing support for the weapon system supply chain that ultimately supports the warfighter.

Initial operating capability for WS SCMs is scheduled for early fiscal year (FY) 2003. Initially, WS SCMs will be assigned to the F-15, F-16, and KC-135. This phased implementation establishes a WS SCM at each air logistics center. During FY03, WS SCMs will monitor improvement to weapon system performance and document lessons learned. Beginning in FY04, the Air Force will phase in the remaining weapon systems incrementally.

Air Force Supply Chain Common Operating Picture

End-to-end spares visibility is a major enabler for successful supply chain management. Providing this enhanced visibility is crucial to successful implementation of the Spares Campaign initiatives. All stakeholders must have access to the same information, provided at the same time, to support integrated, system-oriented decisionmaking. Further, supply chain information systems must employ the latest information technology, ensure full integration of supply chain business processes, and be more user-friendly than current systems. The Air Force solution to supply chain visibility, the SC COP, provides a single tool that uses authoritative data sources to provide needed information for all levels of activity and management across the supply chain. The SC COP will greatly streamline and standardize information management and dissemination to effectively manage spares support for the warfighter.

Today, there are a number of spares management tools, each requiring different user-identification names and passwords. Data integrity (inaccuracies due to erroneous entries and use of secondary sources) and data latency (differences created by secondary systems providing the data at different times) create confusion within the supply chain and limit the analytical capability of decisionmakers. To address and solve these issues, organizations throughout the Air Force are collectively expending resources to develop systems that help manage their workload. This results in the development of duplicative, local, homegrown solutions that focus on segments rather than the entire supply chain. As a result, fielded tools often provide different answers to the same questions.

SC COP development stemmed from the concept that, while a variety of organizations comprise the spares supply chain, data and information requirements across the chain remain largely the same. The SC COP's goal is to provide comprehensive asset visibility, enabling users to manage weapon system spares from a fleet-wide supply chain perspective. Once fully fielded, SC COP should serve as the single source of information to manage the spares supply chain.

Initial operating capability from the SC COP was fielded on 28 March 2002, and users can access it through the Air Force portal. The initial thrust of this effort brought together the functionality of several different AFMC and ALC tools to display one authoritative source of information. Subsequent improvements to SC COP were released as *spirals.* Spiral Two was fielded on 28 June 2002 and debuted a presentation layer that depicts the spares management supply chain in a process-centric circle. Spiral Three will have the capability to actually see data from throughout the weapon system supply chain. Users will have drill-down capability, allowing easy navigation from fleet-wide metrics to specifics on individual NSNs. Future spirals will add more capability that will eventually meet the goal of visibility of all assets, in all locations, and in all conditions.

Another exciting project currently in the research and development phase is the Air Force supply chain portal. This project harnesses portal technology to create a workspace for supply chain members to perform transactions necessary to accomplish mission objectives. If early design tests are successful, a mechanic at the depot could log on to the SC portal and search real-time inventory positions throughout the Department of Defense and even at participating contractors' facilities. Once asset status is known, an order can be made and, through collaborative messaging processes, real-time status received on where the part was issued and when it can be expected at the mechanic's location. Through this technology, all dependent transactional systems (financial, inventory, and transportation) will be updated at the time of the order processing.

With this charter and the described tools, the WS SCM will serve as a broker, coordinator, and quarterback for the weapon system supply chain, linking supply chain stakeholders in an extended process and coordinating activities that deliver products and services to customers. Through these efforts, the WS SCM will be able to cross organizational boundaries and achieve improved spares support. The development of information technology provides a degree of control not possible when current processes, policies, and organizational structures were designed. As noted in the *Handbook of Logistics and Supply Chain Management 2001*:

> Successful supply chain management requires integrating business processes with key members of the supply chain. Implementing supply chain management requires making the transition from a functional organization to a focus on process, first inside the enterprise and then across the supply chain. By taking a process focus, all functions that touch the product or provide information must work together. Operating an integrated supply chain requires a continuous information flow, which, in turn, helps create the best product flows.[3]

Standardize Use and Expand Role of the Regional Supply Squadron

The third major initiative of the C2 Supply Chain Team is the regional supply squadron—the component that helps bridge the gap between suppliers and operational requirements generated by the warfighter.

The genesis of the regional supply squadrons dates back to the massive buildup of US and coalition forces in support of Operation Desert Shield in 1990, where resupply issues quickly surfaced. The lifeline of the deployed unit was the war readiness spares kit, a deployable spares package that was the forerunner of today's readiness spares package. To replenish the kits, each deployed unit would download its replenishment requirements to a tape and mail it to the home station, where the transactions would be sorted manually and downloaded to the Standard Base Supply System (SBSS). This process added 2 weeks or more in administrative processing for weapon system spares replenishment—unacceptable in a wartime environment.

To address these issues, the Air Force required a centralized activity that could receive, consolidate, and pass requirements from deployed units to sources of supply in a near real-time, automated fashion and act as a single, authoritative focal point with sources of supply. The Air Force realized this vision with the Air Force Contingency Supply Support Activity (AFCSSA), created in 1990 to centralize and streamline the weapon system spares-replenishment process. AFCSSA proved its worth during Operation Desert Storm by reducing order and ship time by 10-14 days and eliminating the inefficiencies and suboptimums caused by multiple units' linking to the home station for core supply support. At the cost of 150 supply people, the centralized supply support concept embodied in the AFCSSA reduced the deployment footprint by 450. Building on the successes of the Gulf War, AFCSSA extended its centralized supply support to operations in the Iraq no-fly zones, Haiti, and Somalia, as well as steady-state Arctic early-warning radar sites.

The Air Force Supply Executive Board took AFCSSA successes a step further and defined the initial concept for regional supply squadrons to provide centralized support for all MAJCOM bases. The centralized supply concept kept the processes associated with physical handling of property and customer and vendor liaison at the base level, while placing the resource management and supply C2 functions in the regional supply squadrons.

In October 1997, the Air Force Director of Supply directed the implementation of this RSS concept in four major commands. By December 1997, ACC had established the first regional supply squadrons in the Air Force, to be followed by AMC, United States Air Forces in Europe (USAFE), and Pacific Air Forces (PACAF). The results were notable. By centralizing supply C2 functions—such as stock control, weapon system spares support, stock fund management, equipment management, and computer operations—the supply career field could realize a reduction of 570 manpower positions for annual savings of $25M.

In addition to the manpower savings, the four operational regional supply squadrons provided significant improvement in several areas of spares support that enhanced support to the warfighter. For example, the PACAF regional supply squadrons reduced not-mission capable requirements; that is, mission capabilities (MICAP) at Kadena Air Base, Japan, were reduced from 574 to 196, while MICAPs at Elmendorf AFB, Alaska, were reduced from 420 to 224, both within the first 30 days under RSS management. The ACC RSS decreased order and ship time by 65 percent in 1 year, reduced command excess equipment by $3M, and cut total not mission capable for supply (TNMCS) rates for several weapon systems, including a reduction greater than 50 percent for the E-3, B-2, and HH-60. Similarly, the AMC RSS has helped reduce the TNMCS rates steadily for the C-5 for the last 2 years. The AMC RSS has made great strides in improving C-5 engine support since regionalizing AMC bases. It reached the war reserve engine (WRE) standard of 65 for the first time in more than 2 years and was a major reason for the command's attaining a WRE level of 87, the highest in 6 years. The AMC RSS has also exercised its role as the lead command for the mobility air force and partnered with Air Education and Training Command's (AETC) Altus AFB, Oklahoma, to reduce its number of average daily MICAPs by nearly 25 percent.

Objectives of the RSS Initiative

Establishment of regional supply squadrons has significantly improved supply support to the warfighter, but as the Spares Campaign C2 Team pointed out in its report in June 2001, the current organizational alignment (six of ten commands without RSS coverage) continues to produce inconsistent results. The team specifically cited the lack of fleet-wide coordination authority to speak for the operational commands on weapon system spares issues, and no one is ensuring that the most urgent fleet requirement is filled first.

As a result, the Spares Campaign undertook an effort—in conjunction with the Air Force Directorate of Logistics Readiness, MAJCOM logistics community, and current regional supply squadrons—to standardize the use and expand the role of regional supply squadrons. This initiative has two primary objectives. The first is to establish RSS coverage in all MAJCOMs, standardizing common supply processes that have proven to be cost-effective and performance-enhancing. All MAJCOMs plan to establish MRSSs to meet this objective. The second is to move distribution decision authority for a few select, intensively managed spares from item managers to an LCRSS. This objective will place distribution authority on the demand side of the equation, with an organization that is closer to operational requirements of the warfighter. Specific LCRSS assignments are indicated in Table 1.

New Emphasis on Fleet-Wide Operational Spares Support

As this article goes to print, the Air Force Deputy Chief of Staff, Installations and Logistics has approved modification of the current MRSS concept for spares support for weapon systems based in the continental United States (CONUS). Under this concept, the ACC, AMC, and Air Force Special Operations Command (AFSOC) RSS will be responsible for MICAP, awaiting parts, and reserve-stock point replenishment support for all CONUS-based combat air forces (CAF), mobility air forces (MAF), and special operations forces (SOF) weapon systems, respectively. The AETC RSS and Air Force Space Command (AFSPC) RSS will provide full weapon system support for *white jet* trainers and space and missile systems, respectively. The AETC, AFMC, Air Force Reserve Command, and Air National Guard RSS operations will provide stock control, equipment management, computer operations, and stock fund management support for their respective commands and will work closely with ACC, AMC, and AFSOC RSSs in support of combat aircraft assigned to their respective commands. This strategy was briefed at the Spares Campaign Summit at Robins AFB, Georgia;

Logistics Readiness Conference at Eglin AFB, Florida; and Air Force Materiel Management Board in October 2002. Operating rules, roles, and responsibilities for this revised strategy for weapon system spares C2 will now be developed by the RSS integrated process team and coordinated through the MAJCOMs.

The LCRSSs identified in Table 1 are core MRSS organizations, with expanded responsibility for fleet-wide weapon system spares analysis and selective item distribution. This LCRSS effort, combined with initiatives to create a VICP and align supply chain management focus, will provide more emphasis on fleet-wide operational spares support for the weapon system and significantly improve Air Force spares C2.

As previously mentioned, the LCRSS has two additional roles and responsibilities beyond those assigned to the MRSS. First, the LCRSS serves as the fleet focal point between the various MRSSs and the commodity SCM for the select few items designated as *fleet distributed*. Fleet-distributed items have significantly more requirements than serviceable assets; frequently have simultaneous multiple, competing demands across commands; and severely impact fleet-wide weapon systems availability. The MRSS, LCRSS, SCM, and WS SCM (or Defense Logistics Agency WSSM) must all agree that selective distribution is warranted. When an item is designated as fleet distributed, the LCRSS makes all distribution decisions in coordination with all impacted MRSSs and the applicable commodity SCM.

Second, the LCRSS will have an analysis activity responsible for monitoring overall spares supportability and identifying items with trends that may indicate supportability problems. As a result of this analysis, the LCRSS will alert the applicable MRSS, WS SCM, and commodity SCM organizations and begin evaluation of actions needed to preclude the item from migrating to the fleet-distributed category.

When analysis indicates, the LCRSS may recommend to the commodity SCM, WS SCM, and MRSS that the item be considered for designation as a fleet-distributed item. The LCRSS also will work with the MRSS to evaluate the overall operational spares posture to determine what additional steps might be taken at the bases to alleviate shortages. This may include changing the repair priority for intermediate-level repair, redistributing backlogged reparables if repair capacity exists at other locations, or other actions as deemed appropriate. All actions will be coordinated with the appropriate MRSS and command maintenance staff.

ACC and AMC RSSs established initial operational capability as the CAF and MAF LCRSSs, respectively, on 1 October 2002. Initial LCRSS operations will provide coverage for the F-15, F-16, and KC-135 aircraft. The other designated LCRSS organizations will be phased in when all necessary organizational actions have taken place.

New Tools Streamline Problem Solving and Analysis

Inherent in the regional supply squadrons' and C2 Supply Chain Team's ability to improve spares C2 support to the warfighter is access to data that show the same view of the total requirement, as well as all assets in all conditions and at all locations. Additional management tools are being made available to help facilitate accomplishment of these activities.

MAJCOM	Aircraft Types
ACC	CAF (fighters; bombers; intelligence, surveillance, and reconnaissance; airborne C2; helicopters [excluding UH-1])
AMC	MAF (airlift, tankers)
AFSOC	SOF (special operations aircraft)
AETC	*White jet* trainers
AFSPC	Space and missile systems, UH-1

Table 1. Lead Command RSS-Designated Organizations

As noted in the section on supply chain management, the Air Force portal will offer access to the Air Force SC COP. This tool will provide supply chain managers at the base, regional supply squadrons, and air logistics centers total visibility of all requirements and assets in all conditions at all locations on a worldwide basis. This will result in more accurate information exchange and feedback between the regional supply squadrons and all supplying organizations. The supply chain common operating picture also will provide links to virtually all other key systems. A number of enhancements are planned for the initial product that will further integrate and improve usability of all activities to include near real-time data availability.

In addition to the SC COP, the RSS Tools Working Group has been consolidating and standardizing a number of MICAP, stock control, and analysis tools for use by the RSS community. To date, the working group has helped facilitate the production of applications benefiting the entire regional supply community, reduced RSS-unique tools, pushed standard tools to the Air Force portal, and developed a standard suite of Web services for the RSS community in support of their customers.

The RSS MICAP, stock control, and analysis tools will provide ad hoc report capability, rollup summaries, drill-down capability, MICAP asset sourcing system boards with expanded history comments, various historical reports, and more than 100 stock control reports and analysis metrics based on standard business rules and metrics in a near real-time environment via an Air Force RSS data mart.

The RSS Standard Toolkit (known as the RSS Dashboard under the SC COP) identifies more than 30 tools for regional supply squadrons in the Air Force portal. The AMC and ACC RSSs and the Standard Systems Group are leading these efforts to allow airmen at the regional supply squadrons use of a single suite of tools to perform all aspects of a job.

The Fleet Analysis Tool Working Group's goal is to develop a fleet-wide analysis tool that will enable users and customers to access data across all supply accounts in the Air Force. The AMC RSS Development Team is building an analysis tool that will be capable of producing reports and graphs, as well as querying data and extracting the data in various formats, including Excel spreadsheets and charts. The database will reside and be maintained in the Electronic Data Warehouse as a supply universe so users will be able to perform logistics analyses on demand. Real-time supply analysis capability will be available to all Integrated Logistics System-Supply (ILS-S) users via the Air Force Centralized Supply Database and the ILS-S Discoverer tool as part of the SBSS modernization efforts under Release 1.2.

The ACC RSS C53.net serves as the foundation and benchmark for the Air Force RSS stock control tool of the future. The USAFE RSS team developed the new and improved *proof of concept* that includes all current capabilities and

expands to meet the requirements of a post-9/11 RSS community. This will include enhanced multidimensional views by stock class and base with drill-down capability to the stock numbers.

The ACC RSS MICAP report builder was selected as the foundation for the Air Force RSS MICAP tool. Currently, the PACAF RSS and the ACC RSS Development Team are ensuring customers have the ability to generate ad hoc reports and perform statistical queries on MICAP data, as well as view all history comments regarding any specific active MICAP. Customers can view single-hit, tail number statistics by weapon system, multiple-hit MICAPs, or all MICAPs at their bases.

One of the driving factors in tools standardization is to make *getting the answers* or the *rest of the story* easier for the airmen and civilians who are the backbone of the Air Force spares support business. ACC developed the *20 questions every MICAPer asks the item managers* to help guide information technology requirements. According to Captain Jondavid DuVall, AMC Supply Systems Management:

> If information technology can provide the answers during one click, then our supply troops, item managers, transporters, contractors, depot personnel, and so on can concentrate on *getting that part* to the customer faster. That is really the bottom line with our information technology efforts: finding the answers to all the questions so we can answer the mail and get back to the real business at hand and putting a part in the hand of maintenance troops a little faster so they can launch their aircraft.

Continued Improvements in Spares Support to the Warfighter

The regional supply squadrons directly support the Agile Combat Support core competency. Agile Combat Support sustains the full spectrum of military operations and steady-state peacetime operations. The regional supply squadrons enable light, lean, and lethal agile combat support and provide capability to meet a 72-hour response for food or bombs on target and flexible and efficient sustainment of deployed forces. Standardization of Air Force supply operations and expansion of the role of the regional supply squadrons, as outlined, will provide a much more responsive spares C2 process and improved support to the warfighter.

Notes

1. "The Supply Chain Management Processes," *The International Journal of Logistics Management,* Vol 12, No 2, 2001, 13.
2. "The Supply Chain Management and Logistics Controversy," *Handbook of Logistics and Supply Chain Management,* 2001,108.
3. "The Supply Chain Management and Logistics Controversy," 120-124.

VICP: Ms Alexander is a logisitcs management specialist, Materiel Management and Policy Division, Air Force Deputy Chief of Staff, Installations and Logistics, and Mr Gunselman is a consultant, Dynamics Research Corporation (DRC), Directorate of Supply Chain Integration, Air Force Deputy Chief of Staff, Installations and Logistics.

SCM: Major Cox is a program manager, Spares Command and Control, Supply Chain Integration and Logistics, Air Force Deputy Chief of Staff, Installations and Logistics; Mr Mathews is chief, Integrated Spares Management, Directorate of Supply Chain Integration, Air Force Deputy Chief of Staff, Installations and Logistics; and Mr Grehawick is a consultant, DRC, Directorate of Supply Chain Integration, Air Force Deputy Chief of Staff, Installations and Logistics.

RSS: Major Brockway is flight commander, Special Mission Aircraft Support Flight, Air Combat Command Regional Supply Squadron, Langley AFB, Virginia; Captain DuVall is chief, Supply Systems Management, Air Mobility Command, Scott AFB, Illinois; Lieutenant Colonel Codispoti is chief, Supply Warfighting Policy, Materiel Management and Policy Division, Air Force Deputy Chief of Staff, Installations and Logistics; and Mr Masters is a consultant, DRC, Directorate of Supply Chain Integration, Air Force Deputy Chief of Staff, Installations and Logistics.

notable quotes

If everyone is thinking alike, then somebody isn't thinking.

—General George S. Patton, Jr

Maryann Kaczmarek, Bobbi LaRue, Duane Anderson, Robert Owen, William Warren, Larry Waite, Tina Womack

Air Force Spares Campaign

Demand Planning in a Demanding Environment

The supply chain process consists of many moving parts that must come together to support customer needs. Only when these moving parts are aligned can the supply chain deliver the right product to the customer at the right time and place. The components of the supply chain process include activities from the strategic planning level to the execution level, such as demand and supply planning at the strategic level and workload and transportation planning at the execution level. The activities that occur at the strategic planning level must be aligned with those that occur at the execution level and vice versa. Thus, the importance of planning in the supply chain is significant for execution. Central to the planning process is determining how customer needs will be met in the short, medium, and long terms.

