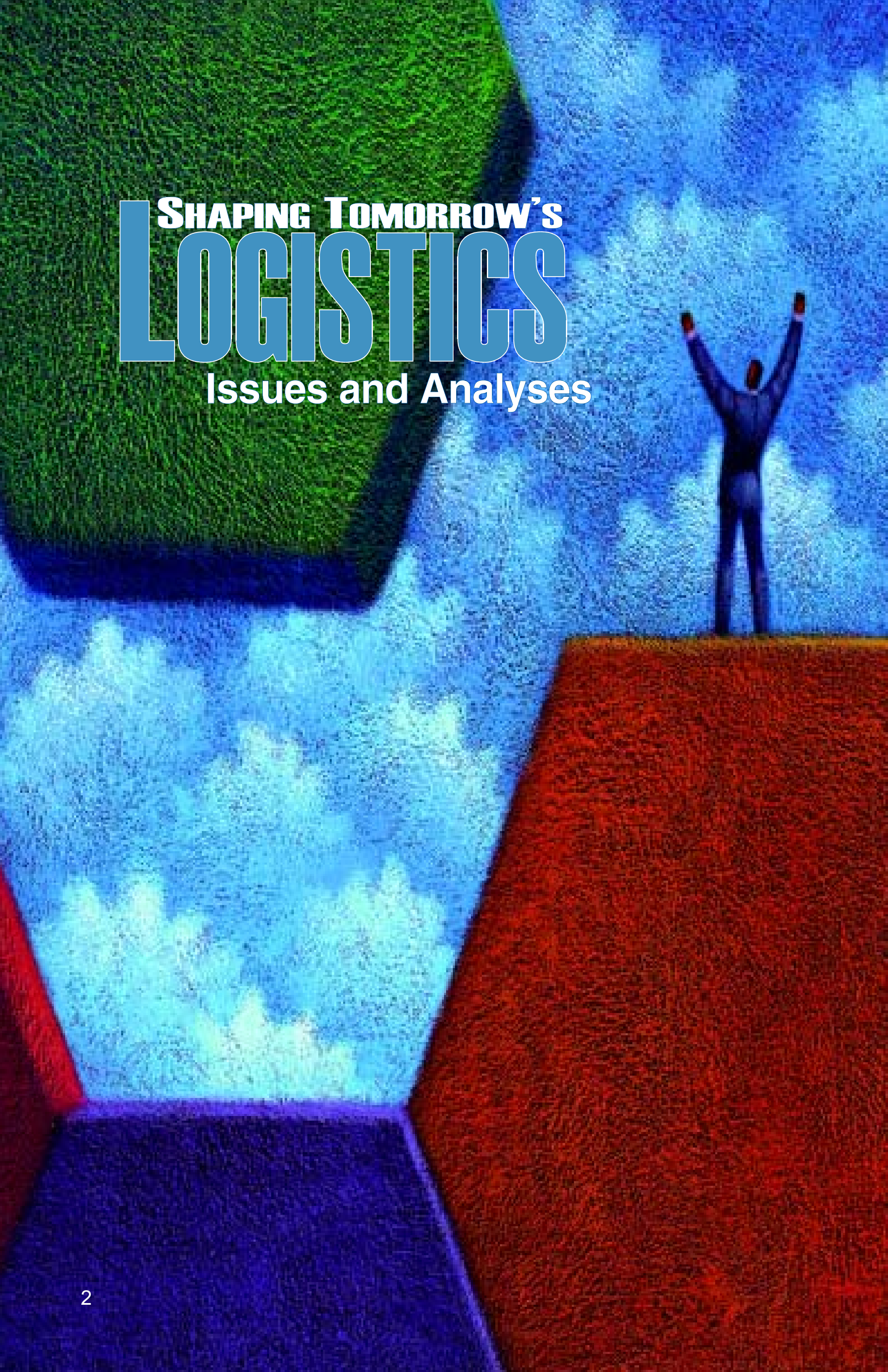
Air Force Logistics Management Agency

Shaping Tomorrow's Logistics

Issues and Analyses

Logistics infrastructure and processes must evolve to support the new spectrum of demands and challenges.

SHAPING TOMORROW'S LOGISTICS
Issues and Analyses



Articles, Essays, and Studies

Shaping Logistics Vignettes

The Editors, Air Force Journal of Logistics

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From peacekeeping, to feeding starving nations, to conducting counter-drug operations, to homeland defense, the military must continue to adapt to evolving missions and working with a broad range of allies or coalition partners. Logistics infrastructure and processes must evolve to support the new spectrum of demands and challenges. New technological advances must be capitalized and integrated into the support infrastructure. Similarly, the logistics community must examine existing processes through a variety of studies and analyses and look for ways to make quantitative and qualitative improvements. Accepted theories, practices, and processes need to be examined and, where necessary, challenged and changed. Two concepts dominate Air Force logistics today: Focused Logistics at the joint level and Agile Combat Support within the Air Force. The vision of both these concepts is the ability to fuse information, transportation, and other logistics technologies to provide rapid response, track and shift assets while en route, and deliver tailored logistics packages at all levels of operations or war. This same vision includes enhanced transportation, mobility, and pinpoint delivery systems.

Air Force logistics will also change as a result of the Chief's Logistics Review (CLR). At the heart of the CLR is changing Air Force logistics to meet the challenges of expeditionary airpower. Major CLR goals include:

Introduction

Shaping Tomorrow's Logistics

- Keeping turbulence at a minimum by evaluating processes rather than organizations.
- Relating all changes and adjustments to the expeditionary aerospace force, specifically whether changes should be made for more centralized or decentralized support for home and deployed forces.

Shaping Tomorrow's Logistics is a collection of 12 essays, articles, and studies that lets the reader examine a variety of research and thought that speaks to shaping and changing tomorrow's Air Force logistics.

- Considering leadership development for officers—look at both logisticians and operators.
- Developing changes or adjustments within constrained funding boundaries.

Shaping Tomorrow's Logistics is a collection of 12 essays, articles, and studies that lets the reader examine a variety of research and thought that speaks to shaping and changing tomorrow's Air Force logistics. Included in the volume is the work of many authors with diverse interests and approaches. Much of the research discussed herein was conducted at the Air Force Logistics Management Agency.

Additional copies of *Shaping Tomorrow's Logisics* are available at the Office of the Air Force Journal of Logistics.

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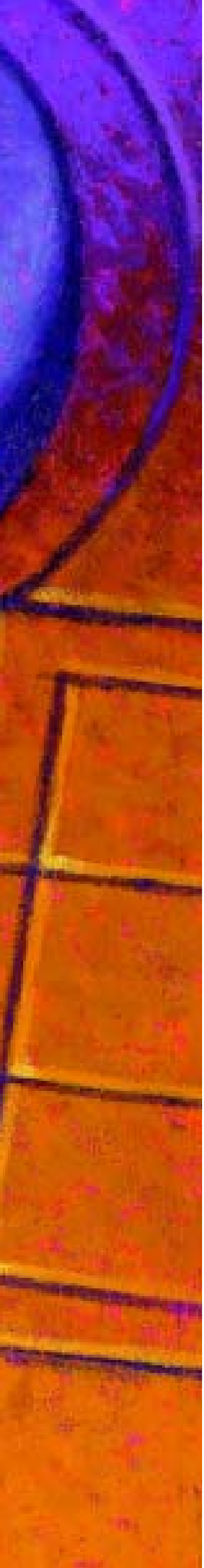
Generating Solutions Today, Shaping Tomorrow's Logistics

Since its inception, the Air Force Logistics Management Agency has grown to be recognized for its excellence—excellence in providing answers to the toughest logistics problems. And that's our focus today—tackling and solving the toughest logistics problems and questions facing the Air Force. It's also our focus for the future.

Lots of organizations have catchy mottoes. Likewise, many have catchy vision statements. We do, too. But there's a big difference—we deliver on what we promise. *Generating Solutions Today, Shaping Tomorrow's Logistics* aren't just words to us; they're our organizational culture. We use a broad range of functional, analytical, and scientific expertise to produce innovative solutions to problems and design new or improved concepts, methods, systems, or policies that improve peacetime readiness and build war-winning logistics capabilities.

Our key strength is our people. They're all professionals from logistics functions, operational analysis sections, and computer-programming shops. Virtually all of them have advanced degrees, some of which are doctorates. But more important, virtually all of them have recent field experience. *They've been there and done that*. They have the kind of experience that lets us blend innovation and new technology with real-world common sense and moxie. It's also the kind of training and experience you won't find with our competitors. Our special blend of problem-solving capabilities is available to every logistician in the Air Force.

Our track record puts us in the lead in delivering robust, tailored answers to the most difficult and complex Air Force logistics problems. This can be seen in our efforts and partnerships that are turning expeditionary airpower support concepts into real-world capability. It can also be seen in our work in making dramatic improvements to the Air Force supply system and developing high-impact logistics publications and our leadership in planning and making logistics play in wargames, simulations, and exercises truly meaningful. The message is also loud—we work the important projects that shape tomorrow's Air Force, and we deliver what our customers need today!



Without an adequate understanding of the entire logistics system, a military leader may lack the proper perspective or a common frame of understanding to effectively plan and employ combat forces and logistics support forces.