The Air Force logistics processes embrace components of the supply chain and emphasize the need for quick response to the customer in programs such as Repair on Demand. A solid planning capability must be in place to ensure the success of quick-response processes and other execution-level endeavors. Demand planning provides the necessary solid planning capability by aligning expected resources, parts, people, and capacity to anticipated customer requirements. It is the process of translating the warfighter's logistics support requirements into executable logistics plans and schedules. This emphasis on an accurate and responsive planning process is a prerequisite for a 21st century logistics system based on pipeline velocity, lean inventory levels, and repair on demand to support aerospace expeditionary force operations.

The importance of demand planning and the alignment it provides cannot be overstated. To understand why a properly aligned supply chain is key to the warfighter, consider a *day in the life* situation in which a shop must repair and turn around a mission capability (MICAP) part quickly. A quick-response process sets the stage at the execution level by providing priority guidelines that support the turnaround of the MICAP. However, a behind-the-scenes planning philosophy and environment must be in place so the MICAP can be eliminated. Without a solid planning environment, the repair of the MICAP would be impaired because of unavailable parts or other resources. To meet the customer requirement, quick reaction would be necessary, and the potential for incurring additional costs in the form of last-minute contracting or overtime would increase. Furthermore, the customer requirement still may not be met despite the quick response. Effects of poor demand planning surface in a number of areas: poor repair planning often results in cannibalizations, shipment expediting, and schedule changes to compensate for stock outages and back orders. Negative results also can be seen in terms of inventory management (too much or too little stock), pipeline velocity (poor use of capacity for speedy throughput), total costs, and customer satisfaction.

In an Air Force logistics environment, the process of demand planning can be applied in many situations. By anticipating customer needs, demand planning can help a shop plan for the key end items required during an engine downtime incident, minimizing the duration of the downtime. Similarly, anticipating customer needs and planning

Supply Support

for these needs can help a shop more effectively align its component parts and avoid awaiting parts (AWP) situations, thereby providing a faster response time. Another situation in which demand planning applies to Air Force logistics is the alignment of capacity and customer requirements. Through the planning process, a shop takes the anticipated customer requirements and examines how current capacity can best meet these requirements. The exercise of balancing anticipated customer requirements with capacity allows the shop to optimize its use of resources, identify shortages and misaligned capacity periods, and produce a realistic execution plan that can be shared with the customer. In turn, the customer can use this information to adjust internal operations.

While the benefits of demand planning are attainable and realistic for the Air Force, the current state of Air Force logistics planning presents notable limitations. The current process is driven by budget requirements and constraints; therefore, it is not a customer-centric process. In the current state, requirements are gathered by several systems that populate the Secondary Item Requirements System (D200A), and from this point, the requirements are aggregated Air Force-wide through the Planning, Programming, and Budgeting System (PPBS) process. These requirements, now in the form of budget figures, are presented to Office of the Secretary of Defense and Congress for approval. During this 2-year process, execution requirements can and do change; hence, requirements become subject to the time line of the budget process instead of being aligned to the needs of the customer.

Current Air Force logistics, at the execution level, operates in a fragmented environment in which different functions—maintenance, supply, and distribution—do not plan in concert. Attempts, such as repair on demand, have been made to improve such inefficiencies, but these have placed emphasis within the isolation of each functional planning area and not in a single logistics planning process across the whole business enterprise. The planning process is centered on a series of unique functional areas rather than on a cross-functional, integrated process. The need of the warfighter or weapon system becomes secondary to the efficiency goal of individual, organizational planning functions. The effect of this functional emphasis has added to the disconnects in overall effective logistics support to the warfighter and the warfighter's weapon systems; for example, insufficient buffers to handle even minor fluctuations in demands. The lack of cross-functionality is also apparent in the design of Air Force legacy data systems developed to support individual functions and planning activities. Many of these systems are unable to incorporate information from other systems and are limited in their ability to create integrated plans that span multiple functions. Personnel must spend substantial time compensating for the limitations of the legacy-system environment via significant manual intervention at the expense of providing support to the warfighter and weapon system. Such a tradeoff is unacceptable in today's Air Force.

From the planning process to the supporting systems, current Air Force logistics planning lacks focus on customer demands. Logistics support to the warfighter and weapon systems, from planning to execution and subsequent measurements, is in need of transformation.

Applying Demand Planning

To realize the necessary logistics process transformations, commercial supply chain management best practices that could benefit Air Force logistics have been identified. One of these best practices is demand planning. A combination of process and technology, demand planning provides a methodology that identifies customer needs, establishes a set of stakeholders accountable for planning actions to meet customer needs, manages customer expectations, and builds and continuously evaluates the customer-centric processes that support those needs. A five-step methodology has been developed for executing demand planning.

Establishing the Stakeholders

Step 1. Front-End Agreement. The front-end agreement's objective is to establish a framework for collaboration across supply chain teams (item managers, supply chain managers, shop leaders) that support the customer's requirements. To achieve its objective, the front-end agreement documents roles and responsibilities for supply chain members involved in logistics support of major end items. The framework for collaboration is the foundation for all other activities in demand planning.

In the Demand Planning Pathfinder for the F101-GE-102 engine that powers the B-1B aircraft, the supply chain members established a front-end agreement, via a charter, to provide structure for collaborative planning efforts and senior-level buy-in. It included areas and trigger points for collaboration, the collaborative process that would be used (including finite periods for achieving specific tasks and the level of collaboration), required skills and knowledge level of the participants, and the procedures for resolving disputes. Customers, operations planners, maintainers, suppliers, and other key members of the F101-GE-102 engine logistics chain supported

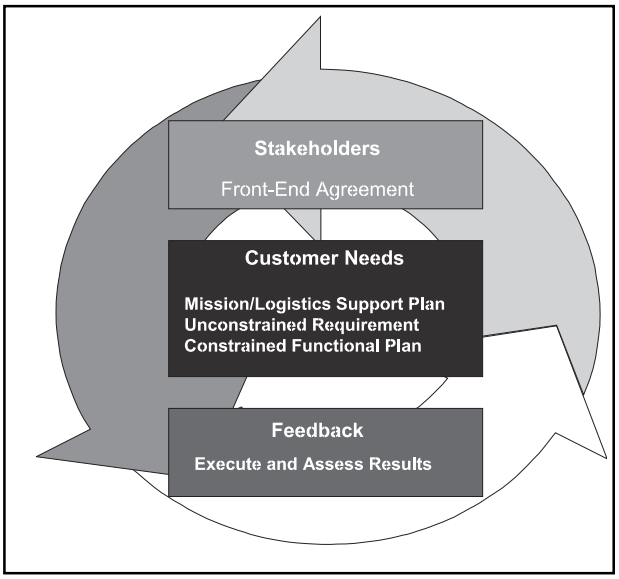


Figure 1. Methodology for Executing Demand Planning

the spirit of the front-end agreement throughout the pathfinder test, which demonstrated better support to the weapon system and the warfighter.

Identifying Customer Needs

Step 2. Mission and Logistics Plan. The mission and logistics plan documents the level of weapon system support, logistics issues, and business parameters that would guide supply chain demand planning efforts.

Step 3. Unconstrained Requirements Definition. The unconstrained requirements definition results in a single forecast of warfighter end-item requirements that is used as the basis for all demand planning activities. This number is based on actual warfighter need and does not include financial, capacity, or other constraining factors. Of key significance is the focus on the anticipated needs of the warfighter—an important paradigm shift from budget constraints as the primary focus in the planning process.

During the initial rollout of the demand planning process, the Core Forecast Team (generally materiel management, production management, and supply management personnel) identifies the full customer demand (reparable requests sent from the field or originating at the depot) the depot repair shop will support. This requirement (estimated quantity needed and approximate timeframe for the need) is used as a baseline for establishing integrated execution plans that will best support this forecast demand.

Step 4. Constrained Functional Plan. The constrained functional plan translates the *unconstrained* demand forecast into an integrated set of functional plans that addresses constraining factors and develops coordinated plans for optimizing logistics system performance, given the constraints. The constrained functional plans are the product of collaboration set forth in the front-end agreement.

In the Demand Planning Pathfinder, the maintenance shop recognized it had only enough capacity to support 14 low-pressure turbine (LPT) rotor repairs per month. As a result, monthly, unconstrained requirements exceeding this capacity would need to be moved to other months to be repaired (preferably earlier than the customer's need date) to avoid degradation in customer support. Because successful repair is dependent on both capacity and getting the required component parts, the supply plan was altered to better match the revised maintenance execution plan, so maintenance would not experience AWP outages during the repair. The result of these changes was a direct benefit to the customer by reducing the number of *not mission capable supply* incidents, and the repair shop experienced reductions in the average actual flow times for the LPT rotor.

Evaluating the Effectiveness of the Process

Step 5. Feedback Loop. A feedback loop enables the incorporation of regular measurement and accuracy adjustment into planning activities as a function of real-world execution. It is key to any process for the purposes of monitoring progress and making process improvements. Additionally, feedback highlights the essential nature of demand planning as a continuously iterative process of planning, execution, assessment, and improvement in forecasting and meeting demand.

Testing Demand Planning—OC-ALC Demand Planning Pathfinder

The demand planning process, as described, was tested on a small scale at the Oklahoma City Air Logistics Center (OC-ALC), Tinker AFB, Oklahoma, in the F101 engine environment. This demonstration, known as the Demand Planning Pathfinder, focused on creating a reengineered approach to the development of a consensus workload forecast, the development of integrated functional plans to meet a single forecast, the identification of operational constraints, and the use of data for feedback and performance measurement. Results achieved during this demonstration were impressive: LPT rotor throughput increased significantly, logistics response times were reduced from 89 to 44 days, shop flow times decreased from 59 to 45 days, and there were no production stoppages for spare parts identified as having supportability constraints 30 days out. Additionally, the Demand Planning Pathfinder identified a number of significant challenges that need to be addressed to translate test environment results into practical application within the broader Air Force logistics chain. These challenges include:

- **Information Technology.** In many instances, the reengineered approach required extensive manual efforts to bring together data and information from individual data systems not designed for integrated information flow. While marginally adequate for a small-scale pathfinder, large-scale implementation requires appropriate enabling systems and technology to reduce manual labor, monitor performance, and provide rapid decisionmaking capability.
- **Change Management.** Efforts are necessary to enable the dramatic philosophy shift necessary to implement a customer-centric process that focuses on collaboration, cross-functional integration, and identifying and resolving constraints lead time away. Critical factors include a disciplined and thorough review of policies and practices. Commitment to formal training of all personnel involved with these new business practices is also essential.

Overall, the Demand Planning Pathfinder illustrated that demand planning is a commercial supply chain management best practice with the potential to improve Air Force logistics significantly.

Implementing Demand Planning Under the Spares Campaign

Recognizing the results and significance of the Demand Planning Pathfinder, the Air Force committed to apply demand planning principles at all air logistics centers by approving a demand planning initiative as part of the Spares Campaign. The initiative is an ambitious effort to reap the benefits of demand planning across the Air Force via a three-phase plan.

Phase I. Initial Operating Capability

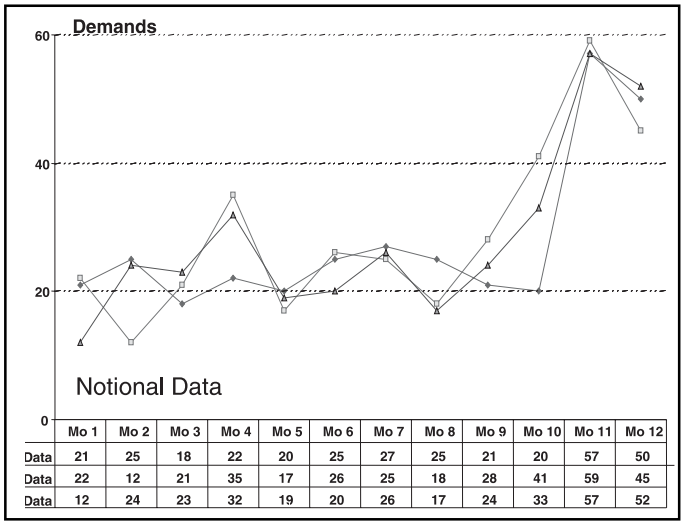
The demand planning initial operating capability (IOC) focuses on discrete process and policy changes attainable

without significant technology resources. This approach emphasizes the change management elements identified in the Demand Planning Pathfinder so that demand planning is adopted as a process first and foremost and then enabled and expanded through technology.

Whether at initial or full operating capability, the core demand planning process is performed at defined intervals (generally monthly for initial operating capability) and is divided into three stages. Each stage is designed to build a specific part of the overall demand plan that will be used during actual execution. The entire process is iterative so that, as it is performed, the Core Forecast Team (generally materiel management, production management, and supply management personnel) uses experience and the assessment of the previous demand plans to influence the development of current plans.

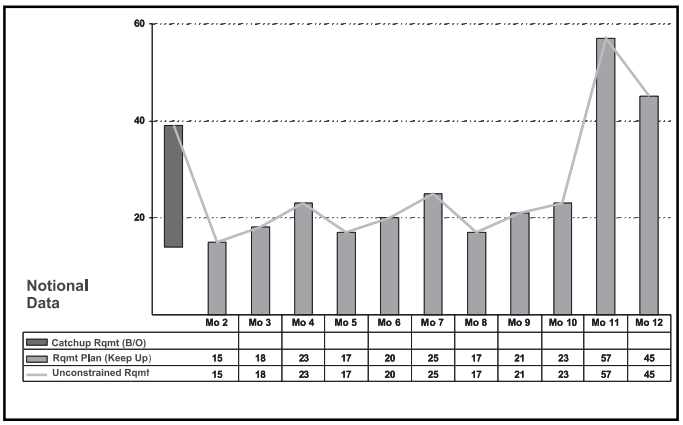
- The planning stage is designed to identify the unconstrained customer demands that represent all anticipated customer needs (estimated quantity and schedule). It also includes the minimum quantity of assets necessary to provide smooth support (pipeline and levels) to satisfy all customer-forecasted demands. This unconstrained requirement is the foundation for developing all future execution plans, which is the next phase.
- The execution stage is intended to build integrated, functional execution plans that are used by each functional area to prepare for the meeting of actual demand for specific items. Once these integrated plans are developed, each functional area will use them to resolve as many potential execution constraints as possible prior to actual execution (for example, induction of the carcass for repair) of the specific items.
- Under the assessment stage, the Core Forecast Team compares actual past execution against what was planned to identify where experience differed significantly from the plan. When the deviation between the previous results and the plan exceed the acceptable parameters, adjustments to the plan are developed for use in the next planning stage. In the IOC phase, a framework establishes the demand planning process through the adoption of the front-end agreement, creation of a core forecast team, an unconstrained requirement, optimization of an integrated execution plan, and a set of metrics.

The Core Forecast Team is formed to develop collaboratively and update (on a monthly basis) the agreed-upon customer forecast for each selected item that should be repaired at the depot. This agreed-upon requirement is known as the *one number forecast* because the entire supply chain will use it. Starting with historical data, the Core Forecast Team analyzes these data to identify seasonal trends and then creates a forecast, manually or through an algorithm, that projects customer demands 12 months into the future. As part of the collaborative effort, the Core Forecast Team will discuss the validity of this forecast and either accept it or modify it as necessary. Modification of the forecast is a key commercial best practice that recognizes forecasting as part math and part expert knowledge and judgment. This also gives the team ownership of the forecast, instead of surrendering decisionmaking to *the system*.



	Mo 1	Mo 2	Mo 3	Mo 4	Mo 5	Mo 6	Mo 7	Mo 8	Mo 9	Mo 10	Mo 11	Mo 12
Data	21	25	18	22	20	25	27	25	21	20	57	50
Data	22	12	21	35	17	26	25	18	28	41	59	45
Data	12	24	23	32	19	20	26	17	24	33	57	52

Figure 2. Historical Forecast Data



	Mo 2	Mo 3	Mo 4	Mo 5	Mo 6	Mo 7	Mo 8	Mo 9	Mo 10	Mo 11	Mo 12
Catchup Rqmt (B/O)											
Rqmt Plan (Keep Up)	15	18	23	17	20	25	17	21	23	57	45
Unconstrained Rqmt	15	18	23	17	20	25	17	21	23	57	45

Figure 3. Projected Monthly Customer Requirements

The forecast is then used to develop the unconstrained requirement for parts, shop capacity, manpower, and so forth. Key inputs to the creation of the one-number forecast and the unconstrained requirement are the projected monthly customer requirements and any external requirements (planned operational or maintenance events, pipeline assets, safety-level assets, readiness spares packages). The *keep up* portion of the unconstrained requirement is generally the customer's minimum projected needs, projected events (time compliance technical orders), and any projected establishment or increases in the levels. The *catchup* portions of the unconstrained requirement are the *hole*s in the existing pipelines or levels and the immediate fulfillment requirement to achieve a new asset level.

Once the unconstrained requirement has been identified, the team's efforts shift to the development of constrained execution plans. Constraints include, at a minimum, maintenance capacity (average available shop and event-driven capacity) and supplier capability (delivery schedule, available volume). Each functional constraint is applied, and all functional results are then reconciled simultaneously to develop an integrated execution plan that best supports the unconstrained requirement while minimizing the risk of producing *excess* assets. The integrated execution plan is then

used to align production to capacity and piece parts to meet customer requirements and measure the performance of demand planning results.

The demand planning metrics are designed to measure the success of the plans and corresponding pre-execution actions on meeting the warfighter's needs while operating within the availability of existing resources. Favorable outcomes should be seen through increased production, which results in experiencing fewer high-priority back orders (occurrence or duration), reduced shop-flow times (including delay times) much closer to the standard values, and improved use of the shop resources. Over time, the average AWP occurrences and duration should decrease noticeably, while the forecast accuracy (end item and components) should improve. Additional metrics will focus on the Core Forecast Team's ability to anticipate customer needs (forecast accuracy) and how the projected execution plan deviates from actual production. As the Core Forecast Team gains experience and understanding of the demand planning process and collaboration effort, the variance between the forecast and actual demand, as well as projected execution plan and actual production, will decrease.

Rollout of demand planning initial operating capability will serve a dual purpose: introduce the demand planning process at the air logistics centers and serve as the platform for expanding demand planning across the supply chain.

Demand Planning Rolled Out

The Air Force has embraced the demand planning concept, and the process was introduced at the Warner Robins ALC (WR-ALC) in March 2002, as an extension to ongoing workload planning activities, and designed to reduce monthly variability in shop inductions.

Key to the identification of the Core Forecast Team members is management-level support of demand planning and workload planning. In meetings with management and working-level personnel, the collaborative nature and customer focus of demand planning was accepted, and the front-end agreement was created to support future activities.

A workshop was conducted in June 2002 to launch the demand planning process. During this workshop, team members collaborated to validate historical data and create a one-number forecast 12 months out, determined capacity during that period, formulated an unconstrained requirement that incorporated anticipated catchup and keep up, and created a realigned maintenance execution plan. Building on this process, the WR-ALC Core Forecast Team has selected 1 low-altitude navigation and targeting infrared for night item and 12 ARC-164 items. Although a nascent process thus far, the workload planning efforts indicate that demand planning will yield significant benefits through back-order reductions and improvements in resource allocation and customer service.

Phase II. Full Operating Capability

The establishment of a demand planning initial operating capability will introduce the air logistics centers to the demand planning process and prepare them to expand the scope of demand planning to additional shops and across the supply chain. Key to this expansion will be introduction and selection of technology to enable the demand planning process. The introduction of technology at this stage will ensure that demand planning is capable of maintaining its emphasis on the process and overall focus on customer requirements. The Core Forecast Team will leverage its combined experience during initial operating capability and apply lessons learned to select the best technology that will transform Air Force logistics to a customer-centric process. This will mark the beginning stage to reach full operating capability.

Demand planning full operating capability will expand the scope of initial operating capability through the selection of additional end items, review of the planning bills of materiel information to support demand planning projected execution plans, and the analysis and selection of information technology tools to support the added complexity and scope of full operating capability across the Air Force Materiel Command.

Phase III. Advanced Planning and Scheduling

To capitalize on the momentum of the logistics transformation Demand Planning Pathfinder at OC-ALC, an APS Pathfinder effort was launched in February 2002.

While the process of demand planning may manifest itself in different forms, either in process or technology such as advanced planning and scheduling, the benefits realized in industry and observed in the Demand Planning Pathfinder cannot be ignored. The fundamental activities of collaboration and proactive planning are constant and provide proactive support to the customer whether or not software technology is being employed. The process of demand planning lays out the framework for collaboration and the information technology, which enables this process and allows an organization to expand the scope of demand planning throughout its supply chain. Any organization whose primary focus is meeting the customer's requirements is compelled to recognize the value of effective planning and execution to meet customer needs. To have multiple organizations work in collaboration for the single goal of supporting the warfighter is the essence of demand planning.

Ms Kaczmarek is project manager, Demand and Repair Workload Forecasting Initiative, Directorate of Supply Chain Integration, Air Force Deputy Chief of Staff, Installations and Logistics; Ms LaRue is a logistics officer, Propulstion Production Division, OC-ALC, Tinker AFB, Oklahoma; Mr Anderson is an item manager, General Electric Engines Section, Logistics Propulsion Management, OC-ALC, Tinker AFB; Mr Owen is an industrial technician, Engine Production Branch, Maintenance Directorate, OC-ALC, Tinker AFB; Mr Warren is a program analyst, Materiel System Group/Software Information Tinker Unit, Air Force Material Command/ Electronic Systems Center, Tinker AFB; Mr Waite is a logistics officer, Logistics Management Section, Logistics Propulsion Management, OC-ALC, Tinker AFB; and Ms Womack is an inventory management specialist, Maintenance Directorate, OC-ALC, Tinker AFB.

Maryann Kaczmarek, Bobbi LaRue, Duane Anderson, Robert Owen, William Warren, Larry Waite, Tina Womack

Air Force Spares Campaign

Advanced Planning and Scheduling

To capitalize on the momentum of the logistics transformation Demand Planning Pathfinder at Oklahoma City Air Logistics Center (OC-ALC), Oklahoma, an Advanced Planning and Scheduling (APS) Pathfinder effort was launched in February 2002. Advanced planning and scheduling is an off-the-shelf technology used for supply chain planning and decision support functions in a variety of commercial manufacturing, distribution, maintenance, and repair environments and, generally, has resulted in significant improvements to supply chain order fulfillment, cycle time, and cost efficiency.

The APS Pathfinder initiative will evaluate APS capabilities and limitations in an Air Force maintenance, repair, and overhaul (MRO) environment and support an implementation decision by Air Force leadership. Secondary objectives of the APS Pathfinder include the development of functional and technical documentation (data maps, process maps, training requirements, roles, and responsibilities) necessary to support APS implementation if such a decision is made by Air Force leadership.

The Demand Planning Pathfinder highlighted a key technical gap in the Air Force—a single system or even a group of systems that can adequately plan requirements for spares and provide an integrated and comparative view of supply chain decisionmaking information in areas such as:

- Difference between planned and actual performance in the supply chain
- Real-time visibility of changes in the spares pipeline
- Ability to see and evaluate the impact of adjusted inventory levels
- Simultaneous assessment of both *buy* and *repair* requirements
- Ability to identify sources of requirements from various operational customers
- Ability to compare both depot-level repair and Defense Logistics Agency (DLA) requirements to funding needs

The current requirement processes and systems tools are unable to adequately identify which conditions contribute to spares shortfalls, impair logistical support to the warfighter, and adversely affect weapon systems availability. The Air Force has several good pinpoint solutions that perform some of these functions. However, integrating these data in a way that allows management to make rapid decisions on how to maximize limited resources to obtain the best possible weapon systems availability is not possible with these pinpoint solutions.

Currently, the Air Force prime item managers are reviewing Engine Supportability Asset Management Plan (ESAMP) listings to identify current and potential supply shortfalls for 30 to 120 days out. Generated over a 3-week span, the Reparability and Forecast Module (RFM) provides the Air Force prime item manager with the ESAMP listing. Using the ESAMP listing, the item manager begins a very labor-intensive process using the Secondary Item Requirements System (D200A), Item Manager Wholesale Requisition Process (DO35A), or Wholesale and Retail Receiving and Shipping (DO35K) data, often accessed through the Navy Supply Maintenance

Aviation Reengineering Team (SMART [OC-ALC-developed data warehouse]), Execution and Prioritization of Repair Support System (EXPRESS [for EXPRESS-managed items]), and phone calls to the scheduler for projections of repair to validate the RFM listing. DLA consumables are worked by retail item managers using a similar process and could consume up to 30 percent of their time. With advanced planning and scheduling software, managers will be able to generate automated reports on demand for review of asset supportability in daily, monthly, quarterly, and even yearly outlooks. In addition, managers will be able to create reports using several different user-defined criteria. In this regard, the APS Pathfinder initiative is closely aligned to the demand planning concept.

APS software was designed to work in tandem with either Manufacturing Resource Planning II/Enterprise Resource Planning (MRPII/ERP) software or corporate legacy systems to allow analysis of current and historical information and, thereby, permit examination of numerous possible alternatives before determining the most feasible plan that will support customer requirements. This fully integrated functionality enables the rapid, repetitive modeling and collaboration of supply chain-related functions, inside and outside an enterprise, for functions such as forecasting, inventory and distribution planning, and rough-cut capacity planning.

The Air Force APS Pathfinder effort is a proof of concept, applying APS software within the F101 engine community at OC-ALC. The pilot is structured to provide information necessary for implementation planning and decisionmaking, testing the functional benefits and technical fit within the Air Force environment, and enabling collaboration with DLA and the original equipment manufacturers.

The intent of the APS Pathfinder is to validate an APS capability for creating a single logistics, system-planning baseline that integrates the various functional efforts (forecasting, inventory and distribution planning, maintenance and production planning) that are currently fragmented across a number of individual organizations, processes, and information systems. The APS Pathfinder endeavors to provide an automated, alerts-based capability to identify, examine, and resolve logistics system constraints by exception (parts availability, physical capacity, and financial restrictions) before they impact production and establish a mechanism for sharing information and supporting collaborative planning capabilities across the extended supply chain (for example, DLA and original equipment manufacturers).

Underway at OC-ALC, within the F101 engine community, a representative group of shop-replaceable units has been selected for the effort; these shop-replaceable units represent a cross-section of the items managed within the Air Force and the piece parts supplied by DLA. The following activities have been completed:

- Hardware and software has been installed and configured.
- Data-mapping efforts have resulted in defining the support processes enabled by current Air Force data systems.
- Candidate systems were reviewed, and inbound data required to support that functionality were identified and compared with existing Air Force Materiel Command (AFMC) and Department of Defense (DoD) legacy systems.
- Record layouts and schemata for both the Enterprise Data Warehouse and operational data stores have been obtained and are under review.

The current F101 supply chain model was developed to highlight the supply chain model in which the APS Pathfinder pilot will operate. The Demand Planning, Supply and Capacity Planning, and Collaborate Modules have been loaded with an initial feed of Air Force legacy data. Initial configuration and testing of the data with Air Force business scenarios, based on the demand planning tenets, are now underway.

The environment detailed above is not all-inclusive; however, it is intended to represent the Air Force modeled in the APS pilot. Highlighted in this view are the critical organizations targeted for the network model; current Air Force and DoD legacy systems were identified based on the information provided by government functional experts, BearingPoint-facilitated meetings, and detailed research into current Air Force and DoD systems. The Ogden ALC (OO-ALC) Logistic Systems Division and AFMC system offices of primary responsibility, Supply Systems Group, and Materiel Systems Group determined applicable systems, frequency, and data availability in regard to transactional versus static data feeds. Some data were available locally within OC-ALC, and other data needs were met by the AFMC Supply Systems Group and the Air Force Logistics Management Agency.

The power of the modules selected—Demand Planning, Supply and Capacity Planning, and Collaborate—address the fit and function of the software to an Air Force MRO environment.

Demand Planning Module

The Demand Planning Module is the enabling technology for Step 3 of the demand planning process. The demand planning software module of the APS Pathfinder uses multiple history streams and algorithms to forecast an unconstrained requirement. Squadron- and base-level historical consumption is imported into the Demand Planning Module; this information is aggregated to higher levels (global requirements) to facilitate the planning process. Establishing forecast models that define how an item is expected to behave creates location-specific item forecasts. Demand planners manage by user-defined exception parameters when the items behave differently than expected.

These demand planners can easily supplement the statistical forecast with additional information; in this manner, the Demand Planning Module enables demand planners to create statistical forecasts based on historical patterns and change plans rapidly when conditions change. It can track forecast accuracy by base, squadron, and so on (flexibility for different mission profiles). This allows demand planners to further refine forecasts over each iterative demand planning cycle by evaluating the set of forecast algorithms and supplemental adjustments that provided the best result.

Current modeling of the demand planning software reveals ease of use and functionality that allows use of historical information from the Standard Base Supply System, collaborating with the warfighter, and reconciling time-change requirements based on life-limited parts. This permits the demand planning forecast to reflect actual warfighter and weapon system needs that are not constrained by financial or capacity-related factors.

Supply and Capacity Planning Module

The Supply and Capacity Planning Module will support development of a master production schedule based on:

- Forecast (from the Demand Planning Module)
- Consumption
- Inventory
- Current production
- Constraints (capacity, materiel, manpower, and supplier lead time)
- Location-specific requisition objectives

Enabling Step 4 of the demand planning process, the Supply Capacity Planning Module will provide a constrained functional plan. The constrained functional plan translates the unconstrained requirements of the Demand Planning Module into an integrated set of functional plans that considers and addresses constraining factors and lays out a coordinated plan for optimizing logistics chain performance. The Supply and Capacity Planning Module possesses simulation-modeling (*what if*) capability. The primary focus of this APS capability is to model the impact of multiple changes across the supply chain (enterprise-wide view), assisting demand planning efforts by highlighting potential problem areas so the most feasible solution can be identified from several possibilities and then forwarded for action or execution. This (*what if*) modeling capability automatically considers various supply chain constraints—supplier capabilities, long lead-time items, repair shop throughput, customer priorities, and financial budgets—that enhance the identification of a potential optimal solution. *What if* analysis can also be conducted to assess the impact of a new item entering or being phased out from the supply chain as changes occur with customers, repair capability, or suppliers.

Collaborate Module

The Collaborate Module facilitates purchasing and supply chain management (PSCM) activities, extends supply chain planning to key suppliers and customers, and enables internal and external communication. The Collaborate Module facilitates both Step 3 of demand planning and Step 4 in determining a constrained functional plan in the Supply and Capacity Planning Module by providing a feedback loop as outlined in demand planning Step 5. The Collaborate Module can provide a near real-time, responsive, and fully integrated supply chain approach to planning and assessment of execution plans. Properly configured, it can provide an enterprise view of selected information from any or all of the various planning organizations (for example, Supply Management Activity Group or AFMC). This means anyone along the supply chain can get an end-to-end view of the plan (customer through supplier), customized to show only information pertinent to that organization.

This module is configured to enable communication with internal customers (regional supply squadrons and base supply) and external suppliers (DLA and the original equipment manufacturers), as well as contract repair facilities. Dependent on the authority granted to the user, collaborative planning permits all users to enter the system with a single entry and have a common view of multiple functional areas such as forecasting, inventory and distribution, and shop capacity. This common view allows everyone to see the potential impact of anticipated planning activity (forecast changes, inventory movement, shop order activity, or order changes) in a near real-time manner.

APS software operates in a state-of-the-art technical environment that provides responsive, flexible, integrated systems capable of meeting the logistical planning needs of all users and demonstrates the value of consolidated functions and standardization of systems, processes, and data to support collaborative supply chain decisions. The additional business modeling, *what if* capability, permits testing multiple scenarios and comparing them to one another to find the most feasible plan for execution. This supply chain capability provides flexibility for incorporating internal and external resources by examining all enterprise-related resource capabilities that can be optimized to meet weapon systems availability. Additionally, APS systems allow for *management by exception* of specific parts or events. System users can set up variable parameters to perform routine tasks on an hourly, daily, weekly, or monthly basis and require human intervention only when the parameters have been exceeded. Then the system will prompt the appropriate person to take some kind of action, which would allow the item manager to spend time on anticipated problem areas vice daily reactive or redundant activities, which is critical in this time of shrinking manpower and increased workload.

Expected Benefits of Implementing an APS System

- Rapidly generate replans until the most feasible plan is identified for execution:
  - Improved decisionmaking is enabled through one telescoping, planning horizon to compare demand and supply with one common view.
  - Multidimensional forecasting permits locating organizations that may be precipitating demand changes.
  - Numerous mathematical algorithms permit improved forecasting options to more effectively plan demands based on subtle variations of historical usage.
  - Decomposition of historical data permits detailed examination of unusual historical events to increase a planner's understanding of how the event should be weighted to influence any future forecasts.
  - Monitoring accuracy of forecast by comparison of planned versus actual activities permits measuring the effectiveness of demand information.
- Manage time-phased product and materiel flow; for example, optimize inventory placement across logistics network and allocate critical or limited inventory based on priority rules or network-wide visibility of stock locations.
- Decision support tool suggests optimal production and procurement plans; for example, automatically fills planned and unplanned requirements-based priorities, identifies lead time to source products for back orders, and identifies and suggests alternate sources and products.
- System propagates multiple types of demand through the supply chain; for example, forecast, stock replenishment, customer orders, and back orders.
- Automated means of considering all known physical supply chain constraints; for example, capacity, materiel, and labor.

- Use of priority rules to assess alternatives; for example, make and repair product earlier or later, use alternate resources, use alternate product, make one customer order more important than another, and ensure order request date can be met with the desired quantities.
- Automated means of suggesting optimization of machine, labor, and materiel to meet production delivery requirements.
- Automatically shared information with supply chain partners; for example, inventory, production, and forecasts.
- Near real-time response to exception conditions.

While the APS project is just a pathfinder within the Air Force, the expected benefits are not new to Department of Defense advanced planning and scheduling as a technology and demand planning enabler is a featured component of DLA Business System Modernization efforts, Navy SMART efforts, and Army logistics modernization initiatives. The Navy, Army, and DLA have integrated or are in the process of selecting and integrating an APS solution for their supply chain information technology framework. Key to the Air Force APS Pathfinder effort is determining how to address the integration of the numerous Air Force and DoD supply chain initiatives, such as DLA's Business System Modernization APS integration and the most recent initiatives of the Spares Campaign, the PSCM concept, and the University of Maryland supply chain portal. DLA's Business System Modernization program will affect the mode and methodology of data sharing among the Services, and APS technology may provide a bridge to various data solutions.

As a software tool that enables the demand planning process, the APS Pathfinder endeavors to provide an integrated, near real-time, responsive approach to planning and assessment of feasible execution plans through an enterprise-wide view of all logistical organizations with which it is connected. To facilitate optimized supply chain network planning for spares requirements and warfighter supportability, advanced planning and scheduling provides one seamless planning environment based on enterprise-wide technology, which includes retail and wholesale systems and is customer-centric in its decisionmaking processes. The ability of advanced planning and scheduling to automatically share data with its multiple applications will substantially reduce the probability of reliance on assumptions, generalizations, or guesswork that can lead to incorrect conclusions and suboptimal solutions. Its ability to evaluate usage history and isolate causes of conditions will accelerate a more rapid implementation of feasible solutions through its dynamic modeling capability, which assists in evaluation of ever-changing circumstances. However, all this capability is reliant on accurate and timely data passed from a solid foundation of transaction systems.

The APS Pathfinder will evaluate APS software capabilities and fit in an Air Force maintenance-and-repair environment by examining the following issues:

- Software functionality provided to item managers, weapon system managers, equipment specialists, and other logisticians involved in integrated planning functions
- Compatibility with current and planned Air Force logistics information systems, technology initiatives, and command and control structures
- Identification of resources, training, process reengineering, and other issues with significant potential to influence an implementation decision

Results of the APS Pathfinder will address the fit and function of the APS software to the demand planning process and support an implementation decision by Air Force leadership. The APS Pathfinder is on time and on track and will evaluate whether APS software can provide an integrated, near real-time, responsive approach to planning and assessment of feasible execution plans.

The Demand Planning Pathfinder at OC-ALC clearly demonstrated the potential benefits of applying the demand planning process to Air Force logistics to support the needs of the customer—the warfighter and weapon systems. While the process of demand planning may manifest itself in different forms, either in process or technology such as advanced planning and scheduling, the benefits realized in industry and observed in the Demand Planning Pathfinder cannot be ignored.

Ms Kaczmarek is project manager, Demand and Repair Workload Forecasting Initiative, Directorate of Supply Chain Integration, Air Force Deputy Chief of Staff, Installations and Logistics; Ms LaRue is a logistics officer, Propulstion Production Division, OC-ALC, Tinker AFB, Oklahoma; Mr Anderson is an item manager, General Electric Engines Section, Logistics Propulsion Management, OC-ALC, Tinker AFB; Mr Owen is an industrial technician, Engine Production Branch, Maintenance Directorate, OC-ALC, Tinker AFB; Mr Warren is a program analyst, Materiel System Group/Software Information Tinker Unit, Air Force Material Command/ Electronic Systems Center, Tinker AFB; Mr Waite is a logistics officer, Logistics Management Section, Logistics Propulsion Management, OC-ALC, Tinker AFB; and Ms Womack is an inventory management specialist, Maintenance Directorate, OC-ALC, Tinker AFB.

notable quotes

Those who invented the law of supply and demand have no right to complain when the law works against their interest.