Educating logistics leaders

The framework of the DoD logistics system should serve as a broad-based overview of DoD logistics for the field grade officer or DoD civilian equivalent attending joint professional military education. The joint educational curriculum addresses joint and combined operations and how to plan, generate, employ, and sustain combat forces in support of national objectives.

Lieutenant Colonel Lyndon S. Anderson

My logisticians are a humorless lot . . . they know if my campaign fails, they are the first ones I will slay.

—Alexander the Great

Introduction

Effective generation and sustainment of combat power requires an education in the fundamental relationship among strategy, tactics, and logistics. Military and civilian leaders should fully understand the role logistics plays as the enabling arm of this triad. Specifically, their continuing education should, at some point, focus on developing a better understanding of how Department of Defense (DoD) logistics supports operational forces. For instance, leaders should understand the essential parts of DoD logistics activities, how these activities fit together to form an integrated whole, and how employment of logistics activities generates and sustains combat power.

Developing this understanding, however, is an educational challenge. The shear magnitude of the DoD logistics system makes

To illustrate size, the logistics system consumed one-third of the DoD budget in fiscal year 2000 (it employs nearly half the DoD work force—925,000 full-time logisticians, plus 350,000 military reserve members), and it comprises 4 Services—9 combatant commands and more than 20 logistics commands and agencies.

it difficult for leaders to fully grasp how the system functions. To illustrate size, the logistics system consumed one-third of the DoD budget in fiscal year 2000 (it employs nearly half the DoD work force—925,000 full-time logisticians, plus 350,000 military reserve members), and it comprises 4 Services—9 combatant commands and more than 20 logistics commands and agencies.[1] Without an adequate understanding of the entire logistics system, a military leader may lack the proper perspective or a common frame of understanding to effectively plan and employ combat forces and logistics support forces. These are serious obstacles.

To illustrate the importance of logistics, US military operations during the conflicts with Iraq, Boznia-Herzogovina, and Kosovo put logistics activities through their paces in the 1990s. The buildup and sustainment for the Gulf War seemed nothing short of miraculous. Heroic efforts took place to deploy 350,000 people, 12,400 tracked combat vehicles, and 114,000 wheeled vehicles in support of the ground offensive alone. Support personnel served more than 94 million meals, pumped 1 billion gallons of fuel, and delivered 31,000 short tons of mail.[2] During the Boznia-Herzogovina conflict, logistics support succeeded despite incredible multinational coordination challenges. The United States had to overcome the inability of allied nations to project and support themselves outside their established areas of responsibility.[3] During the Kosovo conflict, logistics support ensured the successful conduct of simultaneous combat and humanitarian operations. This was achieved despite conflicts and complexities not normally present when such operations occur independently of one another.[4]

The skill of US leaders in guiding logistics forces to achieve such support was noteworthy. They understood how the activities of DoD logistics worked together to support military operations. They possessed the necessary knowledge and experience to successfully plan and execute logistics operations in support of each of the above campaigns. Future generations must be able to do the same.

Purpose

This article gives meaningful insights that should influence planning and facilitate informed decision making by providing a tool that describes the framework of the DoD logistics system. Regardless of military service or organizational background, this framework should help the reader think simply and sensibly about how DoD logistics influences combat effectiveness. The framework also should help the reader influence how logistics can improve the generation and sustainment of combat power.

The framework presents a generic, holistic, and objective view of the current DoD logistics system. Its focus is on the logistics activities that generate and sustain combat forces. It does not advocate any particular military service or concept of operation and leaves value judgments to the reader.

Why a Framework Is Useful

The framework of the DoD logistics system should serve as a broad-based overview of DoD logistics for the field grade officer or DoD civilian equivalent attending joint professional military education. The joint educational curriculum addresses joint and combined operations and how to plan, generate, employ, and sustain combat forces in support of national objectives. The framework for the DoD logistics system can complement this curriculum. It does so by helping officers and civilians with diverse backgrounds and experiences think about logistics as a structured, interconnected, end-to-end supporting system. The framework's usefulness is underscored by answers to the following questions: How should the framework for the DoD logistics system change the reader's thinking about logistics and its role in military operations? How can this change in thinking influence the generation and sustainment of combat power?

How Should the Framework for the DoD Logistics System Change the Reader's Thinking?

One of the underlying aims of the framework for the DoD logistics system is to help the reader think about logistics in a simple, logical way. By focusing on essential elements, the framework strips away the mountain of details that

The framework helps the reader to think about logistics activities as an integrated system made up of inputs, a conversion process, and outputs.

cause confusion and hamper understanding. The result is a more holistic view of DoD logistics that shows how the essential elements fit together to form a connected end-to-end system. The framework's holistic view provides a broader perspective of DoD logistics. It links the national economy with combat capability by describing a logistics system that transcends military service and organizational lines. Understanding these links and how they fit together should provide the necessary context and points of view that will help the reader better grasp and apply logistics products and capabilities to the task of generating and sustaining military operations. The framework considers four areas—integrated systems, core components, levels of operation, and structure—to help the reader think differently about logistics.

First, the framework helps the reader to think about logistics activities as an integrated system made up of inputs, a conversion process, and outputs. The framework describes inputs as the goods, services, and information used to feed the logistics system. It then explains the core components and levels of logistics operations that work together to convert input into useful output. It finally shows how output products and capabilities of DoD logistics serve as the enabling input for operational forces.

Second, the framework helps the reader to think about the core components that make up logistics activities within the system's conversion process. The core components are enablers, competencies, conditions, and command. Enablers are the resources, organization, infrastructure, and technology that empower logistics operations. Competencies are the processes, functions, and missions that produce the system's end products and capabilities. Conditions are the physical and ideological environments that surround, guide, and shape the system. Command is the controlling authority that unifies the system. Together, they form the foundation of the system's conversion process.

Third, the framework helps the reader to think about DoD logistics at the national, theater, and unit levels of operation. National-level logistics involve DoD activities that prescribe policy and procedures; develop strategy, doctrine, and directives; and oversee strategic-level logistics activities. Theater-level logistics activities plan and execute operations that generate and support combat forces in a particular geographic location. Unit-level logistics include those activities that provide direct support to operational forces.

Finally, the framework helps the reader to think about logistics in a more structured way. The logistics system is presented as a figurative pipeline that serves as a cognitive roadmap to bring order and structure to a large and complex system.

How can a change in thinking influence the generation and sustainment of combat power? The ultimate goal of the framework for the DoD logistics system is to enable readers to gain a better and broader understanding of logistics. By educating them on the essential elements that frame the DoD logistics system, they may develop a broader perspective of logistics activities that enhances awareness and understanding. A broader perspective and understanding of DoD logistics can help in a couple of important ways. First, it provides insights that lead to a more thorough analysis and scrutiny of important logistics actions. Such scrutiny facilitates discernment, which leads to better decision making. Second, it reveals dependencies and relationships. Understanding these dependencies and relationships helps one assess situations more accurately, balance limited resources with operational requirements, and influence operational and campaign planning to function within the bounds of feasible logistics capabilities.

Educating Logistics Leaders

The ultimate goal of the framework for the DoD logistics system is to enable readers to gain a better and broader understanding of logistics. By educating them on the essential elements that frame the DoD logistics system, they may develop a broader perspective of logistics activities that enhances awareness and understanding.

Framework of the DoD Logistics System

> *Logistics…as vital to military success as daily food is to daily work.*
>
> —Captain Alfred Thayer Mahan

The purpose of logistics in the Department of Defense is to create and sustain support for combat forces to provide the physical means to exercise power.[5] This support is generated by a series of activities that make up DoD logistics. This section looks at these activities more closely

Inputs take the form of goods and services that come from the nation's economy and information that comes from strategy and requirements.

to identify and describe their component parts and to show how they fit together to satisfy military operational needs. The activities of DoD logistics will be examined in the context of a system. Figure 1 shows the generic framework of the DoD logistics system. It is composed of three primary segments: System Input, Conversion Process, and System Output. The framework can be thought of as a pipeline that converts and channels input goods and services into useful products and capabilities necessary to generate and sustain combat power.

System Input

System inputs are the first step in an examination of the DoD logistics system. Inputs take the form of goods and services that come from the nation's economy and information that comes from strategy and requirements. In a general sense, requirements identify the need, economy produces the goods, and services and strategy provide the broad overarching guidance.

Requirements identify and communicate the needs of military forces. They are the specific pieces of information that engage logistics activities and the procurement process. Operational forces drive requirements by identifying the need for specific products and capabilities. Requirements that identify a particular product specify

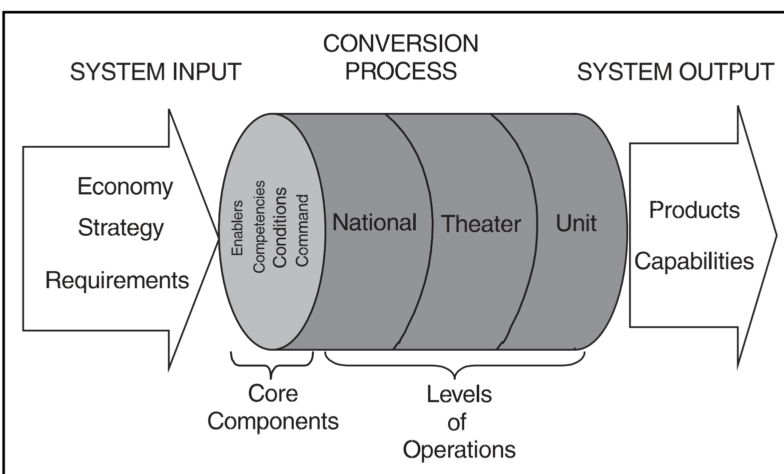


Figure 1. Framework of the DoD Logistics System

what, when, where, and how much of that product is needed. Requirements that identify a particular capability express it as a desired ability or set of conditions necessary to enhance the warfighter's combat effectiveness.

Oversight of the requirements process is critical in the joint environment. The purpose of the requirements process is to place a demand on the logistics system. The leader's challenge is to ensure an efficient process is in place among the Services to understand the requirement and then transmit the requirement to a supplier in an accurate and timely manner. Once requirements get to the supplier, the economy's pipeline starts to flow.

The national economy is made up of the nation's educational, industrial, labor, and financial institutions. Together, these institutions and the political and social system that undergird them produce the goods and services that feed the DoD logistics system.[6] The military relies on the vast resources, capability, and industrial might of the nation's economy to produce the food, fuel, water, ammunition, weapon systems, clothing, repair parts, administrative supplies, and medical products necessary to effectively wage war.

Strategy is generally broad national-level guidance used to provide direction for how the nation will employ military power. Strategy serves to shape and prepare military forces for the challenges and opportunities that await them in the future. Without it, the military lacks proper focus and sense of direction on when, how, and why to use its forces.

Accordingly, within the bounds of strategic directives, the leader should be able to comprehend how requirements engage the economy, generating goods and services that feed DoD logistics.

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The Conversion Process

The logistics activities of each military service, the Defense Logistics Agency (DLA), US Transportation Command (USTRANSCOM), and combatant commands comprise DoD logistics. These activities convert input goods, services, and information into output products and capabilities.

Educating Logistics Leaders

The core components of the logistics system consist of the behaviors and actions that make up logistics activities at the national, theater, and unit levels of operation.

The size and complexity of these conversion activities make it difficult to conceptualize its end-to-end operations, its major components, or how they fit together to achieve the desired effect for the warfighter. For instance, it is difficult to comprehend all the DoD logistics activities need to acquire, produce, sustain, and dispose of every weapon system, large and small, for each of the Services. It is equally difficult to imagine all the activities involved in the procurement and distribution of food, fuel, ammunition, and water to sustain military operations and the assembly and sustainment of combat and support bases, living quarters, and production facilities worldwide. The framework will, therefore, be used to make sense of this massive operation.

Explanation of Core Components

The core components of the logistics system consist of the behaviors and actions that make up logistics activities at the national, theater, and unit levels of operation. As shown in Figure 2, these components are Enablers—the items that empower the system; Competencies—processes, functions and missions that produce the products and capabilities of the system; Conditions—the activities that guide the system; and Command—the authority and control exercised over the system.

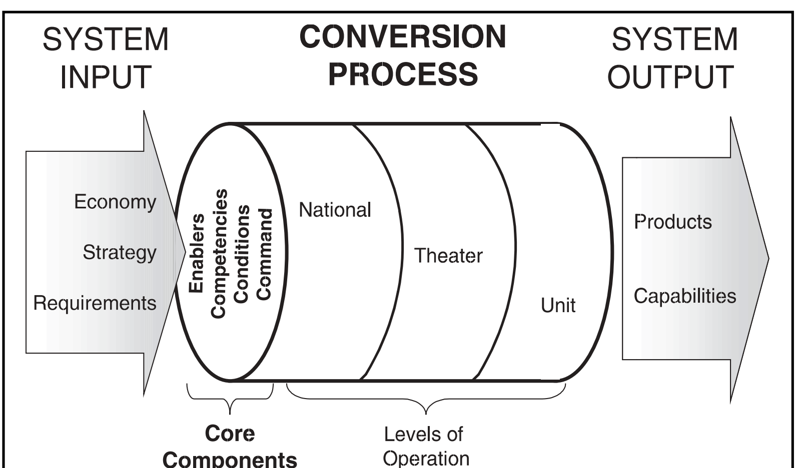

Figure 2. Conversion Process Core Components

Enablers. Enablers are the resources, organizations, infrastructure, and technology that empower the system. They perform a dual role by serving as the primary enablers of the logistics system and by limiting the system by realities of availability.

Resources serve as an enabler of the logistics system through its people, funding, and equipment. An effective logistics system requires people properly trained and motivated to operate within their own military service or organization's logistics activities.

Resources serve as an enabler of the logistics system through its people, funding, and equipment. An effective logistics system requires people properly trained and motivated to operate within their own military service or organization's logistics activities. It also requires people properly educated to understand the breadth and depth of joint and combined logistics across multiple levels of operation and across the full spectrum of conflict. Funding provides the purchase power to procure or obtain items. The programming, planning, and budgeting process affords staffs, military services, and combatant commands the opportunity to forecast and request funding to accomplish assigned roles and missions. Equipment provides the necessary tools of the logistics system. Primary equipment includes transport vehicles (air, land, and sea crafts) used for strategic and theater lift and information technology systems (communication, information, and computer systems) used to move voice, data, and other forms of information electronically. Test and support equipment covers a broad area of specialized gear used to ensure effective and economical support of primary equipment and to aid users in performing specific logistics tasks.[7] Materiel handling, dunnage, test equipment and tools, medical support, and food preparation are examples of different types of test and support equipment.

People, funding, and equipment require considerable management expertise. In the case of people, expertise may vary considerably among the military services or organizations. For example, airmen should know how to effectively deploy and redeploy expeditionary air forces. Sailors and marines should know how to provide logistics support at sea and over the shore. Soldiers should know how to move and support massive ground forces over land. Together, they should know the fundamentals associated with strategic and theater lift, port control, distribution

Organizations enable logistics activities through their structure and culture. Organizational structure is the systematic order or arrangement of operations and activities and their interrelationships with one another.

systems, war readiness, reserve materiel responsibilities, and host-nation support. This knowledge is necessary so logistics activities among the Services, DLA, USTRANSCOM, and combatant commands can be fully integrated into the planning and execution of military operations. In the area of funding, leaders need to make tough fiscal recommendations and decisions to balance efficiency with effectiveness within each of the Services, combatant commands, and other organizations. Though the methods vary, each military service must validate and prioritize needs to get the most from the taxpayers' dollars. This requires careful upfront planning and programming to help the decision maker exercise prudence in managing this limited resource. In the area of information systems, leaders must be able to fully exploit technology within the bounds of sensible returns to satisfy the needs of their organization's logistics activities. As with any resource, wise leaders can take full advantage of information technology if they develop the necessary skills to manage confidently and competently.[8] Specialized equipment requires the same degree of attention. Materiel-handling equipment, for example, must be considered in the planning process to ensure ports can handle the onload and offload of strategic- and theater-lift vehicles. Leaders should understand and use available resources to integrate the logistics activities of each military service, DLA, USTRANSCOM, and combatant commands across the full range of military operations to achieve desired combat effectiveness.

Organizations enable logistics activities through their structure and culture. Organizational structure is the systematic order or arrangement of operations and activities and their interrelationships with one another.[9] Since the staffs, military services, and combatant commands are responsible for their own organizational structure, it is important that leaders know what the structure is intended to achieve. Organizational structure defines division of labor, establishes hierarchy of order, specifies a system of control, identifies flow of information and communication, and provides continuity across generations of organizational change.[10]

Organizational culture refers to the pattern of shared basic assumptions that affect the way one perceives, thinks, and feels about the organization.[11] Understanding the culture of logistics activities within the staffs, military services, and combatant commands helps a leader anticipate and overcome cultural issues within the organizations. It also helps the leader identify differences among the organizations and pinpoint unwanted effects of resistance to change.

Collectively, organizational structure and culture are closely linked with authority and responsibility. If there is confusion about authority and responsibility, the organization is probably at fault.[12] Leaders must, therefore, be sensitive to the structural and cultural differences among the staffs, military services, and combatant commands. Because the logistics activities differ among these organizations, it is reasonable to expect the structure and culture of these organizations to differ as well. Understanding these differences helps the leader communicate and coordinate authority and responsibility more efficiently and effectively. They consume less time and energy trying to overcome perceived obstacles. In short, a thorough understanding of organizational structure and culture can lead to successful organizational integration.[13]

Infrastructure functions as an enabler of the logistics system through the use of real property and the industrial base. Real property includes such things as bases, posts, camps, stations, depots, office buildings, living quarters, distribution centers, aerial ports, and seaports. It also includes pavement, roadways, railways, pipelines, real estate, storage facilities, utility systems, and warehouses.

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An infrastructure is important for two reasons. First, logistics infrastructure consumes an enormous amount of resources. Inefficient, cumbersome, obsolete, or expensive infrastructure drains an organization of valuable and limited resources. Attention in this area can yield

Technology serves as an enabler of the logistics system by enhancing its capabilities. It involves advances in the systems and equipment used by the activities of logistics. Dedicating resources to examine and develop new technologies is a necessary investment.

substantial savings that could be used to pay for other things such as force modernization.[14] Second, infrastructure is critical to effectively mobilizing and sustaining operational forces. Moving personnel and equipment into an area of operation is only possible if sufficient aerial ports, seaports, roads, and rail networks are available to support the deployment, reception, staging, onward movement, integration, and sustainment of those forces.[15] Inadequate infrastructure to move forces into a theater of operation and sustain operational activities can seriously jeopardize a commander's ability to generate combat power. Careful up-front planning may help anticipate and overcome potential infrastructure shortfalls.