—Anwar Sadat

Jon Newsome, Verdis Redmon, Mark Terry

Air Force Spares Campaign

Financial Issues Overview

The Spares Campaign initiatives result from months of intensive review and analysis by teams specifically tasked to identify process improvement opportunities in a number of areas, including programming and financial management. The five process reengineering teams were composed from a broad cross section of the Air Force logistics community and commercial technical experts. Their findings and recommendations were assessed and prioritized by the major commands (MAJCOM). Final review by senior Air Force leadership resulted in the selection of eight initiatives for implementation, three of them focusing on the roles of finance, budget, and programming that impact the spares process.

With the focus on the Air Force process of providing spare parts to organizations that manage and maintain weapon systems, several consistent disconnects were identified. The disconnects can be grouped around five major areas:

- Lack of price stability from year to year. Price swings make it difficult to accurately forecast budget requirements and, in the year of execution, cause disconnects between available funding and what is actually needed.
- Lack of understanding about the true costs associated with providing spares and the misalignment of cost-recovery methods used with the actual activities of the processes performed. This misalignment makes it difficult to identify and manage costs, particularly within the common business operations processes.
- Incomplete spares requirements forecasts for which spares will be needed, by whom, in what quantities, and in what timeframe.
- Inability to adjust to shifting priorities from day-to-day operations. The current process does not allow quick reactions to those changes.
- Difficulty in identifying and achieving desired levels of mission-capable weapon systems as a result of varying funding levels and changes in spares usage. This lack of *cause and effect* hampers adjustments in the year of execution and to future Planning, Programming, and Budgeting System (PPBS) cycles and does not give factual, analytical support for decisionmaking.

There are three major programming and financial initiatives within the Spares Campaign to address these five issues. These initiatives are intended to improve pricing and help clearly identify the cost structure of spares (depot-level repair [DLR] and cost-management). They will centralize the spares requirements determination process to establish a single, understood Air Force spares requirement for programming and budgeting purposes, as well as provide capability to track budgetary expenditures to expected availability of spares to meet the warfighter's weapon systems availability needs.

An explanation of these Spares Campaign programming and financial management initiatives and their objectives, expected outcomes, and major milestones follows.

Changes to DLR Price and Cost Structure

The overall objective of this initiative is to improve DLR price stability and better allocate the costs associated with providing spares to the warfighter's weapon systems. Current DLR pricing methodology focuses on total cost recovery at the stock number level,

realized through sales. It requires that recovery of business operations and materiel replacement costs be recovered from sales that are forecast years in advance. A major cause of price fluctuations is that determining exactly what stock number will sell years in advance is not possible. Some stock numbers thought to sell will not, and not in the quantities expected, and others not expected to sell will. This occurs because a forecast is just that, a forecast, and by its nature cannot be 100-percent accurate. There is no way to determine exactly what parts will break, when, and how often. In the aggregate of all stock numbers, for budgeting purposes, one can get close, but not for each individual stock number. The result has been that, each year, many individual stock numbers have seen large price swings. This confounds the budget process for the repair and operational units that buy the spares. And it leads to lost cost recovery in the year of expenditure—if a stock number that is expected to sell does not, its cost recovery factor is not achieved. This creates a bill.

The new DLR pricing structure attempts to reduce this variability. Under the initiative's methodology, all Air Force customers pay only the latest repair cost or the latest acquisition cost. The business operations costs (including inventory pipeline adjustments, business operations, replenishment buys, and nonsales-based repair), previously charged to the customer, will be centrally reimbursed to the working capital fund (WCF). The end result is a more stable price to the customer and full cost recovery to the fund. This proposal will be implemented in phases—a flat surcharge in fiscal year (FY) 2003 and 2004 for business operations cost recovery—and moves toward full implementation in FY05 once system changes can be made.

Multiple organizations within the Air Staff and the Air Force Materiel Command (AFMC) are working to ensure this initiative maintains a close tie to the cost-per-flying-hour program used by the Office of the Secretary of Defense, Office of Management and Budget, and Congress to review the Air Force budget. They are also working to develop a new WCF business operations reimbursement process and identify required system changes. Expected results, once this initiative is fully implemented, include:

- Reduced customer price volatility
- Better cost visibility throughout the spares process
- Reduced WCF losses in the execution year
- Accounting for all costs of providing spares
- Better cost management, using activity-based cost management (ABC/M)

ABC/M is an important element of this initiative. Applying it takes advantage of proven best commercial business practices. ABC/M tools can be used to better identify and understand the total cost of providing spares and give visibility to those who can best influence these costs. The Spares Campaign ABC/M initiative takes spares process business operations costs (overhead costs) and uses proven methodologies to determine which of these costs are actually incurred in the delivery of spares. ABC/M then assigns these costs to *cost objects* like weapon system, base, MAJCOM, or DLR. In this way, spares management business operations costs can be linked (traced) to whom or what the activity is benefiting. Overall, ABC/M should allow for better cost management; point out areas for cost improvement; and provide the capability to identify, justify, explain, and defend business operations costs.

Improving the Spares Forecasting, Programming, and Budgeting Process

The Spares Campaign is also focused on improving the spares forecasting, programming and budgeting process used to identify the total spares requirement. This second initiative focuses on improving integration of spares planning and forecasting within the PPBS process to ensure the entire spares requirement is fully understood and made visible to the Air Force corporate structure.

This initiative begins with full implementation of the Spares Requirement Review Board (SRRB), whose responsibility is to develop and agree on a single, credible Air Force total forecasted spares requirement to meet specific weapon systems availability goals. The spares requirement forecasting process had become fractured over the years. The lack of coordination among flying-hour spares consumption estimates, spares pipeline requirements and readiness spares packages yielded forecasts that were incomplete at best. This often resulted in unplanned year-of-execution bills to the Air Force. Since the flying-hour computation covered consumption requirements only, nonsales-based requirements (readiness spares packages, safety stock, and pipeline) were not always included in MAJCOM program objective memorandum (POM) submissions. These different requirements processes made total spares requirements assessment, selection, and prioritization difficult.

Under the SRRB process, all forecasted spares requirement computations are synchronized into a single, agreed-upon spares forecast for planning, programming, and budgeting. Budgeting and programming spares forecasts are created based on the best analytical data and consensus of all relevant parties. First meeting in December 2001, the SRRB process was used to develop the FY04 spares POM requirement. The work has resulted in lessons learned that will be applied to the FY05 spares forecast. With the completion of an Air Force instruction, update to the *USAF Supply Manual*, and publication of a process guide by the end of calendar year 2002, the SRRB will be an implemented initiative.

Another component of this initiative is expanding use of the Aircraft Availability Model logic used in computing safety levels for items in repair status. Currently, safety levels are calculated only for items in a buy status. Expanding this capability to items being repaired and improving the algorithms to include factors for price and individual weapon system aircraft availability targets (currently an average is used) should provide a more accurate safety level and better define the spares requirement.

Improved Financial Management Decisionmaking

The Spares Campaign is also taking steps to complement improvements in the spares PPBS process by developing a tool with the enhanced ability to track execution of weapon system support against the approved plan and budget. This tool will improve the ability to manage and react to variations between forecast performance and actual execution, track variations, and provide alternatives for problem resolution in real time. These

capabilities will assist decisionmakers in identifying specific performance issues, assessing feasible alternatives, and making adjustments where necessary.

This is a difficult undertaking, as the Air Force spares requirements and execution processes are highly dynamic. In spite of a host of existing metrics and related analyses, there is no effective automated mechanism to track how well current year execution is performing against the approved plan (approved spares funding level). There is currently no way of directly linking execution-year funding to operational outcomes. These limitations have led to many man-hours routinely being consumed to backtrack to the cause of the perturbations between what was forecasted and approved and what performance was actually experienced. Once adjustments are identified as needed, there is no effective way to make mission-capability tradeoffs among weapon systems. The Improve Financial Management Decisionmaking initiative attempts to provide solutions to these problems.

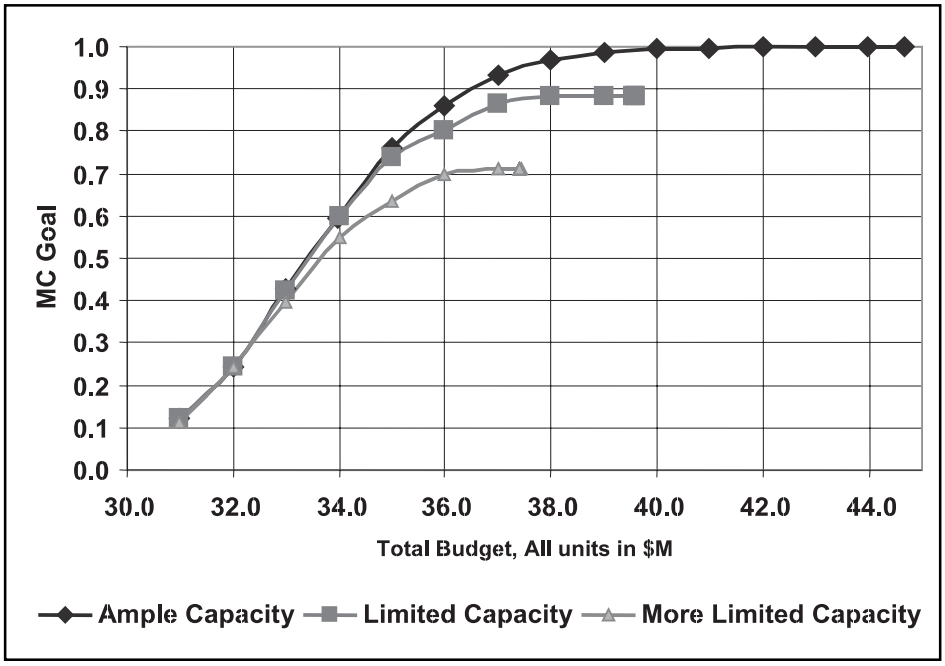


Figure 1. Confidence of Meeting 90-Percent MC Goal, 72 PAA F-15C Unit

As a solution, the Spares Campaign is evaluating the feasibility of developing a closed-loop, decision support tool that will track the execution of weapon system support against the approved plan and budget. This tool will assist the Air Force programming and budgeting planners with allocating spares support budgets to reach the best weapon systems availability given funding and repair constraints. The intent is to automatically set support system targets based on funding and operational goals, which will aid logistics planners in evaluating how close they are to their budget during execution. It will also allow them to make tradeoffs of buy-and-repair decisions among multiple systems in the execution year when operational requirements or budget allocations change. This should save considerable time (estimated 30-40 percent) in determining a course of action when faced with changes in requirements or budget authority. Additionally, the impacts of increased or decreased funding could be identified almost immediately.

RAND is developing the analytical underpinning and overall architecture of the decision support tool. Dynamic Research Corporation (DRC), as part of the BearingPoint team, is taking the RAND developmental prototype and building the initial proof-of-principle operational model. Initial computational algorithms for the execution-year planning module have been programmed and tested. The supply repair database design has been defined and set up to directly feed the prototype-planning model. The next step is to complete the building of the test data sets, along with collection of the operations data and development of the databases that will feed the prototype-planning module.

The initial architecture was presented on 17 January and 5 February 2002 for review, and the work to date is very promising. The majority of data sources for the planning model have been identified, as well as the test cases. Data for F-15 C/D, F-15 E, and block 40 F-16s have been successfully demonstrated in a limited number of repair cases. DRC is drafting a concept of operations (CONOPS) in coordination with RAND and the AFMC Management Sciences Division, Item Requirements Branch, and Financial and Analysis Branch. The CONOPS should be complete in fall 2002. Once the proof of principle is complete, Air Staff and AFMC will evaluate the tool for an implementation decision.

The Spares Campaign Programming and Financial Management initiatives are intended to address some fundamental spares support issues. Simplified pricing should allow warfighters to spend less time on financial management issues and more on warfighting issues. Better cost management should help logistics planners understand the total cost of spares ownership and give insight into areas for process and cost improvement. The Spares Requirements Review Board will provide a single spares forecast. The SRRB forecast will present the entire spares requirement to the Air Force for programming and budgeting. While the entire forecasted requirement might not be funded, it will be recognized, and expectations for spares support can be aligned to get the best weapon systems availability given the fiscal reality at the time. The closed-loop decision support tool will provide feedback on how well the approved spares funding is meeting anticipated outcomes, primarily mission capability. Taken together, these initiatives should help transform Air Force logistics and better support the aerospace expeditionary force.

Mr Newsome is senior manager, BearingPoint, Directorate of Supply Chain Integration, Air Force Deputy Chief of Staff, Installations and Logistics; Lieutenant Colonel Redmon is project manager, Financial Management, Directorate of Supply Chain Integration, Air Force Deputy Chief of Staff, Installations and Logistics; and Mr Terry is a consultant, BearingPoint, Directorate of Supply Chain Integration, Air Force Deputy Chief of Staff, Installations and Logistics.

Margaret Staib, Lori Michaelson

Air Force Spares Campaign

Purchasing and Supply Chain Management

Purchasing and supply chain management (PSCM) describes a comprehensive approach that has emerged for linking supply chain management and strategic goals. Under this rubric, commercial firms apply newly defined PSCM techniques and tools to combine functions and obtain performance improvements and reductions in total operating cost. By reviewing the practices of these commercial firms and mirroring the initiatives that support the Air Force spares support strategy, the Air Force can transition its purchasing and supply chain management from a tactical, reactive buying posture into a strategic, proactive force multiplier to help create the performance improvements and cost savings necessary for meeting current and future warfighter needs.

However, this kind of change will not come easily. Leading thinkers in the supply chain field caution that significant and far-reaching changes must be made in order to run successful PSCM improvement programs. Among them are:

- Moving the focus from price cost;
- Moving from a vertical, stand-alone process to a horizontal, integrated one;
- Transitioning from low-skilled to best skilled people;
- Evolving from standard approaches to innovative tools; and
- Changing focus from data to insight.[1]

In addition to the standard conditions for success shared by all enterprise-wide change efforts, the Air Force, as a government and military agency, will encounter impediments that may make it more difficult to implement purchasing and supply chain management than in a commercial firm. It will need to address such constraints up front to ensure the successful adoption of purchasing and supply chain management. Examples of such constraints (identified in a RAND study)[2] include the short tenure of civilian and Air Force executives, a strong functional structure, the difficulty in mining data, and requirements mandated by legislation to support overarching government programs (for example, socioeconomic targets). For all these reasons, wholehearted adoption of best PSCM practices in the Air Force requires an organizational culture change and can be expected to take at least 3-5 years. To foster such all-encompassing change, purchasing and supply chain management, like all transformational initiatives, needs to be led and supported by top management who can put the PSCM program on senior managers' calendars, set aggressive targets, and appoint the right people as PSCM improvement leaders.[3] In spite of the difficult road that surely lies ahead, it should be clear the spares support status quo is unacceptable, and significant benefits can be gained from adopting best PSCM practices.

The Air Force Supply Chain

The PSCM initiative seeks to transform existing, disjointed supply chain processes. The existing structure suffers from numerous process disconnects and points where the supply chain is not yet integrated. These points limit the Air Force's ability to create and foster strategic supplier relationships. Specific examples (Figure 1) include:

- The sustainment supply base is not developed concurrent with initial weapon system and product development.
- Base-level maintenance lacks incentives to get carcasses to suppliers responsively.
- Suppliers see only aggregated, lumpy demand.

Supply Support

- Stakeholders lack visibility throughout the supply chain.
- Requirements and contracting processes are stovepiped and do not promote a strategic focus on the supply chain.
- Disjointed databases inhibit the creation of an Air Force- or DoD-wide picture.
- Procurement is, for the most part, conducted tactically versus strategically.
- End-to-end acquisition practices promote short-term relationships that are adversarial and lack communication and trust.
- The focus of the contract monitoring function is reactive and organizationally separate.
- No single entity manages the supply base, now or for the future.
- Supply chain managers are responsible for supply chain performance, but they do not have the authority or appropriate tools to manage the supply chain.
- Supplier performance may not always match need, and corrective actions are not always taken.
- Operational data are not linked to contracting data.
- No one manages key suppliers from a strategic Air Force perspective.
- Budgeting and financial incentives drive short-term supplier relationships.
- Supply chain managers are not fully or properly trained in best commercial PSCM practices.

These process disconnects are symptoms of at least six underlying supply chain management issues:

- The metrics and incentives throughout the supply chain are not aligned with strategic goals.
- Life-cycle supply chain management is inhibited by a functional focus.
- No one entity is responsible for managing the supply base and supplier relationships.
- Sourcing is largely tactical rather than strategic.
- There is a lack of visibility throughout the supply chain.
- The workforce is inadequately educated and trained.

Correcting these shortcomings will require fundamentally changing the way the organization conducts its work. Providing supply (parts) has traditionally been the responsibility of the purchasing function, while the demand side has been the responsibility of the supply or materiel management function. Historically, these functions have been organizationally separate. The resulting functional stovepipes break the link between supply and demand. This, then, inhibits communications and responsiveness, so there is a lag between when changes occur and when they can be incorporated into planning.

The Commercial Lessons

Increasingly, however, enterprises, including the Air Force, have been under pressure to reduce costs, improve customer service, and focus on core competencies. These imperatives led top commercial firms to reexamine how they are structured to purchase goods and services. Many of these businesses recognized that an organizational structure based on functional specialization makes it difficult to coordinate the interrelated activities required to satisfy their customers. Accordingly, they have reorganized to consolidate the various materiel management functions—purchasing, inventory management, and distribution—to provide a more integrated systems approach, much like the systems approach to management that emerged in the 1960s (Figure 2). Under a systems approach, the objective is to optimize the performance of the system, rather than optimizing the performance of individual operating units. A systems approach also promotes a closed-loop feedback mechanism, whereby the organization can respond more readily to any perturbation (on either the purchasing or supply side) that may arise.

This consolidation approach, which has come to be termed *purchasing and supply chain management*, is generally described as a strategic, streamlined, and integrated approach that seeks to link demand planning; purchasing; inventory management; and supply chain, supplier, and supply base management to create more effective and efficient supply chain integration and develop a more responsive, reliable, and robust supplier base.