Technology serves as an enabler of the logistics system by enhancing its capabilities. It involves advances in the systems and equipment used by the activities of logistics. Dedicating resources to examine and develop new technologies is a necessary investment. Such investment can reap huge dividends by improving the efficiency and effectiveness of logistics processes. Ignoring technological advances can cause considerable inefficiencies by continuing to depend on increasingly obsolete equipment and by unnecessarily consuming limited resources.

Technology, when properly exploited, can serve as a force multiplier. For example, the technological advances in information systems have automated many logistics processes, including command and control, requisitioning processes and stock control functions. Such automation reduces lead time to produce an item, enhances intransit visibility through the distribution pipeline, and improves response time to get the item to the user. Education, integration, logistics footprint, and vulnerabilities are just a few areas to consider when examining new technologies for application to current logistics processes.[16] The real challenge is to determine how best to exploit new technologies within a theater of operation to herd and integrate the myriad of military service and organizational activities in a common direction to achieve mutual objectives.

Competencies. Competencies are the second core component of the Conversion Process. They are the processes, functions, and missions of logistics activities that produce the system's output products and capabilities. Competencies are listed in Table 1.[17] The nine major logistics processes are the overarching methods, practices, and procedures that generate and sustain combat power. These processes are accomplished by organizations with assigned functions and missions. Functions are the stovepiped logistics responsibilities of an organization. Eight functional responsibilities are included in Table 1. Within each organization, specific functional-related missions are assigned. Table 1 links the specific missions to functional responsibilities. These missions serve as the bridging mechanism that links the organization's function with the broader processes it supports.

The major processes of the logistics system are accomplished through organizational functions and their assigned missions. Some organizations have functional responsibilities and missions that directly support one or more of the logistics processes. These organizations include those assigned specific responsibilities in the functional areas of Supply, Maintenance and Salvage,

The major processes of the logistics system are accomplished through organizational functions and their assigned missions. Some organizations have functional responsibilities and missions that directly support one or more of the logistics processes. These organizations include those assigned specific responsibilities in the functional areas of supply, maintenance and salvage, transportation, civil engineering, and support.

Logistics Processes[i]	
Programming, Planning, Requisition, Procurement and Contracting, Distribution, Sustainment, Disposition (evacuation), Deployment, and Redeployment	
Organizational Functions and Missions[ii]	
Supply	Requisition, Receive, Store, Control, Issue
Maintenance and Salvage	Retain, Restore, Repair
Transportation	Strategic Lift, Deployment, Redeployment, Air/Sea Port Management
Civil Engineering	Facilities, Roads, Land, Utilities
Support	Program, Plan, Train, Educate
Health Services	Care, Treatment, Hospitalization, Evacuation, Medical Supplies, and Materiel
Other Services	Food, Exchange, Clothing, Laundry, Billeting, Finance, Religion, Postal, Personal Hygiene (toiletry/showers)
Mortuary Affairs	Search, Identify, Recover, Prepare, and Dispose of Remains

Table 1. Competencies of the Conversion Process

Regardless of the competencies and how they are defined, logistics activities from all supporting organizations must blend together in a theater of operation to provide the combatant commander with effective logistics support.

Transportation, Civil Engineering, and Support. Other organizational functions—such as Health Services, Other Services, and Mortuary Affairs—provide support in a less direct way. They provide services to the people that make up an organization regardless of its function, mission, or process. They have the weighty responsibility of ensuring all personnel (support and operational forces alike) remain physically, psychologically, and spiritually healthy, fit, and ready to accomplish their assigned task.

Competencies require careful consideration. Competencies vary between the Services, combatant commands, and other DoD organizations. Some functions or missions may not be required (or only minimally so) within a military service, command, or organization, while others may be grouped differently or defined differently to accommodate specialized needs. Regardless of the competencies and how they are defined, logistics activities from all supporting organizations must blend together in a theater of operation to provide the combatant commander with effective logistics support. Marrying these competencies together is one challenge of the leader. Leaders must work within the bounds of each military service and other logistics organizations to ensure logistics activities provide a smooth flow of forces and equipment to support operational requirements. This requires a viable communication system to allow requisitions to flow out and a responsive distribution system to ensure goods and services flow in. The competencies of the four military services, USTRANSCOM, and the Defense Logistics Agency need to work in concert with one another to make this happen. The leader acts as a conductor of sorts, integrating this complex group of activities to achieve the desires of the combatant commander.

Conditions. Conditions are the third core component of the Conversion Process. Conditions are the physical and ideological environments within which logistics activities operate. Physical conditions impose limitations on logistics that constrain operations; ideological conditions provide guidance and focus that enhance operations. Consideration of the physical environment helps the leader recognize, plan, and adapt to the restrictions the environment imposes on military operations. These conditions generate many concerns. For example, what climatic conditions exist that could hamper logistics operations? What effect will terrain—open seas, littorals, deserts, mountains, jungles, ravines, and urban areas—have on logistics support? Logistics activities must be able to operate effectively regardless of the physical environment. Thorough analysis of terrain, weather patterns, and climatic conditions and careful up-front planning will help minimize the constraining influence physical conditions can have on logistics support.

History, principles, and attributes are the components that make up the ideological environment of logistics. They are like guideposts that channel the energies of logistics along a particular path. They provide purpose and direction. They form the conscience of logistics by shaping the leader's thoughts as rules, policies, goals, and expectations are established for governing how logistics activities will operate.

Each component has an important role. History provides the leader with perspective and prevents the leader from having to reinvent the wheel by recognizing mistakes of the past and by pulling the best of the past forward to apply to the logistics processes of today and tomorrow. Historical literature covering the conduct of war or the execution of logistics provides nuggets of fundamental truths valid and relevant to problems faced in today's fast-paced techno-powered world. Likewise, archives of lessons learned from past campaigns offer yet another source of relevant information. Colonel Gene S. Bartlow put knowledge of history in proper context when he said, "Unless leaders grasp the events of the past, the difficulties of the present are distorted, and the successes of the future may be delayed indefinitely."[18]

Principles are the basic truths of military logistics hard learned from past experiences. They help sensitize the leader to potential problem areas or to those areas that require special attention. Principles are codified in doctrine. Joint Publication 1 (JP-1), *Joint Warfare of the Armed Forces of the United States*, defines military doctrine as "fundamental principles that guide the employment of

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Combatant commanders use conditions to establish logistics guidance. The combatant commanders will weave in the realities of the physical environment and knowledge gained from history, principles, and attributes with personal experiences to develop guidance for the logistics activities under their control.

forces." JP-1 states doctrine provides "authoritative guidance, based upon extant capabilities of the Armed Forces." "It incorporates time-tested principles for successful military action as well as contemporary lessons, which together guide aggressive exploitation of US advantages against adversary vulnerabilities." In short, "doctrine shapes the way the Armed Forces think about the use of the military instrument of national power."[19]

Attributes are the idealistic standards of logistics, usually derived from historical lessons or from sound logistics principles. The six attributes of logistics, as suggested in DoD logistics strategy and transformation documents and joint and military service vision documents, are responsiveness, cost-effectiveness, adaptability, survivability, interoperability, and feasibility.[20] Leaders can use them as aim points to plan and employ logistics forces.

Combatant commanders use conditions to establish logistics guidance. The combatant commanders will weave in the realities of the physical environment and knowledge gained from history, principles, and attributes with personal experiences to develop guidance for the logistics activities under their control. This guidance will serve as the basis for policy, regulations, and procedures produced by the joint officer or civilian equivalent. To do their job effectively, these leaders must be able to understand and relate to the logic of the combatant commander thereby ensuring the commander's guidance is properly communicated and followed.

Command. Command is the fourth core component of the Conversion Process. It is the critical unifying component of the logistics system because it "transforms war potential into combat power by its control and use of the logistic process."[21] All the components of the logistics system are tied together using the processes of command and control, the concepts of lines of authority and responsibility, and unity of command.

Command and control is the primary means the commander uses to exercise command authority. It is necessary for several reasons. First, it provides flexibility by responding to shifts in focus from among competing force operations or by adjusting to changes in mission. Second, it can oversee and manage logistics operations involving multiple logistics activities from the Services and other logistics staffs and organizations. Third, by virtue of being the nerve center for logistics, it is a vulnerability that invites attack by an enemy.[22] And fourth, it integrates and controls the activities of the logistics system by providing specific direction over the processes, functions, and missions of logistics activities; assessing risk; establishing priorities; monitoring and measuring efficiencies and effectiveness; and integrating, unifying, and balancing capability with requirements across the dimensions of time and space.

Command and control over logistics forces occurs within two military command lines of authority and responsibility.