The ultimate objective of the integrated supply chain is to synchronize supply and demand so the rate of supply matches the rate of demand along the entire supply chain (including suppliers and their suppliers). While the principle is inherently simple, many perturbations can

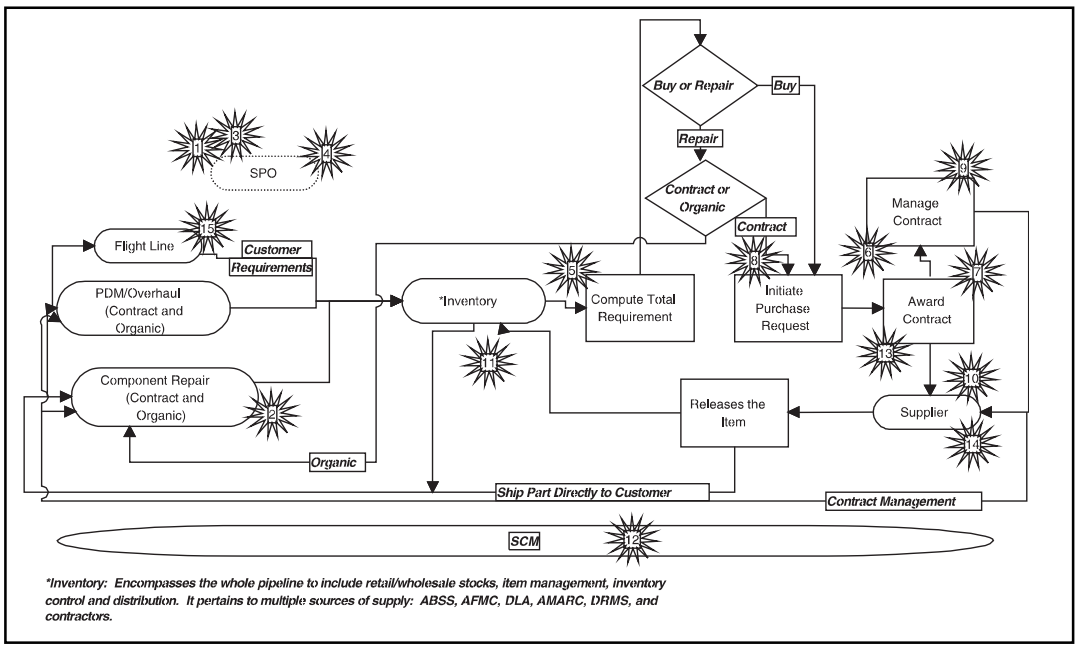


Figure 1. Supply Chain Process Disconnects

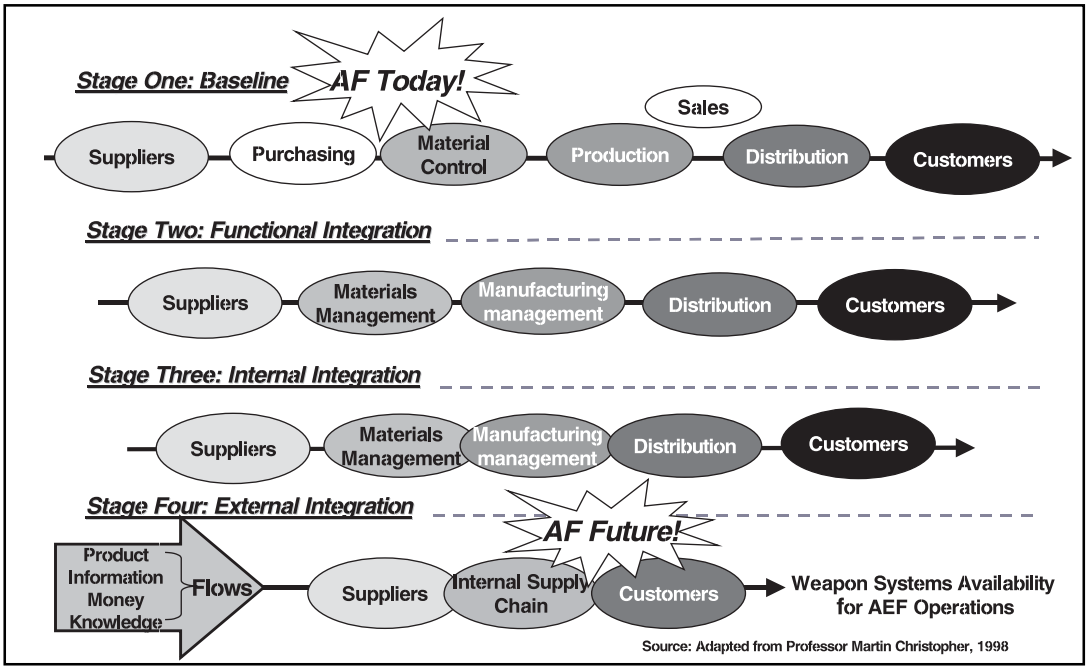


Figure 2. Achieving an Integrated Supply Chain

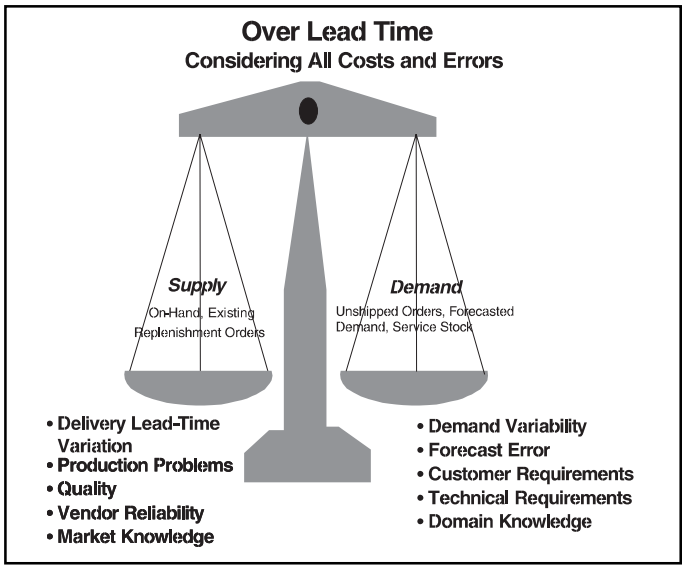


Figure 3. Synchronized Supply Chain

occur on both sides of the scale (Figure 3). Purchasing and supply chain management lies at the nexus of the extended supply chain network, where supply meets demand. In a PSCM organization, personnel gather information from customers and suppliers and pass it throughout the chain to ensure the flow of goods and services meets customer requirements. The complexity of this interaction becomes apparent when it is understood that a balance needs to be achieved at each node of the chain (from supplier's suppliers to the enterprise, to the customers, and then ultimately to the customer's customer) (Figure 4). Distorted information from one end of a supply chain to the other can lead to tremendous inefficiencies: excessive inventory investment, poor customer service, misguided capacity plans, ineffective transportation, and missed production schedules.[4] Further, the degree of variability in supply and demand in the supply chain is amplified up the chain, creating a bullwhip effect. Because of the amount the safety stock contributes to the bullwhip effect, it is easy to see that, when the lead times for the resupply of the items along the supply chain are longer, the fluctuation is even more significant.[5]

PSCM As an Approach to Logistics Transformation

Historically, the Air Force has focused its business process improvement and cost-saving efforts on personnel reductions and acquisition reform for major weapon systems. Yet, the purchased goods and services segment of an organization's budget offers a large and growing target for enhanced performance and cost reductions. Commercial firms that have implemented comprehensive PSCM programs claim initial savings from 3 to 20 percent or more in specific categories, with ongoing new total spend savings of 3 to 5 percent per year.[6] They also report performance improvements such as quality improvements of 10 to 13 percent per year, delivery responsiveness improvements of 7 to 10 percent per year, and faster product development (almost 3 percent per year) (Table 1).[7]

In fiscal year (FY) 2001, the Air Force purchased more than $35B worth of goods and services from a broad range of suppliers, including other government organizations (Figure 5). Taking the lowest end of the commercial sector's savings experience, the suggestion is that successful PSCM implementation could result in approximately $1.5B in annual savings. These savings could be spent on research and development, new systems acquisition, war and strategic stocks, or upgrades to information technology and infrastructure. In fact, purchasing and supply chain management has been proposed by the Air Force as an alternative to the A-76 competitive sourcing strategies for achieving significant cost savings. However, it is important to note that implementation of the Spares Campaign PSCM initiative is not intended as a reduction in personnel, and in that way, the objective is different from A-76. Rather, its purpose is to improve, indeed transform, purchasing and materiel management processes and practices. Accordingly, any savings are to be redistributed to other higher priority Air Force requirements.

The Air Force's Unique PSCM Approach

The PSCM initiative addresses existing, underlying supply chain weaknesses through supporting adoption of an integrated set of activities that will effect transformational change. Industry best practices associated with purchasing and supply chain management continue to evolve as buyers learn from their experiences. Because each firm has its own unique culture, environment, and goals, every organization defines and implements PSCM somewhat differently based on its specific strategy. The Air Force recognized that it, too, would want to tailor its adoption of purchasing and supply chain management

to its unique organizational characteristics. Thus, as part of the supplier relationships effort of the Spares Campaign, the Installations and Logistics Integration staff was tasked with exploring specific opportunities to incorporate commercial best practices, including techniques, methods, customs, processes, rules, guides, and standards, for application to the Air Force. Their work resulted in a recommendation that the Air Force implement the specific PSCM tenets, techniques, and tools enumerated below.

Tenet: Align Purchasing and Supply Goals with Operational Goals

Technique: Establish Outcome and Process-Focused Metrics That Link to Organizational Mission and Goals

Tools: Balanced Scorecard, Supply Chain Council's Supply Chain Operations Reference (SCOR) Model[8]

Organizations state PSCM goals in terms of explicit enterprise-wide strategic goals (for example, reduction in total ownership cost or improvements in performance). Such strategic goals allow the organization to:

- Identify and track metrics that measure PSCM performance over time;
- Compare performance with enterprise and customer needs and other enterprises;
- Measure the performance of internal organizations, individuals, and teams and hold them accountable; and
- Measure the performance of external sources and hold them accountable (for example, shift spending if performance does not meet requirements).

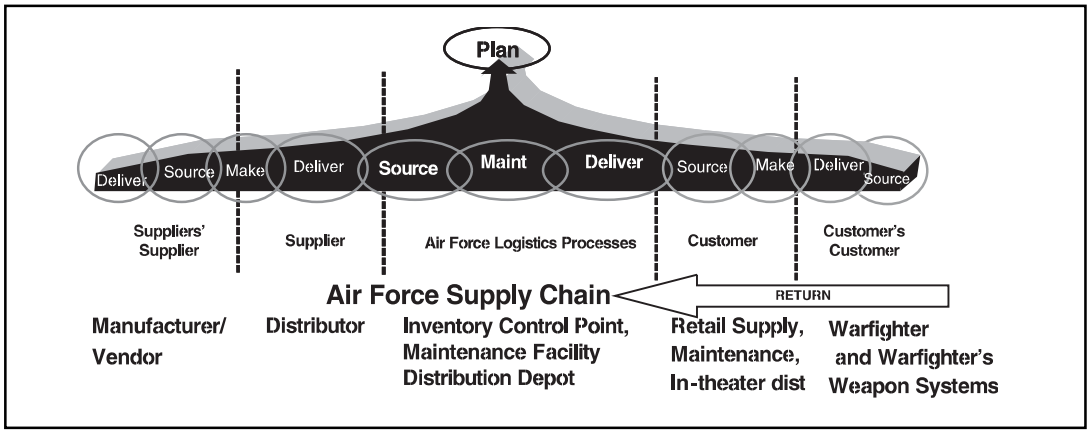


Figure 4. Air Force Supply Chain

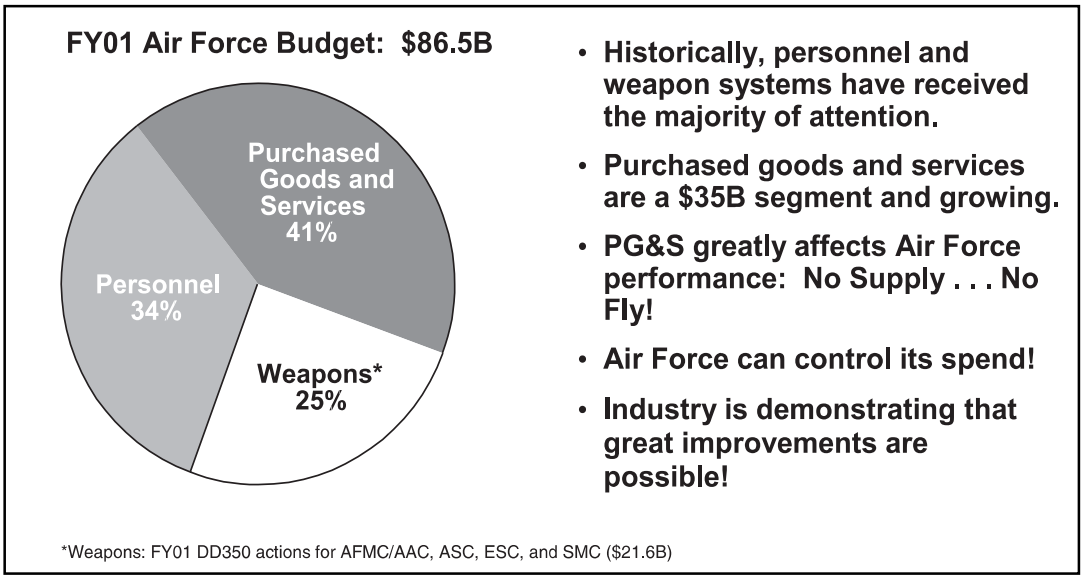


Figure 5. PSM Opportunities in the Air Force

Benchmarks	
• Reduce total supply chain costs by 3-20% • Improve delivery responsiveness by 7-10% • Increase quality of goods and services by 3-4%	
IBM • Transformation achievements delivered $12B incompetitive advantage. • 4,900 supplies in 1993—now 50 suppliers account for 85 percent of $17B production purchases.	**Harley-Davidson** • Cut suppliers from 4,000 to 800. • Shaved $40M in materiel costs since 1996. • Integrated key suppliers as resident staffers at plants—now almost 80 in place. • 52-week forecasts of parts demand available to customers.
Honda • Saved 17% in 4 years.	**Chrysler** • Saved $1.5B in 1998 and $2.3B in 1999.
John Deere • Reduced suppliers from 1,675 to 20—cut costs 13%.	

Table 1. Industry PSM Benchmarks and Results

Tenet: Gain Knowledge of Where the Enterprise's Money Is Spent

Technique: Spend Analysis

Tool: Customized Databases, Web-Based Spend Analysis Software

Conducting a spend analysis, the first step in a PSCM implementation project, gives the organization insight into how much money is being spent on specific goods and services. In addition, it identifies where those goods and services are being bought and who is doing the buying. This analysis shows how different goods and services rank in terms of the amount spent, who the biggest suppliers are, and where the best opportunities for requirements consolidation may be.

Tenet: Gain Knowledge of the Supply Chain

Technique: Map the Supply Chain, Conduct Process Flow Analysis

Tool: Supply Chain Council's SCOR Model

Purchasing and supply chain management includes the integrated application of well-known concepts of business process reengineering—for example, benchmarking and process measurement—into a cross-functional and cross-enterprise framework. This approach promotes an understanding of the characteristics of the supply chain, where to direct improvement and optimization efforts, and the extent that the supply chain can be effectively contracted out. This activity is also used to determine which supply chain steps are value additive and, in the process, identify opportunities for improvement or realignment.

Tenet: Tailor Sourcing Strategies Depending on Value and Risk to the Enterprise's Operations

Technique: Procurement and Operational Risk Assessments

Tools: Supply Segmentation Analyses, Materiel-Positioning Matrix Studies

A supply strategy refers to the critical choices that must be made when establishing sourcing relationships, such as the number of suppliers, the type of relationship between the suppliers and the buyer, and the length of contract that is most appropriate for acquiring spares or services. The choice of strategy is usually determined by the nature of the items, the importance of the items to the enterprise, and the items' value (cost).

Typically, there is no *one size fits all* strategy for all the procurement in one organization or even in one department. Rather, different strategies need to be developed for different items, based on the item's characteristics. Using a supply segmentation or materiel-position matrix analysis, the enterprise can group its goods and services according to key characteristics and then apply the most appropriate sourcing strategy. Most enterprises will have a continuum of supplier relationships, from an adversarial arm's length interaction to strategic alliances and working partnerships. Similarly, contractual relationships may run the gamut from instant, transactional ordering to strategic, total life-cycle collaborations.

Tenet: Actively Manage the Supply Base

Technique: Supply Base Mapping, Market Analyses, Defense Logistics Agency's Weapon System Capabilities Process

Tools: North American Industry Capability Standards

A significant part of managing relationships is the ability to effectively understand the current and future capabilities of the supply base for a given weapon system, commodity, service, or part. This capability creates opportunities to strengthen existing partnerships, identify new suppliers for long lead-time parts, and become more efficient across the supply chain. Increased supplier base awareness improves the ability to find new suppliers, create competition in the marketplace where none exists, reduce production lead times, implement tailored supply strategies more effectively, and maintain sources of supply for low-demand goods and services. Market analysis also helps buyers understand the whole picture, which contributes to developing better bargaining power and making better strategic decisions.

Tenet: Optimize the Supply Base

Technique: Market Research, Strategic Sourcing

Tools: Supplier Evaluation Scorecards (Contractor Performance Assessment Reporting System; Government Performance Assessment Reporting System; Red, Yellow, Green Rating System)

Based on the results of its spend and supply analyses, the organization will want to begin to shift spending to its best suppliers, based on reputation and past performance (quality, responsiveness, reliability, and total operating cost) to leverage spending, gain better terms and conditions, and improve quality and performance throughout the supply chain. Partnerships and strategic alliances that produce continuous improvements require dedicated management effort and applied resources; therefore, the enterprise needs to decide which types of relationships are appropriate with each of its suppliers. In most commercial firms, this process has led to a rationalization of their supply base to leverage the spend and reduce the number of relationships that have to be managed.

Tenet: Move from Transactional to Strategic Contracting

Technique: Strategic Sourcing

Tools: Various Contracting Strategies, including Direct-Vendor Delivery, Vendor-Managed Inventory, Performance-Based Services Acquisition (for example, Logistics Contracting), Long-Term Contracts, and Corporate Contracts

Once logical groupings of items have been determined (through the spend analysis and procurement and operational risk assessments), the most appropriate contracting vehicle can be determined based on the specific outcome required for that particular grouping. For example, if it is critical to retain maintenance activity in house, then a vendor-manager inventory arrangement for the piece parts might be appropriate. If, on the other hand, it has been determined that the work under review is not core and a commercial capability should be used, a long-term, performance-based services acquisition agreement may be appropriate. Performance-based logistics (PBL) contracting, in particular, can be enhanced by PSCM implementation. PBL contracting uses logistics performance requirements and contractual incentives to mitigate obsolescence and lower the total cost of ownership through application of flexible sustainment, direct-vendor delivery, technology insertion, reliability-centered maintenance, and public or private partnering and teaming strategies. These techniques and tools can be used most effectively in an environment that also supports strategic supplier relationships and supply chain integration, such as that created by purchasing and supply chain management.