Command and control over logistics forces occurs within two military command lines of authority and responsibility. Under the military service line, command and control runs along the chain of command from the Secretary of Defense through the Service secretaries and major commands to operational units. Their focus is, among other things, to organize, train, and equip forces for use by combatant commands.[23] Along the combatant command line, the chain of command runs from the Secretary of Defense through the combatant commander to combat units. The focus of this command relationship is to prescribe and establish force structure to conduct military operations.[24] Together, the intent of these command relationships is to establish clear but separate lines of authority and responsibility for command and control of forces in *preparation* for military operations (military services) and command and control of forces to *perform* military operations (combatant commands). The logistics commander operates within both lines of authority and responsibility. During peacetime, the commanders and their forces generally fall under the Services for daily operations. During contingency or war, the logistics commander may be tasked to generate and sustain combat capability for a combatant command to accomplish its assigned operational mission.

Closely linked with lines of authority and responsibility is the concept of unity of command. Unity of command (and the related concept of unity of effort) is central to

Evaluating performance of logistics activities is another critical area to monitor. The commander must know whether logistics activities are providing effective support to operational forces.

effective control of logistics activities. Unity of command means all forces operate under a single commander with the necessary authority to direct all forces employed in pursuit of a common purpose.[25] Its goal is to ensure unity of effort under one responsible commander. Unity of effort—coordination through cooperation and common interests—is an essential complement to unity of command. It requires coordination and cooperation among all forces toward a commonly recognized objective.[26]

Effective command of logistics forces requires the commander to exercise proper control and authority of forces. Successful commanders thoroughly understand their command and control system and how to exploit it, the source and responsibilities of their authority and how to exercise it, and the concept of unity of command and how to observe it.

The leader plays an important role by ensuring processes are in place that enable the commander to exercise authority. Clear and direct methods for communications must exist to ensure the commander's intent and directions are conveyed. This is especially important when crossing military service lines where differences in culture and a lack of a common frame of reference can inhibit effective communication and coordination. Evaluating performance of logistics activities is another critical area that must be monitored. The commander must know whether logistics activities are providing effective support to operational forces. Consumption of materiel and expendables, port throughput, monitoring chokepoints, weapon-system readiness, customer wait times, and pipeline asset visibility are examples of areas that may require special attention. Assessing risk to balance limited resources against operational needs is another area of crucial importance. The leader's challenge is to ensure thorough and objective assessments of problem areas. This must be done in a timely manner to produce recommendations that point toward achieving desired combat effectiveness. Likewise, the leader must ensure a process exists to effectively assess, establish, and communicate priorities when demand exceeds available supply. Finally, the leader has a responsibility to think ahead for the commander, anticipating potential problem areas before they occur. To sum up, the leader must understand the processes and concepts used by command to provide the commander timely, objective, relevant, and feasible recommendations that maximize logistics support for the warfighter.

Explanation of Levels of Operation

The second major part of the Conversion Process is its levels of operation. Figure 3 shows the three operational levels. All activities of the Conversion Process occur at one of these levels. Core components work together within each level of operation and along the logistics pipeline to channel logistics support to operational forces. Logistics activities combine the core components of enablers, competencies, conditions, and command at each operational level, producing competencies that generate products and capabilities. These activities are then employed in different ways at the national, theater, and unit levels of operation to satisfy requirements levied on the system. A brief description of each level of operation is presented along with a discussion on seams—joints between each level that can inhibit the smooth flow of items across logistics support activities.

Logistics activities combine the core components of enablers, competencies, conditions, and command at each operational level, producing competencies that generate products and capabilities.

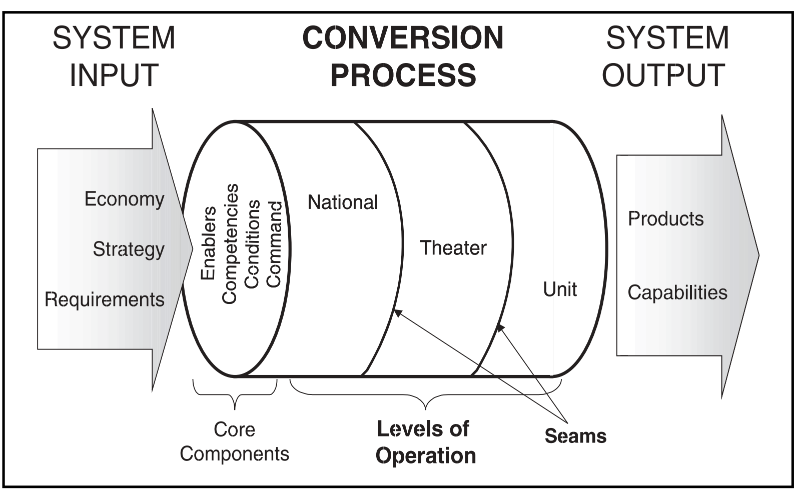

Figure 3. Conversion Process Levels of Operation

The senior logistician on the Joint Staff is the Director for Logistics (JCS/J4). The Director for Logistics, a military officer of three-star rank, serves as the principal advisor to the Chairman of the Joint Chiefs of Staff.

National-level Logistics. National-level logistics are those DoD and joint logistics activities outside the scope and control of the Services and combatant commands. National-level logistics involves the creation and support of defense logistics through organization, planning, execution, and supervision. Its purpose is to prescribe policy and procedures for the conduct of subordinate logistics activities. This is done through development of strategy, doctrine, and directives; by establishment and review of plans, programs, and budgets; and through the administration and oversight of strategic logistics processes. National-level logistics activities are found within the Office of the Secretary of Defense, management levels of the Joint Staff, Services, Defense Logistics Agency, and USTRANSCOM.

As a civilian political appointee, the Deputy Under Secretary of Defense for Logistics and Materiel Readiness serves as the principal staff assistant and advisor on the DoD's logistics and materiel-readiness activities to the Secretary of Defense; Deputy Secretary of Defense; and Under Secretary of Defense for Acquisition, Technology, and Logistics. As the principal logistics official within the senior management of the Department of Defense, the Under Secretary works with other deputy under secretaries within the Acquisition, Technology, and Logistics secretariat, prescribing policies and procedures for the conduct of logistics, maintenance, materiel readiness, and sustainment support.[27]

The senior logistician on the Joint Staff is the Director for Logistics (JCS/J4). The Director for Logistics, a military officer of three-star rank, serves as the principal advisor to the Chairman of the Joint Chiefs of Staff. The director's primary role is to provide strategic logistics integration by ensuring the logistics policies and plans of the Services and combatant commands are adequate. Through the staff, the director also assesses the logistics impact of proposed and ongoing security assistance programs on logistics readiness of active and reserve component forces.[28]

Each of the military service headquarters includes a senior logistician and staff. Usually a military officer of three-star rank is responsible to the Service's Chief of Staff (or equivalent) for logistics policy, planning, programming, budgeting, management, staff supervision, evaluation, and oversight. Within each military service, staffs work to align resources within programs and establish policy, ensuring continuous design, development, integration, and compliance of logistics activities to meet force requirements.[29]

The Defense Logistics Agency is a national-level logistics organization under the Office of the Secretary of Defense. The DLA Director, a military officer of three-star rank, reports to the Under Secretary of Defense for Acquisition, Technology, and Logistics through the Deputy Under Secretary of Defense (Logistics and Materiel Readiness). Through the director, the Defense Logistics Agency is charged with providing effective and efficient worldwide logistics support to the Services and combatant commands, other DoD components, federal agencies, foreign governments, and international organizations.[30] This vast organization operates both at home and abroad to supply nearly every common-use, consumable item needed to support operational forces.

USTRANSCOM is a unified command with a pure logistics role.

USTRANSCOM is a unified command with a pure logistics role. Its senior logistician is the Deputy Commander in Chief, a military officer of three-star rank. The command's primary role is to provide air, land, and sea transportation for the Department of Defense, both in peacetime and wartime.[31] The air component of USTRANSCOM is the Air Mobility Command (AMC). AMC is the single manager for air mobility with a mission of providing airlift, air refueling, special air missions, and aeromedical evacuation.. The land component is the Military Traffic Management Command. Its mission is to provide global surface transportation and traffic management to meet national security objectives. The sea component is the Military Sealift Command. Its mission is to provide ocean transportation of equipment, fuel, supplies, and ammunition.[32]

The senior logistics leaders within these organizations serve on the Joint Logistics Board and the Defense Logistics Executive Board, coordinating improvement

Theater-level logistics involves the planning and execution of logistics operations to support military forces in a particular geographic location. Its purpose is to apply logistics resources to generate, support, and sustain theater combat power.

efforts within DoD logistics. They provide a more unified long-term focus for the DoD logistics community. Their primary focus is to advance the Secretary of Defense's initiative on logistics transformation and the Chairman's Joint Vision initiative on Focused Logistics.[33]

Understanding responsibilities of logistics organizations at the national level will help leaders unite and integrate national-level logistics operations with theater-level logistics activities. For example, at the national-level, the leader may be responsible for recommending allocation of limited strategic lift assets to support a theater of operation. At the theater level, the leader may recommend adjustments to the time-phased force deployment list during the planning process to prioritize when forces enter the theater of operation. In either case, the leader will need to assist with coordination and integration of national-level logistics activities into military service logistics activities to ensure the combatant commander receives responsive, quality support.

Theater-level Logistics. Theater-level logistics involves the planning and execution of logistics operations to support military forces in a particular geographic location. Its purpose is to apply logistics resources to generate, support, and sustain theater combat power. Application of combat power rests with the combatant commands. Though each of the Services provides logistics resources, combatant commanders must ensure that the overall plan for using these resources supports their specific theater needs.[34] Combatant commanders do this through the Theater Logistics System. Collectively, this system plans for and receives military forces and logistics support items and distributes them to operational or support units via a distribution pipeline.

The distribution pipeline is a channel through which the Department of Defense conducts distribution operations. In its larger context, the pipeline is a complex assemblage of integrated national- and theater-level activities that provide materiel, resources, information, and communication to front-line operational forces.[35] The pipeline consists of two major parts. The first part, the strategic side of the distribution pipeline, consists of the national-level logistics providers—the Services, Defense Logistics Agency, and USTRANSCOM. The Defense Logistics Agency provides common-use items to the combatant command. USTRANSCOM provides the strategic-lift vehicles and facilities necessary to move forces and equipment from point of origin outside the theater of operation to air, land, and sea ports of debarkation within the theater of operation.

The second part of the pipeline consists of elements of the Theater Logistics System that extend from the port of debarkation to operational and support areas within theater.[36] The combatant commander has responsibility for planning and execution of the second part of the distribution pipeline. The commander does this using the combatant command's J-4 (or equivalent) staff; a logistics readiness center; a group of joint logistics offices, boards, and centers; and military service component commands.

Each of these activities has specific responsibilities in support of theater logistics operations. The combatant command's J-4 staff has responsibilities for developing logistics plans and coordinating and supervising logistics activities. They ensure military service logistics activities are properly integrated with the commander's concept of logistics support. The logistics readiness center serves as the hub of all joint logistics operations. It works with each of the Services to plan, monitor, and coordinate logistics activities; direct and coordinate logistics support for future operations; and advise the combatant commander on the supportability of proposed operations. The combatant commander may also use such activities as joint logistics offices, boards, or centers to centrally manage critical assets and react more effectively to unexpected situations. These offices, boards, or centers have as their objective the support of joint operations while attempting to achieve efficient support operations. Finally, the military service component commands implement, execute, and control their own administrative and functional logistics activities. Unless otherwise provided, each military service is responsible for its own logistics support.[37]

Keeping the products of the logistics system flowing through the distribution pipeline is of prime importance.

Keeping the products of the logistics system flowing through the distribution pipeline is of prime importance. To do this, leaders can ensure the processes each military service uses to request and fill necessary logistics support items exist in a way that provides efficient and effective combat support.

Unit-level logistics are activities located in the United States and within a theater of operation that provide logistics support or combat-service support directly to operational forces. Logistics support forces directly support combat forces during home-station or garrison operations.

To do this, leaders can ensure the processes each military service uses to request and fill necessary logistics support items exist in a way that provides efficient and effective combat support. For example, they must coordinate among theater- and national-level logistics activities to deconflict as well as prioritize limited strategic-lift assets, optimizing availability when moving forces into and out of theater. They must ensure forces flowing in and out of a theater do not overtax the capacity of airports, railheads, and seaports. They must ensure port capabilities are maximized to efficiently offload and store incoming forces and materiel and to move those forces and materiel into the intratheater distribution pipeline. Finally, they must work with the host nation to maximize use of the nation's economy and infrastructure for such things as intratheater transportation, fuel, food, lodging, and security services. The effort of these leaders should be to focus on integrating common logistics activities and to complement Service-specific logistics that generate and sustain combat forces.

Unit-level Logistics. Unit-level logistics are activities located in the United States and within a theater of operation that provide logistics support or combat-service support directly to operational forces. Logistics support forces directly support combat forces during home-station or garrison operations. During peacetime, these activities fall under the authority of their respective Services. They are typically assigned to or embedded in an Air Force wing, Army or Marine Corps brigade, or Navy battle group. Their task is to support their Service's Title 10 responsibilities of organizing, training, and equipping forces in preparation for combat. Logistics support forces take on the role of combat-service support forces during contingencies or during war. Their mission changes from *preparing* for combat to *supporting* combat. They fall under the authority of a combatant command and provide the necessary front-line capabilities and activities to generate and sustain combat forces within that theater of operation.

Other logistics support activities exist at the unit-level as well. Military service depots, research and development organizations, and academic institutions are examples. Each supports the logistics activities of its respective Service but typically is not assigned to a combatant command.

At this level, the leader focuses primarily on military service-specific issues. They are concerned about issues such as locating and erecting facilities and support bases and establishing stockpiles of materiel, expendables (fuel, food, water, ammunition, and hardware), and equipment (spares, test and support equipment) to sustain a fighting force. They are also concerned with providing important quality-of-life services such as food, lodging, medical, postal, finance, laundry, and religious activities. To maximize support to operational forces, these leaders must ensure lines of communication remain open to communicate requirements up the chain of command to theater level and ensure forces and materiel at their disposal are used frugally and wisely.

Seams are the major transfer or handoff activities in the movement of forces, equipment, and materiel from point of origin to point of use.

Seams Between Levels of Operations. The diagram of the Conversion Process Levels of Operation in Figure 3 shows seams between each of the levels of operation. Seams are the major transfer or handoff activities in the movement of forces, equipment, and materiel from point of origin to point of use. Seams can inhibit the smooth flow of forces or can work so smoothly that operations appear seamless. Responsibility for these seams varies depending on their location. Typically, USTRANSCOM, as a national-level logistics activity, has responsibility for moving forces from originating locations to ports of embarkation or staging areas outside a theater of operation to ports of debarkation within a theater of operation. At this point, theater-level logistics activities take over responsibility for moving forces from ports of debarkation to assembly areas or directly to final destinations. Unit-level logistics activities assume responsibility for moving forces from assembly areas to the point of use.

Seams can be a nemesis at any of these handoff points if improperly managed. History is replete with examples where forces were delayed at the seams because the transfer activities were mismanaged or lacked sufficient capability or capacity. Transfer activities at ports, staging areas, and assembly areas are potential seams requiring special attention.

Another way to express the concept of seams is to think about a logistics distribution network. At each location, materiel must travel through a conduit that gets

Products of the logistics system are the goods and services that satisfy the requests and needs of operational forces.

Materiel	All items (including ships, tanks, self-propelled weapons, and aircraft and related spares, repair parts, and support equipment) necessary to equip, operate, maintain, and support military activities.
Services	Activities that enhance quality of life—food, lodging, medical, postal, finance, laundry, and religious activities.
Facilities	Real property consisting of buildings, structures, utility systems, pavement, and underlying land.
Equipment	All nonexpendable items needed to outfit or equip an individual or organization.
Expendables	Supplies that are consumed in use, such as ammunition, fuel, water, food, surgical dressings, drugs, and medicines or those that lose their identity, such as spare parts.

Table 2. Products of the DoD Logistics System

progressively smaller. At the large end is the nation's economy that can mass produce items to fill military needs. This conduit feeds a smaller strategic-lift conduit to move items into a theater of operation. As they enter the theater, items are transferred to even smaller conduits to move them to their final destinations. For example, Meals Ready to Eat arrive from suppliers en mass, are distributed via strategic lift to continental United States and worldwide storage locations, and distributed to the end user using theater-lift and local transportation systems. At each transfer point, a handoff occurs that can cause potential delays if not accomplished in a smooth and efficient manner. Leaders must be sensitive to these potential problem spots, especially in the planning process, to ensure sufficient capability and capacity to keep forces, materiel, and equipment flowing smoothly from source of supply to point of use.

System Output

The output of the DoD logistics system, as shown in Figure 4, is its products and capabilities. Products of the logistics system are the goods and services that satisfy the requests and needs of operational forces. The five product categories are listed and defined in Table 2.

When satisfying the end user's requests for logistics support, the delivery of a requested product is but one of four conditions that should exist to satisfy the user's need. Other conditions include consideration for time, location, and quality. The end users may not be fully satisfied unless a product is delivered on time; at the right location; and in the right quantity, quality, and cost. Capabilities of the logistics system satisfy these considerations.

The capabilities of the logistics system are its ability to adapt and respond effectively to a user's need across the full range of military operations. A user's need is generally satisfied when all four conditions are met. How well the system as a whole is integrated from end to end to provide efficient and effective support to the end user dictates how well the system will respond to these conditions. The enablers, competencies, conditions, and command elements of the logistics system work in concert with one another at the national, theater, and unit levels to provide a balanced, integrated, and responsive system that generates and sustains combat power for operational forces. Together, these products and capabilities make up the logistics system's output.

A relationship exists between the logistics system's output and the operational forces' input that the commander and logistician should thoroughly understand. The logistics system's responsive and adaptable output of logistics products (materiel, services,

A relationship exists between the logistics system's output and the operational forces' input that the commander and logistician should thoroughly understand.