Tenet: Manage Key Suppliers Strategically

Technique: Performance Evaluation, Collaborative Supplier Relationships

Tools: Supplier Evaluation Scorecards, Supplier Management Councils, Strategic Supplier Alliances, and Partnership Agreements

In the past, large inventories often masked quality and delivery problems, leading buyers to believe they really did not need supplier management strategies. However, as enterprises have learned they can simultaneously lower total costs and improve performance, they have become more aware of the critical role buyer and supplier relationships can play in their success. Such partnerships require organizations to take a proactive approach to managing supplier relationships. Instrumental in developing and managing supplier relationships is knowledge of their performance. This entails some form of supplier evaluation system. Strategic management of suppliers also involves sharing information and working together to achieve goals.

Tenet: Link Demand and Replenishment Planning
Techniques: Dynamic Collaborative Forecasting and Replenishment Planning
Tools: Advanced Planning and Scheduling Systems

The large inventories of the past were used to help buffer against variability in supply and demand. However, the business environment has changed. Increased pressure to reduce costs, coupled with acceleration in technology obsolescence time lines, has made it unaffordable and impractical for organizations to stock large inventories. Thus, the unavoidable variances in supply and demand need to be managed as closely as possible to achieve a balanced, projected inventory position a lead time away. The goal is the lowest possible inventory holdings to cover unacceptable risk.

To ensure inventories are kept to a minimum, the organization must be able to conduct detailed analyses within a much shorter time than the historic lead times. This requires PSCM professionals to have a comprehensive understanding of customer requirements (including forecast demand and what alternatives are acceptable) and the sourcing solutions available, including supplier capacity and alternative sources of supply or alternative items that meet the needs of the customer. This, in turn, requires, a constant or dynamic review of the supply chain dynamics that can provide an early warning of escalating costs or poor performance. It also implies materiel management and sourcing functions can no longer remain separate if they are to support the customers' requirement with reduced lead times and lower total cost of ownership.

Tenet: Increase Supply Chain Visibility
Technique: E-Business Applications, Data System Integration
Tools: Web-Enabled Information Systems, Use of Middleware in Concert with Long-Term Supplier Relationships

Electronic business allows seamless supply chain management by using shared data environments with real-time data exchange. The Internet, the World Wide Web, and Business-to-Business Internet market exchanges provide universal and relatively cheap media for data flow. The exchange of real-time data allows optimization of the supply chain functions—including supply planning, demand planning, production or maintenance planning, and inbound and outbound logistics—by allowing all participants (customers, suppliers, logistics managers, and purchasers) to make decisions collaboratively to satisfy logistics objectives. The result is the delivery of goods and services to customers at the right time, place, and cost. New software, known as middleware, facilitates the integration of legacy systems. However, because system integration is often quite costly and time-consuming, long-term supplier relationships are often a prerequisite to developing external supply chain visibility.

Tenet: Align the Supply Chain for Optimal Efficiency
Technique: Lean Logistics, Six-Sigma
Tool: Pert Analysis, Kaizen and Kaikaku, Variance Analysis

To effectively use supplier strengths, a more efficient supply chain is needed. This effort must seek to reduce waste and variance to reduce the time required to meet changes in customer demands. A more efficient process will reduce inventory requirements, improve responsiveness to surges in requirements, and reduce waste and defects. This is a continuous process to seek improvements.

Tenet: Develop an Integrated Organizational Construct
Technique: Blend Critical Skills Sets Around Enterprise, Supplier, and Supply-Base Foci
Tool: High-Level, Centralized, Multifunctional PSCM Organization and Teams

An appropriate organizational construct is required to support a strategic approach to improved purchasing and supply chain management. Many businesses have recognized that an organizational structure based on functional specialization makes it difficult to coordinate the interrelated activities required to satisfy customers. Accordingly, they have reorganized to consolidate the various materiel management functions (for example, purchasing, inventory management, and distribution) to provide a more integrated approach. The objective is to optimize the performance of the whole system, rather than optimize the performance of individual operating units.

In many cases, putting these concepts into operation has led firms to create a new organization to implement strategic policies and strategic relationships with suppliers, while employing a decentralized execution approach. Other firms are moving to a more hybrid PSCM organization with elements of both centralization and decentralization. The centralized organization is responsible for setting up large, complex, strategic partnerships and comprises a multidisciplinary workforce. The lower tier, local organizations, meanwhile, manage centrally established relationships (for example, purchase orders) and set up lower priority, simpler, customized, local contracts. The Air Force also needs to reorganize to meet its enterprise needs rather than local interests. Emphasis must be placed on blending critical skill sets around enterprise, supplier, and supply-base foci. In addition, the organization should incorporate high-level, centralized, multifunctional teams.

Tenet: Automate Routine Activities
Technique: E-Procurement, Outsourcing, Catalog Buying
Tools: E-Business Applications

The PSCM workforce should be transitioned from a reactive buying force to a planning staff. This requires the adoption of automated techniques to reduce manual workload. Routine tasks that cannot be automated and are not core, such as the purchase of office supplies or other commodity items, may be outsourced if a more efficient source, such as a third-party provider, can be found.

Tenet: Develop a More Strategically Focused Workforce
Technique: Refresh, Restructure, and Retrain the Workforce
Tools: Education, Training, Strategic Hiring, Effective Communication, Incentives Aligned with Strategic Goals

The complexity and range of PSCM activities necessitates development of a dynamic, new PSCM professional career path that can be used to grow and retain the most talented staff. PSCM professionals will need to be able to grasp the total value of the supply chain, know how it relates to the broader overall goals and objectives of the enterprise, and have plans to achieve them.

For this type activity, they will have to draw on a range of new and enhanced skills. For example, PSCM professionals will have to demonstrate analytical abilities for undertaking such tasks as market research, total ownership, and financial statements analysis. They will have to be able to work with new information technology, and they will need advanced interpersonal skills. To support its workforce in making this transition, the Air Force must provide new education and training opportunities to enable personnel to grow their skill sets from predominantly *tactical* to *strategic* supply management and sourcing. This is consistent with the Developing Aerospace Leaders initiative that intends growing transformational materiel leaders with credibility in multiple operational occupations to synthesize materiel management efforts. This may have significant impact on some career fields.

Tenet: Pursue Continuous Improvement

Technique: Embed Innovation in the Culture of the Organization

Tools: Six Sigma, Total Quality Management

Purchasing and supply chain management is not an isolated implementation action; rather, it is a philosophy of continuously looking for ways to improve the responsiveness of the supply chain while also reducing costs.

Each of the tenets described above can be considered a building block within an overarching, comprehensive strategy for purchasing and supply chain management. The implementation of these tenets individually will provide only incremental improvement, not the significant transformational improvement that leading companies implementing purchasing and supply chain management have achieved. To illustrate, the Six Sigma program should not be seen as a separate program to purchasing and supply chain management, rather, it should be seen as a tool that supports the ability to achieve continuous improvement in supply.

The Air Force PSCM Implementation Strategy

Following an extensive review of best practices in industry, RAND presented the PSCM vision to the Secretary of the Air Force and the Air Force Chief of Staff in July 2001—both endorsed the PSCM concept for implementation. Additionally, following the Spares Campaign Team's adoption of purchasing and supply chain management as one of its eight initiatives, the Air Force senior leadership overwhelmingly endorsed the PSCM concept at its October 2001 Corona session.

Initial Spares Campaign PSCM activities have been organized around a four-pronged implementation strategy involving: (1) translating commercial PSCM concepts to the Air Force environment, (2) developing PSCM implementation projects at the three air logistics centers, (3) developing strategic alliances with top Air Force suppliers, and (4) developing an e-business strategy to support supply chain management. The PSCM effort built upon cases where the Air Force has already begun to implement some of the tenets, techniques, and tools, such as efforts already underway to tailor sourcing strategies depending on value and risk (Strategic Sourcing).

Translating PSCM Concepts to the Air Force Environment

With the overarching framework defined through PSCM tenets, techniques and tools, and the four-pronged implementation approach, the Headquarters Air Force (HAF) and Secretary of the Air Force (SAF) PSCM Team began work to build awareness and support for the PSCM concepts within the Air Force. A key event was the first-ever Air Force/Industry Senior Executive PSCM Seminar on 12 February 2002 at Tinker AFB, Oklahoma. The seminar was designed to give base leadership an opportunity to hear directly from renowned industry executives who have led the way for similar initiatives within their firms and benchmark with recognized leaders in industry. The list of representatives included leaders from John Deere & Company, Hewlett-Packard, Motorola, Creative Procurement Strategies, Kemp Enterprises, and Sara Lee. The seminar was a great success. In particular, it established a foundation for the applicability of commercial best practices to the Air Force environment by highlighting the fact that virtually every purchasing situation the Air Force faces has an industry equivalent and a potential solution strategy. The Secretary of the Air Force continues to advance PSCM education and awareness through periodic briefings with Air Force leadership and by distributing reports of the status and results of the implementation project efforts.

The HAF/SAF PSCM Team is also assisting with the development of an organizational model that would create oversight of purchasing and supply chain management. As part of the recent effort to reorganize depot maintenance within the air logistics centers, the Air Force Materiel Command (AFMC) commander has directed the development of an organizational construct to support the PSCM vision of increasing weapon system performance and reducing total ownership costs by strategically integrating materiel management functions throughout weapon system supply chains. AFMC's initial working group identified this new organization as the Purchasing and Supply Chain Management Directorate.

PSCM Implementation Projects

The inclusion of implementation project pilots in the PSCM strategy was designed to showcase practical trials of the PSCM tenets, techniques, and tools and put them into practice in the Air Force environment. It was hoped that, through these limited projects, the Air Force could identify policy and procedural, organizational, cultural, educational, and training requirements to ensure successful implementation on a broader scale. The specific objectives of the pilots are to demonstrate measurable improvements in weapon system support, provide lessons learned in advance of Air Force-wide implementation, and illustrate the use and benefits of strategic supplier relationships.

Originally, the ALC implementation projects were scheduled to run consecutively, beginning in January 2002 with Oklahoma City ALC's (OC-ALC) effort focused on the F100 engine. However, in March 2002, following review of the initial PSCM implementation project activity at OC-ALC, AFMC's commander directed the acceleration of PSCM implementation projects at the two remaining air logistic centers at Robins AFB, Georgia (Warner Robins ALC [WR-ALC]), and Hill AFB, Utah (Ogden ALC [OO-ALC]). Summaries of progress to date follow.

OC-ALC. The weapon system focus of the OC-ALC PSCM implementation project is the F100 engine program, which provides propulsion for all F-15s and the majority of F-16s. As the Air Force's largest sustainment program (approximately $1B annually), the F100 has consistently been a top Air Force readiness issue. Engine availability is not meeting goals, and parts availability is a significant factor.

As the first major PSCM implementation effort within the Air Force, a cross-functional, organic team at OC-ALC is making

significant headway applying the tenets of purchasing and supply chain management toward the F100 engine program. The OC-ALC organic PSCM Team is augmented by a variety of external resources including RAND, BearingPoint, (formerly known as KPMG Consulting, Inc), Logistics Management Institute, Dynamics Research Corporation, and representatives from the Office of the Secretary of Defense's Change Management Center.

Implementation methodology is divided into three phases: (1) baselining the current process performance; (2) formulation of improved policy, procedural, organizational, cultural, educational, and training processes; and (3) implementation of the *to be* state. Activity to date has involved applying spend analysis and supply chain mapping techniques to develop cost, performance, and process baselines for the entire F100 supply chain from the supplier's supplier to the customer's customer. This deep-and-wide look at current processes is necessary because the Air Force previously has not approached the F100 supply chain from a strategic viewpoint.

The OC-ALC Team has been gathering and analyzing the spend data from FY99-01 to begin developing materiel management and supplier strategies for the near- and long-term future. They have also been mapping the global supply chain of the F100 into an industry standard (SCOR) model to allow supply chain benchmarking with best commercial practices. Additionally, they have been evaluating some of the short- and long-term educational and organizational issues that are critical to designing an integrated supply chain for the F100. Development of this *as is* supply chain baseline concluded in June 2002, and now the PSCM Team is shifting its focus to using the data to support the development of specific supplier strategies and identifying supply chain optimization opportunities and tailored solutions.

WR-ALC. The PSCM implementation project at WR-ALC is focused on the C-130B-H platform. The WR-ALC Acquisition Center of Excellence is currently forming a cross-functional, organic team to begin applying the tenets of purchasing and supply chain management toward this program. The team will be augmented by a variety of external resources, similar to those at OC-ALC.

The initial steps will mirror those of the OC-ALC implementation, including gathering and analysis of historical spend data, mapping the global supply chain of the C-130B-H into an industry standard model, and evaluation of some of the short- and long-term educational and organizational issues critical to designing an integrated supply chain for a weapon system. After baselining the *as is* supply chain, the PSCM Team will begin developing materiel management and supplier strategies for the near- and long-term development options and move toward implementing a streamlined and improved supply chain. This implementation project will have an added component that emphasizes building on an ongoing e-business effort between WR-ALC and key C-130 suppliers.

OO-ALC. This air logistics center has decided to focus PSCM implementation on its Commodities Directorate. As at WR-ALC, the Acquisition Center of Excellence will direct the project. A detailed project plan is being developed, but initial steps will follow a methodology consistent with that in place at the other two air logistics centers.

Developing Strategic Alliances with Top Air Force Suppliers

The purpose of building effective supplier alliances is ensuring supply, today and in the future, at an affordable cost. A recommended strategy for achieving this goal is to develop strategic alliances with key internal and external suppliers. Through its PSCM initiative, the Spares Campaign has started down a path of implementing strategic partnerships and agreements with a number of its top suppliers in terms of spending. Examples of such relationships are detailed below.

- **Lockheed Martin.** At WR-ALC, partnering has commenced with Lockheed Martin, a key player in the C-130 sustainment program that supports the PSCM initiative in two ways: (1) creating a partnership with the Air Force's largest supplier in terms of spending and (2) developing an e-business strategy for an Air Force weapon system. Lockheed Martin has been collaborating with the Air Force over the last 12 months to develop broader integration across the two supply chains to provide better weapon system support. Initially, Lockheed Martin and the Air Force initiated an e-procurement pilot supporting the Web-based purchase and sales of spare parts and services for the C-130B-H platform. Currently, that effort is evolving into a broader effort aimed at leveraging initiatives that are already in progress or planned for other weapon systems and at bringing those initiatives to bear on a single weapons platform—the C-130B-H. Lessons learned will be migrated to other Lockheed Martin platforms and beyond the Air Force/Lockheed Martin relationship. As a concrete endorsement of this activity, in March 2002, the Air Force Deputy Chief of Staff, Installations and Logistics; Air Force Directorate of Supply Chain Integration; SAF Contracting; and WR-ALC commander signed an e-business Supply Chain Integration pilot memorandum of understanding (MOU) with Lockheed Martin to establish an official framework for these collaborative efforts.
- **Northrop Grumman**. The Supply Chain Integration PSCM staff has also recently begun dialogue with Northrop Grumman and has begun the processes of developing an overarching MOU and concept of operations with them to support Spares Campaign goals of increasing weapon systems availability and expanding mission capabilities. Initial efforts will focus on integrating with the C130 PSCM pilot implementation project plans, but the future vision is for strategic integration initiatives across the Air Force. Of particular interest to the Air Force is Northrop Grumman's spend analysis capability, which might serve as one of several benchmarks for the Air Force as it explores developing its own internal capability in this area.

Developing an E-Business Strategy to Support Supply Chain Management

The technological opportunities in today's environment are key enablers for the logistics and supply chain management transformation process. Using modern information systems, organizations can establish a gateway for the electronic relationship between themselves and their suppliers via the Web. Once the relevant logistics information is digitized and harmonized, it can be distributed throughout the supply chain without manually rekeying. Associated efficiencies result, such as an increase in the velocity of data exchange, removal of time lags from the system, reduction in the number of transactional errors, and cuts in lead times. Together, these efficiencies result in lower inventory levels, removal of process inefficiencies, improved product quality, more meaningful management information (business intelligence), and reduction of the

deployment footprint. They also create cost savings—commercial examples indicate that enabling the supply chain with e-business technology has helped companies achieve more than a 20-percent reduction in supply chain costs.[9]

Recognizing the critical role such technologies can play in automating routine activities and increasing supply chain visibility and integration, the PSCM Team began, as part of its initial activities, to become further educated in the field of e-business and develop examples of practical and implemental e-business strategies. It is the intention that lessons learned in the initiative's pilot activities will facilitate the intelligent and informed application of e-business to the Air Force supply chain.

E-Procurement Pilot Project

Under the sponsorship of the Deputy Chief of Staff, Installations and Logistics and SAF Acquisitions, WR-ALC recently completed pilot testing of e-procurement concepts in the C-130B-H spares environment The project supported direct e-procurement of unscheduled maintenance parts from Lockheed Martin and other vendors for micropurchases up to $2,500 and purchases up to $25,000 made with existing contractual agreements using the Government-Wide Purchase Card. The focus was on unscheduled parts not available through established retail and wholesale mechanisms. This effort, which was operational for 60 days, established a *.com* sourcing and buying environment for the C-130 support team.

Although small in scope, the implications of the pilot were significant. Moving Air Force suppliers toward electronic catalogs with real-time pricing and availability data is a key step in moving materiel managers away from tactical and into strategic roles. Furthermore, the project helped highlight key policies, processes, and issues that must be addressed for the effective implementation of electronic purchasing across the Air Force.

Follow-on efforts focus on incrementally expanding the suite of e-business applications to the supply chain. It is envisioned that such expansion will be conducted in an integrated fashion with key Air Force suppliers, including Lockheed Martin and Northrop Grumman, but individual solutions will be designed to be nonvendor-specific. All this activity supports the ultimate Air Force e-business and e-commerce vision of having an enterprise-wide electronic environment in place by 2010 where best business practices and enabling technologies are used to facilitate efficient exchange of business information.

Conclusion

For the Air Force, managing the supply chain is a critical element of its strategy to improve logistics to the level necessary to support the expeditionary aerospace force. The commercial sector has demonstrated that adopting PSCM best practices can help make radical improvements within sustainment and operational activities. With its strategic focus on purchasing and supply activities, purchasing and supply chain management ensures supplier relationships, supply chain, and supply base strategies are focused on the strategic goals of the organization—in this case, creating improvements in performance, quality, responsiveness, along with a reduction in total weapon system operating costs. Applied with strong leadership, in a comprehensive manner, purchasing and supply chain management can provide powerful support for the Air Force Installation and Logistics supply chain transformation, allowing it to fully step into its ultimate role of providing improved support to the warfighter.