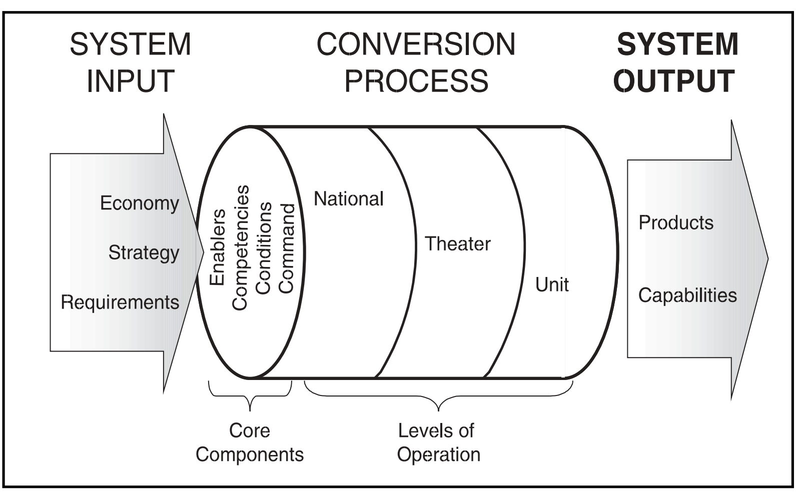

Figure 4. System Output

Altogether, effective logistics support ensures the combat arm of the military possesses the necessary means to conduct military operations.

facilities, equipment, and expendables) serves as the basic resource operational forces use to produce combat capability. The logistics system provides the necessary resources that enable operational forces to generate and sustain combat power. Altogether, effective logistics support ensures the combat arm of the military possesses the necessary means to conduct military operations.

Using the Framework

> *The success of the commander does not arise from following rules or models. It consists in an absolute new comprehension of the dominant facts of the situation at the time and all the forces at work . . . .*
>
> —Winston Churchill

An example may be helpful to illustrate how the framework is used. Suppose a joint task force (JTF) is being established to conduct military operations on an island in the Pacific. The JTF commander has directed that the director of logistics (JTF/J4) provide a briefing on the logistics concept of operation supporting the task force's mission of providing peacekeeping operations following a period of civil unrest.

How can the framework of the DoD logistics system help the JTF/J4 think through this task? It provides a perspective to help focus thought and a way of thinking about the essential elements that empower a logistics system and the organizational hierarchy that uses those elements to generate and sustain combat capability. Knowing what the essential elements are and how they fit together provides context and perspective that helps the user cognitively categorize the activities of logistics and retain their particular function.

The JTF/J4 and staff may start the task by reviewing the commander's guidance, military logistics doctrine, logistics principles, and historical lessons learned. These items offer important information that can guide the thought process as the JTF/J4 develops a logistics concept of operation. Next, to gauge scope and size of the operation, the JTF/J4 may want to consider the geography, topography, climate, weather patterns, port availability, and transportation network that exist in and around the island. The framework referred to these two sets of items as

Doctrinal guidance also suggests the JTF/J4 should focus on command and control.

c*onditions*. In the case of the former, it stressed the importance of recognizing their effect on providing focus and guidance on the logistics system; in the case of the latter, it stressed their influence on imposing limitations and constraints on logistics support.

Armed with this knowledge, the JTF/J4 may proceed by following doctrinal guidance to steer the development of a logistics concept of operation. Doctrinal guidance suggests the JTF/J4 should concentrate on issues associated with logistics planning, force deployment, employment and sustainment, and force redeployment activities. The framework's discussion on *competencies* sheds light on the importance of understanding these major processes and how they and their associated functions and missions produce the logistics system's products and capabilities for the combat forces.

According to doctrinal guidance, the JTF/J4 should consider key enablers such as resources, organization, and facilities. The logistics concept of operation should acknowledge resource issues such as force configuration and availability, equipment accessibility and readiness, and related funding issues dealing, for example, with host-nation support. Organizational considerations to identify the most effective theater logistics support structure should also be considered, as should facilities availability, condition, and throughput capacity. The framework's exposition on *enablers* sheds light on these issues and their effect on the logistics system.

Doctrinal guidance also suggests the JTF/J4 should focus on command and control. Questions that should be addressed include what command and control capabilities exist; what are the command and control requirements; and will the designated command relationship provide for unity of command? The framework's section on *command* discusses these issues and others, reminding the JTF/J4 and staff that command is the critical unifying component that transforms war potential into combat power.

The JTF/J4 will also want to know whom the theater-level staff needs to coordinate with among the national-level logistics providers (Defense Logistics Agency and USTRANSCOM) and among the Services to integrate the flow of logistics products and capabilities into the theater

The framework provides context and perspective to help the reader analyze logistics more critically. The reader can delve into logistics issues with confidence, and their basic understanding of logistics is sufficient to help them ask more pertinent questions that target particular areas of interest.

of operation. This flow of logistics support and sustainment items must move smoothly and efficiently from point of origin through the ports of debarkation, through the ports of embarkation, and to the final destination at the unit level of operation. The framework offered discussions on *levels of operation,* familiarizing the JTF/J4 with their roles and responsibilities. The framework also contained a discussion on the likely *seams* between each level of operation that can inhibit the smooth flow of forces and equipment.

This brief illustration points out that the framework's real value is not in its direct applicability to the user; rather, its value is appreciated in its indirect use as an educational tool to help the user better understand the essential elements that make up a military logistics system. From this, the user's broader understanding of military logistics can result in meaningful insights that influence planning and facilitate more informed decision making.

Providing Meaningful Insight

The framework provides context and perspective to help the reader analyze logistics more critically. The reader can delve into logistics issues with confidence, and their basic understanding of logistics is sufficient to help them ask more pertinent questions that target particular areas of interest. Their working knowledge of logistics may now be adequate enough to allow them to focus more intently on the issue at hand without spending unnecessary time and effort trying to comprehend the logistics circumstances that surround the issue. In short, they are better prepared to discern issues more quickly and more accurately. A tool that provides broader perspective leads one to be more astute about targeting the important issues. Meaningful insights may influence planning and lead to better decision-making opportunities.

Influence on Planning

The framework may be useful in the area of war planning. An *Airpower Journal* article published 14 years ago sheds light on this subject. In his article, "The Operator-Logistician Disconnect," Colonel Gene S. Bartlow argued that it is important for commanders and logisticians to understand that logistics is a critical element of the operational art of war. He said that logistics is possibly the least understood part of war planning. According to Bartlow, operational commanders do not understand the role of logistics in war because they do not fully understand how logistics affects operations. For both the commander and the logistician, understanding the role of logistics helps the commander to factor logistics realism into plans and concepts.[38] To do this, Bartlow believed war planners (commanders and logisticians alike) must understand the difference between *what* to think (training) and *how* to think (education) as they plan logistics support for operational forces.[39] Doctrine and experience serves as a tool that can govern *what* to think regarding logistics; the framework of the DoD logistics system serves as a tool that can govern *how* to think about logistics.

The framework helps the reader think about the role logistics plays in supporting military operations. It shows that logistics provides the means to generate and sustain operational forces.

The framework helps the reader think about the role logistics plays in supporting military operations. It shows that logistics provides the means to generate and sustain operational forces. The framework can clarify thought regarding the relationship between logistics, strategy, and tactics by enforcing the notion that strategic and tactical planning is incomplete without incorporating logistics considerations as the means to employ operational forces. The framework is an instrument for changed thinking by offering a tool that simplifies and organizes the DoD logistics system in a way that makes the system and its purpose easier to grasp. The tool enlightens by helping the reader think about the essential elements of DoD logistics activities. Describing the fundamental elements of the logistics system may help the reader realize that the resources of people, equipment, and funding not only enables the system but also limits it. Grasping the reality of limited resources provides the reader a better perspective with which to plan.

As a consequence, the reader is better able to assess if plans are logistically feasible. The framework helps the reader link the means with ends by describing the system's output products and capabilities that serve as the means that enable the generation and sustainment of combat power. The system's output of materiel, services, facilities, equipment, and expendables, coupled with the system's

"The commander's strategic and tactical plans depend on his logistics capabilities; all three must be modified in accordance with a single, integrated intellectual process—the mind of command."

ability to adapt and respond effectively across the full range of military operations, provides the warfighter the means needed to execute an operational plan of action. The framework's description of how these products and capabilities are produced and delivered to operational forces can provide a healthier awareness for the scope, difficulty of effort, and limitations that may hinder desired results. One can then reason whether a plan is logistically feasible by considering how resource limitations may affect outcome.

The basic dilemma the planner faces, as noted by Rear Admiral Henry Eccles in *Logistics in the National Defense,* is how to achieve the maximum overall combat effectiveness within the limitations imposed by resources.[40] Better awareness of logistics limitations helps the planner and commander balance means with ends. The framework provides the planner a perspective that shows how finite resources restrict strategic and tactical planning. This perspective helps the commander better assess how to use available resources to achieve the desired planning goals and objectives. Eccles ties it together when he states, "The commander's strategic and tactical plans depend on his logistics capabilities; all three must be modified in accordance with a single, integrated intellectual process—the mind of command."[41]

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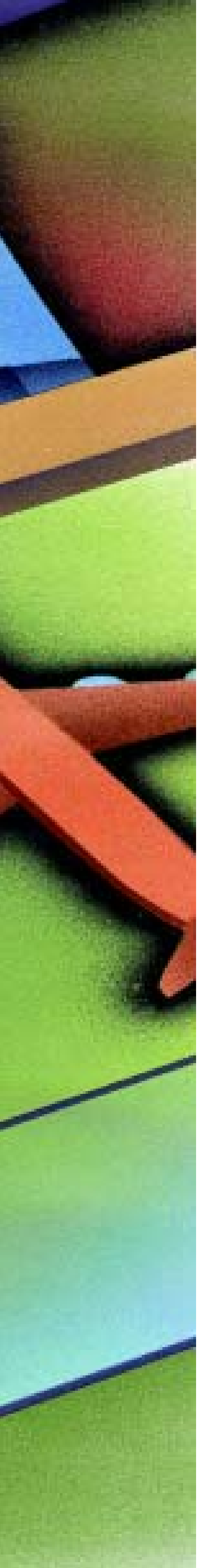


Any changes to transportation policies must take into account inventory costs and operational performance impacts.