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Wing Commander Staib is a Royal Australian Air Force exchange officer in the Directorate of Supply, Air Force Deputy Chief of Staff, Installations and Logistics, and Ms Michaelson is a senior consultant, BearingPoint, Directorate of Supply Chain Integration, Air Force Deupty Chief of Staff, Installations and Logistics.

notable quotes

Failure to prepare is preparing to fail.

—John Wooden

The Most Efficient Organization Misperception

Captain Jonathan L. Wright, USAF

So XYZ Air Force Base recently completed an A-76 cost comparison study. Five different contractors submitted proposals in hopes of winning the contract. Among them, a contracting officer chose one contractor as having the most advantageous proposal. Manpower professionals then compared the cost of this proposal to the cost of conducting the operation if the team were comprised of civil service employees. This team, also known as the most efficient organization (MEO), and the five contractors based their costs on the statement of work (SOW). The result: the most efficient organization won the competition. The next step? Throw the SOW out the window. Does this really happen? Is the MEO held to the same performance standards as a contractor would have been? While this misperception may arise from base to base and study to study, on the contrary, the MEO is required to comply with the SOW. The key difference is that the MEO does not have a contract per se that uses funds (and the threat of withholding them) to motivate contract compliance. Instead, other avenues are available to enforce compliance with the SOW.

The issue is critical because the Air Force needs someone—regardless if it is the contractor or the MEO—to satisfy the requirements found in the SOW. The only question that an A-76 study answers is, who can do it cheaper? Either way, the job still needs to get done. This issue is also important because of the fairness involved in competing out the noninherently governmental activity with private industry. Contractors who bid on the solicitation would want to ensure that the winning MEO did not underbid the contract.

Contrary to popular belief, the MEO monitors its own performance in terms of compliance with the SOW. According to Air Force Instruction (AFI) 38-203, *Commercial Activities Program*, the MEO is required to maintain a quality control program, which is:

> An internal program used by functional managers to ensure that MEOs are being effectively and efficiently accomplished on a daily basis based on the requirements and quality standards established in the PWS [same term as the SOW]. The authorizations necessary to staff this quality control program are included and costed in the MEO staffing.[1]

In addition to the quality control personnel within the MEO, functional commanders have oversight of the MEO.[2] The functional commander is responsible for the SOW operation, regardless of whether the function is conducted by a contractor or an MEO.

On a local level, if issues are raised about an MEO's performance, then the functional commanders need to be contacted to seek clarification and correction. For example, if one has a complaint about an MEO that is presumably not correctly performing its mess attendant duties at a dining facility, the customer should consult the functional commander for the dining facility.

Functional commanders have many different means of controlling the MEO's performance. They can motivate individuals with performance appraisals, time-off awards, performance cash awards, and quality-step-increase promotions. For unacceptable performance, they can place individual employees into a management plan or simply provide extra management attention on problem areas.

Installation commanders are required to hear a semiannual briefing on the health of the services contract program.[3] Functional commanders are typically invited to brief the status of their service contract performance. For those who do not believe MEOs are required to comply with the SOW, why not include the status of the MEOs' performance in these briefings as well?

The functional commanders are entrusted with ensuring that MEOs have been implemented in accordance with the SOW, and the MEO is subject to scrutiny by outside organizations as well. Post-MEO reviews are required, per AFI 38-203.[4] They will be conducted annually on at least 20 percent of the MEOs that have been implemented throughout the Air Force. The post-MOE reviews determine if the MEOs have performed within the requirements of the SOW, as measured by workload, responsiveness, and quality of work. The Air Force Audit Agency (AFAA) determines which MEOs will be audited. An organization could recommend that the AFAA include a particular MEO in its review.

Further, the servicing manpower and organization office monitors the MEO's compliance with the SOW. However, current manning authorizations do not provide adequate support for the the servicing manpower and organization office to provide day-to-day oversight of the SOW. Air Force Manpower, Reserve Affairs, Installations, and Environment allocates authorizations for *contract administration*,[5] but the Air Force instruction is silent on allocating authorizations for MEO administration. Therefore, the servicing manpower and organization office most likely reverts to the least manpower-intensive quality assurance method: customer complaint. While AFI 63-124, *Performance-Based Service Contracts*, directs quality assurance personnel to rely on this method[6] (this method best reflects customer commitment), a quality assurance surveillance plan typically uses a variety of methods—not just one—to determine if contract requirements are being met. If the servicing manpower and

(Continued on page 47)

A History of Transporting Munitions and Its Relevance to Aerospace Expeditionary Forces

Transporting Munitions

Major Kirk L. Kehrley, USAF

The Air Force transformation to an AEF parallels the expeditionary forces of Alexander the Great, the Ottomans, Napoleon, Grant, and Guderian.

Throughout history, great armies have successfully used a transportation infrastructure to create their greatest asset—mobility for their expeditionary forces. The forces of Alexander the Great, the Ottoman Empire, Napoleon Bonaparte, and Ulysses S. Grant successfully used their own or their host nation's transportation infrastructures to enhance mobility. Their successes occurred because they had an efficient means of transportation and transportation infrastructure with which to be supplied. In contrast, during World War II, the German Army could not be resupplied during Operation Barbarossa, thus denying the mobility on which the blitzkrieg was based. Air Force leadership for the aerospace expeditionary force (AEF) must understand how a host nation's transportation infrastructure affects munitions flow to the warfighter.

A responsive transportation system, integrating commercial and military modes, must be considered and evaluated. Operation Allied Force proved movement of US munitions is dependent on a host nation's transportation infrastructure. The lessons learned from historical applications of a transportation infrastructure necessary to support munitions movements can be applied to today's AEF.

Logistics was the basis of Alexander the Great's successful strategy. It was the most responsive and flexible force in existence because of its small logistics footprint. Philip, Alexander's chief logistician, ensured the troops carried their own arms, armor, and some provisions while marching, compensating for the lack of a transportation infrastructure. Oxen and oxcarts were not used. Oxen could achieve a speed of only 2 miles per hour, their hooves were unsuitable for carrying goods for long distances, and they could not keep up with the army's daily marches, which averaged 15 miles per day. The army did not use carts or servants to carry supplies, as was the practice of contemporary Greek and Roman armies; horses, camels, and donkeys were used in Alexander's baggage train because of their speed and endurance. As necessary, roadbuilders preceded the army on its march to keep the planned route passable.[1]

Alexander depended on host-nation support to keep the routes his armies traveled open and protected, very much like is called for in the Joint Vision 2020 doctrine of multinational operations.[2] While marching through arid areas, such as present-day Greece and Turkey, Philip provisioned depots throughout regions where grain and water were not available. To enable this, Alexander secured the alliance of people along the route who would be responsible for supplying the depots and protecting the routes his army would use.[3] Transportation routes used to bring supplies were guarded heavily; their primary purpose was to ease the passing of marching troops and animals to the storage depots.

Many of these same ancient roads are still in use today, some even with the original engineering infrastructure. One such bridge, the Saint Julien, was constructed by the Romans in the 3d century BC in the Provence region of present-day southern France and spans the Coulon River. To this day, the bridge supports normal vehicle traffic. As archers' missiles evolved to the use of cannons in the 14th century, even well-built roads and bridges, such as the Saint Julien, could not quickly accommodate heavy-footprint items like cannons.[4] However, the Ottoman Empire overcame this handicap in the 15th century.

The Ottoman Empire

The Ottoman Empire, which reached its zenith in the 16th century under Sulaiman the Magnificent, stretched from North Africa to Hungary and from the Aral Sea in the east to the Caspian Sea in the west. Similar to Alexander's strategy, the key to conquering an area that size was the mobility of its army. A French traveler in the 14th century characterized the mobility of Ottoman troops with, "They can start suddenly . . . . When the drum sounded, they put themselves immediately to march, never breaking step, never stopping till the word was given. Lightly armed, in one night, they travel as far as their Christian adversaries in three days."[5] Even with the use of heavy cannons, the army could move quickly, unencumbered by the heavy logistics footprint of munitions because it created a special cannon corps to manage its munitions program.

Cannons of the mid-15th century created a challenge to mobility, and as a result, their use was initially resisted by the Ottoman cavalry.[6] These bronze cannons typically were 12 to 15 feet long with diameters of 30 inches or greater.[7] Under the reign of Murat II (1402-1451), the Ottomans created a cannon corps, known as the *Topçu Ocaðý*, to manufacture and use cannons. Murat II's son, Mehmed II, established a cannon wagon corps, known as *Top Arabacý*, to transport arms and munitions during campaigns. Additionally, a specialized fleet of boats carried cannons. Foundries were built in different parts of the empire.[8] The Ottoman cannons, powerful enough to knock down the walls of Constantinople during a 53-day siege in 1453, were cast outside the city walls.[9] The furnaces and molds to make the cannons were placed outside the walls, and the raw materials were brought there.[10]

In terms of transporting firepower, the Ottomans moved 80 ships overland from the Bosphorus Sea to the Golden Horn to get a better strategic fighting position for the siege of Constantinople—the transition of the fleet allowed them to subject Constantinople to siege from any side. The Golden Horn was the waterway that served as the city's harbor and was protected with metal chains, preventing the entrance of the Ottoman fleet. Mehmed II's engineers built a road that rose 200 feet above sea level, upon which was laid a track of greased timbers. The ships were pulled out of the water and laid on metal-wheeled cradles. Teams of men and oxen pulled the entire 80-ship flotilla 1,400 feet overland from the Bosphorus to the Golden Horn.[11] Thus, whether lightly armed or bearing heavy cannons or foundry equipment, the Ottomans delivered the firepower necessary to build an empire.

Napoleon and Transportation Infrastructure

Like the Ottomans, Napoleon Bonaparte created a munitions transportation infrastructure. The mobility of the Napoleonic armies was tied to the mobility of their supporting munitions infrastructure. In his book, *Essai Général de Tactique*, written in 1772, Comte de Guibert's vision of battlefield mobility greatly influenced Napoleon Bonaparte. De Guibert wished to end the practice of private contractors' delivering supplies from rear magazines to armies on the march. He believed supply controlled a general's movements because he was ignorant of the working of the supply system. "It is a fundamental error to separate the science of subsistence from the science of war."[12] He stressed that army officers should learn supply.[13]

De Guibert proposed a reduction in the weight of artillery to increase its mobility. His goal was to allow the troops to have the maximum firepower with their mobility so they could be directed at a weak point and overcome the enemy.[14] De Guibert advocated mobile field artillery because large quantities of artillery and support for them hindered an army's mobility.[15]

In 1805, when Napoleon went to war against Austria, he ushered in a new logistics concept of constant resupply by supply convoys. In a matter of weeks, he assembled a supply and transport system for a 170,000-man army. Similar to Alexander, Napoleon's staff sent dispatches to cities along the proposed routes to secure provisions and supply the army along the way. Through Heilbronn, Germany—possibly the first recorded munitions depot in Western warfare—flowed 75,000 to 100,000 rounds of ammunition during the Austrian campaign. In addition to the munitions depot at Heilbronn, Napoleon had a military transportation system, consisting of wagons and boats, to move the munitions needed to support the artillery; he allocated 2,500 of 4,500 wagons to support the artillery. In 1807, Napoleon replaced hired vehicles and drivers with fully militarized transportation personnel and equipment.[16]

Grant and the Necessity of Surface Transportation

In terms of transportation infrastructure, one has only to read the Civil War dispatches of General Ulysses S. Grant. His concern for transportation infrastructure is summed up in the first paragraph of his report of the US Armies 1864-1865 to E. M. Stanton, US Secretary of War. Grant relayed (despite the numerical inferiority of the Confederate Army):

> The resources of the enemy and his numerical strength were far inferior to ours; but as an offset to this, we had a vast territory, with a population hostile to the government, to garrison and long lines of river and railroad communications to protect, to enable us to supply the operating armies.[17]

Grant knew resupply of the Union expeditionary campaigns depended on Confederate-controlled rails, roads, and water ports.

According to Grant, if the South could have prolonged the war, it would have won with a stalemate. "In the North, the people governed and could stop hostilities whenever they chose to stop supplies."[18] To bring the war to an end, Grant planned to have continuous operations of his forces "regardless of season or weather;" therefore, he needed to continuously supply his forces.[19]

Grant knew that roads, railroads, and rivers were centers of gravity around which the Civil War revolved. Railroads became the military roads for both armies, and special garrisons were established to protect them.[20] In February 1862, General D. C. McCallum was appointed Military Director of Railroads, with authority to take possession of railways and engines required for the transport of US troops, arms, and military supplies. The ordnance supplied for the Union came from arsenals, foundries, and armories throughout the North, incidentally located on railroads and waterways.[21]

In terms of transportation infrastructure, Major General Rufus Ingalls, Union Chief Quartermaster of the Armies operating against Richmond, stated, "In order that the enormous streams of supply may be uninterrupted, the wagon roads should be of the best construction, drained, hard and smooth."[22] Ingalls also outlined how to use the roadways to maximize logistical support.

Ingalls relayed that, at Gettysburg, all wagon trains were assembled at Westminster, approximately 25 miles to the rear. Only ammunitions wagons and ambulances were brought up to the immediate rear lines. The established priority for moving mule-driven supply trains was, "Wagons containing small-arm ammunition coming first and then those containing the ordnance, subsistence, and forage . . . ."[23]

Grant's goal was to have his wagons never operate more than a single day's march from their supply depots, usually at railheads or river ports. Speaking of the Army of the Potomac in 1864, he said "Too much credit cannot, therefore, be awarded to the quartermaster and commissary departments for zeal and efficiency displayed by them."[24]

In terms of the importance of munitions to the Confederacy, a law was enacted requiring any ship that entered a Confederate port to have arms or ammunition else it would be confiscated. Referring to Confederate soldiers, Captain Henry G. Sharpe wrote in 1896, "Though the soldiers were often barefoot, ragged, and hungry, they never lacked arms, nor were they defeated for want of ammunition."[25] Nearly all Confederate States established munitions factories under the exclusive control of the Confederate Government.[26]

Grant's dispatches clearly show the importance of a transportation infrastructure to the Union and the Confederacy. In a dispatch to Major General Sheridan during the Shenandoah Valley campaign in October 1864, he said, "If you make the enemy hold a force equal to your own for the protection of those thoroughfares, it will accomplish nearly as much as their destruction."[27] The thoroughfares he refers to were the Virginia Central Railroad and canal. In the Shenandoah Valley campaign to capture the railroad, Grant said, "This road was very important to the enemy. The limits from which his supplies had been drawn were already very much contracted, and I knew he must fight desperately to protect it."[28] In another example, Grant knew the importance of the Danville railroad to General Robert E. Lee as Grant advanced on Five Forks, Virginia, prior to the battle at Gettysburg. He knew that by pressuring the Danville railroad Lee would fight. "These roads were so important to his very existence while he remained in Richmond and Petersburg, and of such vital importance to him in the case of retreat, that naturally he would make most strenuous efforts to defend them."[29]

The Road Known as the Sacred Way—Verdun, France, 1916

Roads are not normally associated with the static trench warfare of World War I; however, the road from Bar-le-Duc to Verdun, known as the *Voie Sacrée* or Sacred Way, was a 50-mile lifeline for the French during the 10-month siege of Verdun. It was at Verdun that General Erich von Falkenhayn convinced the German Kaiser he could bleed the French to death. To understand the importance of Verdun to the French, remember that two-thirds of the whole army passed along it bound for Verdun.[30] As one passes through this picturesque Lorraine region today, various monuments dot the Sacred Way from Verdun to Bar-le-Duc. A sign on one of the monuments indicates that in 9 months 2.4 million men and 1 million tons of munitions were moved down this vital artery. In June 1916, at the peak use of the Sacred Way, more than 12,000 vehicles deployed through it, one vehicle passing through every 14 seconds.

To bleed the French to death at Verdun, the Germans concentrated on logistical support for artillery. They planned to use their heavy guns to blast a hole in the French lines and then send in their infantry.[31] Prior to the first shot fired on 21 February 1916, the Germans had stockpiled 2.5 million shells, some 3,000 for each artillery battery.[32] On the plateau leading up to Verdun, the German Fifth Army built more than 10 railway lines and 24 new stations. Seven spur lines were built in the Spincourt Forest to provision the heavy guns the Germans would put there. The largest German guns were the 422-millimeter mortars or Big Berthas. The shell was as tall as a man and weighed more than a ton. It took 12 wagons to transport one of the immense guns and 24 hours to put it together once its destination was reached.[33] A crane was required to load the shell in the gun tube.[34]

The Roads of a Blitzkrieg

In his 1937 book, *Achtung Panzer* (Attention Armor), General Heinz Guderian gave insight into how vital tanks and supporting armor vehicles would be in the conduct of future wars to avoid

the attrition of World War I trench warfare.[35] He was the principal architect behind the infamous blitzkrieg strategy.

Guderian was convinced that tanks could not be successful without logistical support. Thus was born the idea of armored divisions to provide the support that allows tanks to fight to their maximum capacity.[36] However, during the creation of the German Armored Force, Guderian's request to motorize heavy artillery battalions was turned down. In his memoirs, he remarked, "The heavy guns remained horse-drawn, with unfortunate results during the war, particularly in Russia."[37]

The key to the blitzkrieg was the army's ability to be mobile, similar to the vision of De Guibert. Guderian stated, "Only movement brings victory."[38] The emphasis for the tanks was appropriately pushed, but not the logistics infrastructure to support them. As early as 1937, Guderian noted that resupply of Panzers was found to be insufficient during validity exercises. He noted that rapid movement of supplies and repair depots were needed.[39]

During Operation Barbarossa, the invasion of Russia, German logistics was based on *Grosstransportraum* (truck-carrying capability) in which trucks would supply the Panzers. Robert Kershaw, author of *War without Garlands*, described a 500-kilometer logistics tripwire, which indicated the limit of logistics sustainability for the Panzer advance. After 500 kilometers, only rail could ensure acceptable logistics support. However, 500 kilometers was too long; the trucks the Germans used, of which approximately 40 percent were captured French vehicles, were in poor mechanical condition at the outset of Barbarossa. The Panzers rapidly outpaced the foot army, which relied on horse-drawn transport. It was calculated that 1,600 trucks were needed to equal one double-track railway over a 500-kilometer distance. German rail troops had to convert Russian rail to German gauge. After approximately 3 weeks into Barbarossa, 480 kilometers of rail had been completed, but it had only one-tenth the carrying capacity of German rail because of ground structural supports.[40]

During Barbarossa, Guderian and Adolf Hitler spoke of the importance of seizing Moscow because it was "the great Russian road, rail, and communications center."[41] The German Army General Staff anticipated defeating the Russians in 8 to 10 weeks. In Barbarossa, Guderian's center of gravity was the establishment of a decent supply route to resupply his Panzer forces.[42] Unlike Alexander the Great or Napoleon, Guderian could not provision his fighting forces at advance depots using host-nation support.

Additionally, he described the importance of capturing road and rail centers to serve as a base to fight from as the campaign continued. General Guderian stated, "We could only move as fast as our supply situation would allow."[43] During the advance on Moscow, Guderian said corduroy roads had to be laid down for miles for his troops to be supplied.[44] Grant, 79 years before, had also remarked that corduroy roads had to be laid in order for his army to advance on Corinth, Mississippi.[45] The Third Panzer Division had to be resupplied totally by air. Besides fuel, munitions, clothes, and food, even the salve for the Panzer's telescopic sights did not arrive, which made the tank guns useless. "If only we were mobile and had our old combat strength, then it would be child's play. The Russian is trained and equipped for winter warfare, and we are not."[46]

When Guderian recommended to Hitler that the Germans withdraw from Russia, he was told to dig into the ground where they were and hold every inch of land. Guderian replied that the troops could not dig into the ground because it was frozen to a depth of 5 feet. Hitler then retorted to blast craters with heavy howitzers. Guderian responded that he did not have sufficient explosives even to blast out defensive positions.[47] Lack of a German transportation infrastructure was further exacerbated by the lack of a local area road or rail. Unlike Alexander or Napoleon during his Austrian campaign, the Germans had no host-nation support to secure bases within their adversary's country in which to establish supply depots.

Operational Allied Force and Lessons Learned about Transporting Munitions

In peacetime, the significance of many elements of wartime logistics and administration are not apparent; consequently, officers can be lulled into a false sense of security insofar as these matters are concerned.

—Rear Admiral Henry E. Eccles

The Air Force transformation to an AEF parallels the expeditionary forces of Alexander the Great, the Ottomans, Napoleon, Grant, and Guderian. As with these armies, AEF mobility is dependent on a responsive transportation system or coalition partner to enable rapid transport of warfighting materials. AEF logisticians must be able to respond rapidly to support a mobile combat force in multiple planned and unplanned locations. The AEF involvement in Operation Allied Force clearly showed the criticality of transportation to project airpower—especially in terms of munitions. Moving munitions presents a tremendous challenge to logisticians because of their bulk, wide variety, and the immense quantities required to support modern air operations. Munitions dominated the logistics footprint during Operation Allied Force. Many items can be purchased from a warfighting coalition partner, including large footprint items such as fuel; this is not the case with munitions. During Operation Allied Force, US foreign military sales (FMS) of $35M were generated, mostly in selling munitions to our allies.[48]

At the onset of Operation Allied Force, the United States Air Forces in Europe (USAFE) munitions infrastructure was evolving from a fight-in-place to an expeditionary concept. In 1989, USAFE had 57 munitions storage areas and an established fight-in-place operations plan with clear stockpile objectives. By 1999, USAFE had 20 percent of its 1989 stockpile and 24 percent of its 1989 storage capacity spread out in only 14 munitions storage areas. Stockpile guidance was vague, and while the force was still in the drawdown mode, Operation Allied Force provided an opportunity to evaluate the munitions infrastructure necessary to support an air expeditionary air force. In Operation Allied Force, USAFE munitions logisticians projected munitions to nine different locations, had multiple changes in munitions requirements, and coordinated numerous country clearance issues.[49]

One of the great lessons learned from Operation Allied Force was that a host country's commercial infrastructure, particularly transportation, was the linchpin to US logistics in the European Command (EUCOM) area of responsibility. EUCOM is in a coalition warfare scenario and requires the munitions throughput capability that only our allies can provide. On the other hand, Thomas Friedman, in a 3 February 2002 *New York Times*

editorial, stated American technology is destroying the North Atlantic Treaty Organization (NATO) alliance. He believes, as a result of being more technologically advanced than its NATO allies, America does not need them to fight a war.[50] Unfortunately, Friedman does not realize how much America relies on the NATO allies' rail and trucking industries to move its munitions.

As Grant pointed out, in referring to the North, "Supplies can be cut off by the whim of the people," so can the whim of our coalition partners hinder or totally cut off our supply lines, which are dependent on the coalition's infrastructure.[51] Flexible transportation is critical because large quantities of munitions must be positioned even though a proportionately small amount will be expended. Target sets and the type of ordnance can change on a daily basis. In Operation Allied Force, 35,000 short tons of munitions were moved, but only 6,000 short tons were actually expended.[52] Munitions accounted for 47 percent of the combat support and sustainment logistics footprint in Operation Allied Force.[53] Integrating commercial and military transportation modes is normal during any munitions move (aside from direct air-force-to-air force airlift). Currently, USAFE evaluates its own infrastructure, such as explosives-sited holding areas or the number of war reserve materiel shipping containers necessary for theater-wide munitions shipments. However, USAFE does not evaluate a host nation's infrastructure throughput for US munitions, even though the critical area is the host nation's transportation of these assets. For example, explosives-licensed, long-haul drivers; security; country clearance; stevedore unions; explosives-sited docks; and explosives-sited rail marshalling areas are unique capabilities for which the the United States depends on its host nation for agile combat support. Restrictions such as transportation on weekends, local police rules and regulations, and overland and overflight clearance were different in each country the Air Force dealt with during Operation Allied Force.[54] Additionally, explosives restrictions existed at host-nation seaports, railheads, railways, highways, and the munitions bed-down locations.[55]

When these variables do not exist, logistics workarounds may increase the throughput of needed munitions. For example, during Operation Allied Force, the seaport at Trapani, Sicily, was located adjacent to US aircraft; however, permission was not given to use the port. To supply US aircraft near Trapani with munitions, an air bridge was established using C-130s from Ramstein Air Base, Germany. For 2-1/2 weeks, an average of three C-130s flew in 28 short tons of munitions each day, enabling the wing to carry out its mission until permission was granted to use another seaport sufficient to download munitions.[56] The port finally used was at Empadocle, Sicily, more than a 4-hour drive from the port at Trapani. Additionally, munitions ships were limited to 100,000-poundsnet explosives while berthing at the harbor.

In another instance, the USAFE munitions staff did not anticipate much munitions movement to support B-52s at Royal Air Force (RAF) Fairford, England, because of the 500- and 2,000-pound bombs already at RAF Welford and RAF Lakenheath. However, the B-52s requested 750-pound bombs (M117). The USAFE munitions staff commenced to source 18,000 from the CONUS. Ironically, from 1992 to 1998, the USAFE munitions staff had sent to salvage more than 11,000 M117s that were in the USAFE stockpile.[57]

Additionally, in May 1999, as a result of projected B-52 drops of Mk-82s, the USAFE munitions staff knew they would run out before resupply from the CONUS. The staff worked to move more than 5,000 from US stockpiles in Norway and used them to fill the gap until resupply could be accomplished from CONUS.[58]

Operation Allied Force required a flexible transportation system to swing munitions wherever they were needed on short notice. Munitions forecasting was a challenge in Operation Allied Force; therefore, a robust transportation system that could react quickly to changing munitions needs was necessary. The USAFE Munitions Directorate developed a munitions authorization and allocation plan for every fighter and bomber unit in the theater by using the standard configuration load (SCL) for each aircraft. The SCL was combined with the Crisis Action Operations Center and a target set to develop a validated plan that became the standard for munitions resupply during Operation Allied Force. From this plan, the USAFE Munitions Directorate developed a munitions storage plan for a 5-day munitions requirement for each combat wing. Of the eight operating locations supported with munitions, only three were capable of storing enough munitions to sustain a 5-day requirement by the combat wings at those locations. This meant constant resupply and movement of much ordnance.

To source munitions, logisticians must have sufficient lead time to coordinate country clearance issues and contract transportation (sealift, airlift, or surface) to ensure the right types of munitions are available for aircraft when they arrive at their forward operating location. In Operation Allied Force, during the anticipated bed down at sites in Turkey, the specific aircraft MDS was not identified until approximately a week out from aircraft arrival. Air-to-air assets were typically flown from Ramstein, whereas laser-guided bomb components (seeker head and tail kit) could be either flown in or downloaded from an afloat prepositioning ship in the area.

The potential setbacks at Empadocle, Fairford, and Turkey were offset because Operation Allied Force benefited from working within a theater that had, in most cases, a strong commercial transportation system. Turkish, Italian, Norwegian, British, and German Allies moved 460 railcars, uploaded and downloaded 7 coaster ships, and operated 1,042 transport trucks to deliver munitions to 8 different bed-down locations during Operation Allied Force. [59]

Since the first recorded drop of munitions in 1911 from an Italian airplane over Turkish troops in Libya, the technology of the munitions dropped from airplanes has evolved; however, the 500-pound bomb dropped in World War II is still that, a 500-pound bomb.[60] Technology has improved the accuracy and possibly reduced the quantity of bombs necessary, but the weights have not decreased. During Operation Allied Force, 35 percent of the munitions dropped were precision-guided, compared with 8 percent in Operation Desert Storm. In our present era of precision-guided munitions, the general-purpose 500- and 2,000-pound bombs, standardized in 1941, still weigh the same but now have different tail kits or seeker heads.[61] It is not fair to assess that precision-guided munitions will reduce the munitions footprint. In fact, the containers for the tail kits and seeker heads make the logistics footprint even larger. We may be seeing an increase in killable targets, but the numbers of munitions may not be reduced as first thought.

Despite the challenges to the movement of munitions, Operation Allied Force was a light challenge to the munitions logistics transportation system: it took 78 days, and 6,600 tons

of munitions were expended. During Desert Storm, ten times that amount were expended in less than half the time. In Operation Allied Force, the US European Command (USEUCOM) transportation system was not stressed. The Army was not engaged, leaving the Air Force, in most instances, full access to the otherwise joint-use transportation resources possessed by US Allies.[62]

How USAFE Is Applying Operation Allied Force Lessons Learned

As a result of lessons learned during Operation Allied Force, the USAFE Munitions Directorate created the Theater Munitions Distribution System (TMDS) to create flexibility for munitions distribution by establishing regional munitions hubs in the north, central, and southern regions of the USAFE area of responsibility (AOR). The hubs were chosen because they had the requisite storage, maintenance, and transportation capabilities of the remaining USAFE bases necessary to stage, repair, and swing munitions to any fight worldwide. The hubs are RAF Welford; Ramstein Air Base; and Camp Darby, Italy. The existing munitions infrastructure and storage capabilities at RAF Welford, along with the outstanding civil trucking and seaport capabilities in Great Britain, make it an ideal location. Ramstein directly supports European operations and provides worldwide support through its airlift capability. Its railhead and truck outload points improve the ability of the United States to stage and move ammunition to and from explosives-sited seaports.

Camp Darby helps support munitions supply for all combat operations south of the Alps. More than half the munitions dropped in Operation Allied Force were shipped from there.[63] It gives the United States tremendous munitions throughput capability and is the only munitions storage area in the entire European AOR with both an explosives-sited water dock and railhead located adjacent to the munitions storage area. The only other US munitions storage area with an explosives-sited seaport adjacent to it is at Kadena Air Base, Japan.

The munitions infrastructure planned under TMDS directly supports joint movement of munitions. The US Army, Europe would benefit directly from Ramstein and Camp Darby for its mission to project land power through the planned storage, staging, and transportation infrastructure. Likewise, Naval Forces, Europe can take advantage of all munitions hub port improvements to facilitate seapower. NATO coalition forces can enjoy the same benefits as US forces for munitions movements through efficient implementation of foreign military sales.

Finally, TMDS helps minimize host-nation challenges. By regionally positioning munitions, we can minimize the number of country clearance activities during coalition warfare. This also gives us the opportunity to establish modes for munitions transport, enabling US forces to fully inform sovereign nations of planned munitions movements; allows concerns to be voiced prior to potential conflicts; and permits USEUCOM to mitigate national concerns before they become serious. TMDS establishes the means and methods to ensure the success of coalition warfare.[64]

Conclusion

For the Air Force to remain mobile and have a truly expeditionary aerospace force, it must realize that coalition warfare is dependent on our partners, who control stevedores, trucking companies, and rail and seaport networks. It must pay attention to the admonishments of Eccles and De Guibert: officers must not be ignorant of their logistics system. This article does not advocate that leaders and tacticians become logisticians; it advocates that munitions logistics be a key planning factor. In particular, the movement of US munitions, within a host nation or from anywhere on the globe, is contingent on the understanding of host-nation transportation infrastructures and that host nations actually will be transporting US munitions. Coalition warfare is transportation-dependent. The United States cannot perform its mission without considering coalition partners in its agile combat support logistics model. For the foreseeable future, munitions expenditures by US aircraft will dominate any coalition warfare in which the United States participates. In an earlier *Journal* article, "AEF Munitions Availability," the authors stated, "To meet the munitions challenges of EAF, the Air Force must look for ways to improve rapid transportation capabilities, infrastructure, and prepositioning support."[65] Operation Enduring Freedom confirmed that the Air Force must heed this advice. As we review the history of a munitions transportation infrastructure, we can focus on one main point—successful military commanders throughout history have concentrated on the transportation of munitions to support the mobility that made their fighting forces successful.

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Major Kehrley is commander, 7th Munitions Squadron, Dyess AFB, Texas.

("The Most Efficient Organization Misperception" continued from page 39)

organization office had sufficient manning to use them, the other methods include trend analysis, periodic inspections, contractor metrics, random sampling, customer complaint, third-party audits, 100-percent surveillance, and a quality index.[7] However, even with sufficient manning to perform quality assurance, they do not have a mechanism to enforce SOW compliance.

Therefore, some people have suggested that the MEO could be treated like a contractor operation. In other words, could one apply the same contract enforcement mechanisms to the MEO? To implement this approach, the contracting officer needs to control the civilian pay funds. Money is the motivator for contractors to comply with the contract requirements. If the requirements are not met, then the contracting officer may use the inspection of services clause[8] to direct the contractor to reperform the services (at no additional expense), thereby conforming to contract requirements. This is the preferred course of action. If reperformance is not reasonable (for example, not enough time is available to do the job again), then the contracting officer may reduce the contract price to reflect the fact that services were not performed in accordance with the contract. It would not be prudent to pay for services when they were not received. However, there would certainly be legal or union problems associated with reducing government civilian salaries for work already performed.

While the inspection of services clause is a negative motivator, a positive motivator exists, and it can be used regardless of whether civilian pay funds are given to the contracting officer. If the MEO were treated like a contractor, then a suitable reward for outstanding performance could be the award term. This arrangement rewards the service provider with additional contract duration for performance that exceeded the contract terms. However, current policy does not specifically address an award-term arrangement. While it states that the MEO is valid for 5 years,[9] an award-term arrangement would require some flexing of the 5-year period to provide the incentive. The award-term arrangement is almost possible; perhaps the next revision of AFI 38-203 would allow the opportunity to treat MEOs even more like contractors in this regard.

For those who do not believe an MEO is required to comply with the SOW, it is time to open the window and retrieve the contract. There are many faces (the functional commander, manpower office, outside audit agencies, and possibly the contracting officer) that exist to ensure the MEO is performing. After all, the A-76 study is supposed to result in cheaper cost, not cheaper performance.

Notes

1. AFI 38-203, *Commercial Activities Program*, 1 Aug 00, para 11.2.2.2.1, 98.
2. AFI 38-203, para 19.2.5, 200.
3. AFI 63-124, *Performance-Based Service Contracts*, 1 Apr 99, para 1.2.6.1, 3.
4. AFI 38-203, para 20.2.2, 205.
5. AFI 38-203, para 19.5.2, 203.
6. AFI 63-124, para 4.1.5, 7.
7. *Ibid*.
8. Federal Acquisition Regulation, Part 52.246-4.
9. AFI 38-203, para 19.2.3.1, 200.

Captain Wright is in the Logistics Career Broadening Program at Oklahoma Air Logistics Center, Tinker AFB, Oklahoma.

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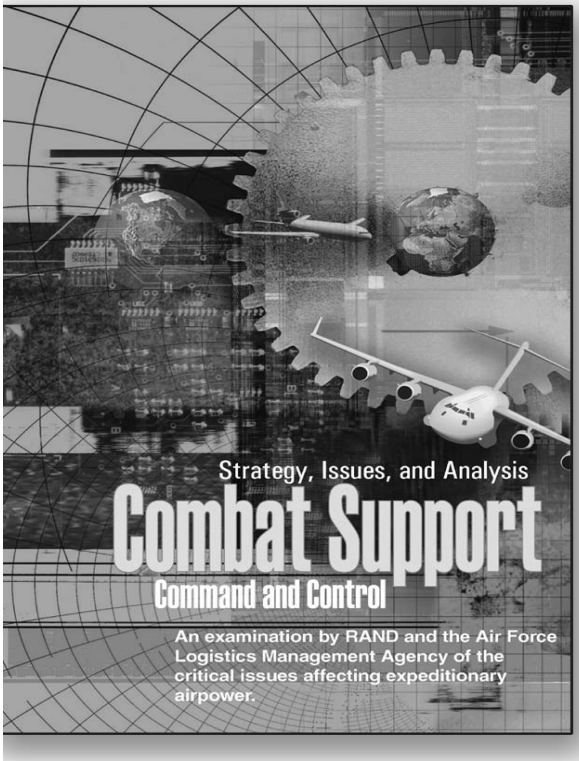
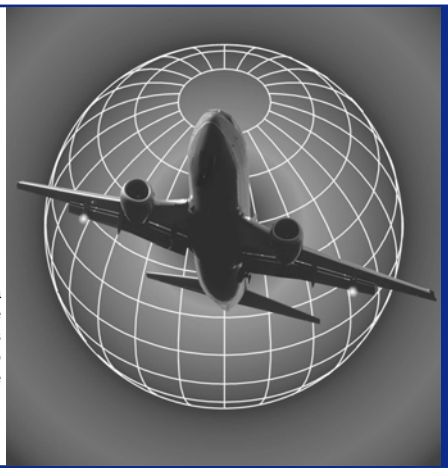


Research Focus

Premium Transportation

Captain Jason L. Masciulli, USAF
Captain Christopher A. Boone, USAF
Major David L. Lyle, USAF

Using premium transportation is a wise, economical decision for the Air Force; however, opportunities may exist for using alternatives to premium transportation in the CONUS.



The Editorial Advisory Board selected "Premium Transportation: An Analysis of Air Force Usage"—written by Captain Jason L. Masciulli, Captain Christopher A. Boone, and Major David L. Lyle—as the most significant article to appear in the *Air Force Journal of Logistics*, Vol XXVI, No 2.