Premium Transportation

an analysis of Air Force Usage

A 6-day increase in the order and ship time of all reparables—as a result of using *slow* transportation—would result in a $96M increase in inventory requirements.

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

Introduction

Air Force supply policies are closely linked to the use of premium transportation. The logic for these policies is based on the classic tradeoff between inventory investment and transportation cost. In general, Air Force inventory policies are sensitive to transportation or pipeline times because inventory costs tend to be relatively high and transportation costs low. It is almost always more economical to invest in rapid transportation than to procure inventory.

In December 2001, the Strategic Distribution Management Initiative (SDMI) Board of Directors raised two issues concerning Air Force use of premium transportation: (1) not using or examining the use of SDMI transportation channels and (2) frequent use of premium transportation from air logistics centers.[1]

It is important to note an apparent disconnect in the use of the terms *premium* and *fast* transportation. The Air Force supply community generally uses the term *premium* to indicate a desired velocity of movement (fast); however, the Air Force transportation community often interprets *premium* as a modal requirement (overnight air).

Regardless, the SDMI Board of Directors believes the Air Force uses premium transportation too often.

Three objectives underpin the examination of the issues raised by the SDMI Board of Directors:

- Identify policies driving the use of premium transportation.
- Validate shipping data presented by SDMI.
- Identify and evaluate transportation alternatives for overseas (Worldwide Express [WWX] versus SDMI) and continental United States (CONUS) shipments.

Analysis

Each of the supply policies driving the use of premium transportation was examined. Current Air Force policy calls for all reparable (XD) items to move via premium transportation. The expensive nature of reparable items and the need for rapid return of unserviceable assets to the depot led to this policy. While not all reparable shipments need to be moved via premium transportation, the lack of asset visibility and knowledge of a real-time asset position require they be moved via premium transportation.

Current Air Force policy calls for all reparable (XD) items to move via premium transportation. The expensive nature of reparable items and the need for rapid return of unserviceable assets to the depot led to this policy.

During the analysis, a necessary activity was to bound the perceived problems associated with premium transportation use by estimating the amount of money that could be saved if all Air Force-managed items were moved using a cheaper mode of transportation instead of using premium, commercial transportation.

The first step in establishing the bounds was to estimate the saving for individual packages. Given the time constraints levied for the analysis, a table of savings was constructed for a few packages (described by weight) moving on a selected route for each theater. The CONUS rates are not route-dependent; therefore, no set routes for the CONUS were included. The route used for the European theater was from CONUS to Aviano Air Base, Italy. The route used for the Pacific theater was from CONUS to Kadena Air Base, Japan. The numbers in the CONUS column of Table 1 are the cost differences (savings) between FedEx 2-day and FedEx ground for each weight category. For the European Command and Pacific Command columns, the numbers are the differences between the average of the three WWX carrier rates and

Weights	CONUS	EUCOM	PACOM
10 lbs	$4.75	$18.19	$17.47
20 lbs	$10.97	$29.12	$27.94
30 lbs	$17.93	$43.52	$39.31
40 lbs	$24.85	$50.03	$44.55
50 lbs	$32.17	$56.95	$54.95

Table 1. Transportation Savings for Individual Shipments

the sum of both FedEx ground-to-seaport-of-embarkation and Military Sealift Command final destination rates. The packages analyzed and the savings estimated are shown in Table 1.

The next step was to estimate the distribution of shipments by weight. RAND provided the Air Force Logistics Management Agency (AFLMA) data on Air Force shipments moved during fiscal year (FY) 2001, including shipment weight. To estimate the weight distribution of Air Force-managed items, all shipments not originating from an Air Force depot were filtered out. Every shipment was then put into one of the five weight categories shown in Table 1. Any shipment weighing from 0 and 10 pounds was put into the 10-pound category, from 10 to 20 pounds into the 20-pound category, and so on. The percentage of shipments for each category, by theater, is shown in Table 2.

Next, using readiness-based leveling data, the total number of shipments was determined for Air Force-managed items to the various theaters during FY01 (Table 3).

Weights	CONUS %	EUCOM %	PACOM %
10 lbs	56	59	57
20 lbs	13	13	13
30 lbs	7	8	7
40 lbs	4	4	4
50 lbs	20	16	19

Table 2. Number of Air Force Shipments by Weight Category/Theater

Transportation velocity significantly impacts inventory requirements. As a result, any changes to the transportation system or transportation policies must take into account inventory costs and operational performance impacts.

	CONUS #	EUCOM #	PACOM #
Items Moved	996,500	77,142	99,132

Table 3. Number of Shipments Moved

Finally, to estimate the upper bound on the total savings if all Air Force-managed items were shipped via routine vice premium, commercial transportation, the following assumptions were made:

- All items shown in Table 3 were moved using premium transportation. This caused an overstatement of transportation savings since commercial express carriers do not handle shipments heavier than 150 pounds.
- All the items were moved as individual shipments. This also overstated the transportation savings because the data often showed the quantity of the items shipped was greater than one. Furthermore, commercial carriers charge less to ship one 50-pound package than fifty 1-pound packages.

The transportation savings for all shipments weighing from 0 to 10 pounds were approximated using the savings for a 10-pound shipment and so on. This overstated the transportation savings because very few shipments weighed exactly 10 pounds. The majority weighed less than 10 pounds, and the savings for a 5-pound shipment was less than for a 10-pound shipment.

The savings for all shipments weighing from 50 to 150 pounds were understated because each shipment in this category weighed more than 50 pounds and the cost for a 50-pound shipment was used.

Given these assumptions, to estimate an upper bound on transportation savings, the number of shipments moved in a theater was multiplied (Table 3) by the percentage of those shipments weighing a certain number of pounds (Table 2). That number was then multiplied by the savings per shipment for that type item (Table 1). The final results are shown in Table 4. For FY01, the maximum potential transportation savings for using routine transportation in lieu of premium transportation were $17.5M.

Transportation velocity significantly impacts inventory requirements. As a result, any changes to the transportation system or transportation policies must take into account inventory costs and operational performance impacts. Air Force supply levels are very sensitive to transportation time. In fact, inventory levels are determined using an established transportation time performance level maintained in the Standard Base Supply System (SBSS) database. This performance level is input into inventory computations in the form of order and ship time (O&ST). O&ST is the average time from submission of a requisition for an item until receipt of that item for each source of supply location. Clearly, a decision to change the transportation system that affects O&ST will have an effect on inventory levels and operational performance.

For consumable items, the SBSS distinguishes items according to a desired transportation velocity. Items are flagged to indicate a desire for fast *transportation or to indicate that* slow *transportation is acceptable. The terms* fast *and* slow *convey a desired velocity.*

Consumables

For consumable items, the SBSS distinguishes items according to a desired transportation velocity. Items are flagged to indicate a desire for *fast* transportation or to indicate that *slow* transportation is acceptable. The terms *fast* and *slow* convey a desired velocity. One could interpret *fast* to be Transportation Priority 1 or 2 and *slow* to be Transportation Priority 3. However, they are not designed to dictate a transportation mode. The modal decision is made by the transportation organization responsible for the shipment in response to the supply priority and required delivery date. The SBSS uses an algorithm to determine what level of inventory would be held using fast transportation and what level would be held using slow

Savings	CONUS	EUCOM	PACOM
10 lbs	$2,671,388	$830,742	$983,152
20 lbs	$1,472,625	$289,908	$378,241
30 lbs	$1,253,320	$258,088	$307,798
40 lbs	$1,009,647	$154,728	$180,010
50 lbs	$6,096,640	$711,699	$959,000
Totals	$12,503,620	$ 2,245,165	$2,808,201
Max Transportation Savings		**$17,556,986**	

Table 4. Transportation Savings Upper Bound Standard Base Supply System Order and Ship Time

For reparable items, the SBSS codes all items for fast transportation. Using information developed during the analysis of consumables, using slow transportation for all reparable items would result in a 6-day increase in O&ST.

transportation. This algorithm makes an economic tradeoff between the transportation velocities. If it is economically beneficial to hold less inventory, then the system flags an item for fast transportation. Otherwise, the item is flagged for slow transportation. The flagging in SBSS was used to determine the difference in O&ST for items coded to move fast and those coded to move slowly. The average worldwide fast O&ST for consumable items was 6 days faster than the average worldwide slow OST.

Reparables

For reparable items, the SBSS codes all items for fast transportation. Using information developed during the analysis of consumables, using slow transportation for all reparable items would result in a 6-day increase in O&ST. Raising reparable item O&ST by 6 days in the Aircraft Availability Model, the Air Force spares requirement computation model, resulted in an increase of $96M to the spares requirement. Therefore, expending $17M, at most, in fast transportation would eliminate the need for an additional $96M in Air Force inventory. This conclusion makes no statement as to what mode of transportation is fast and what mode is slow. It only indicates the decision to use fast transportation appears to be a wise one.

Consumable items are also shipped via premium transportation. However, the analysis did not focus on these items since few consumable items are Air Force-managed. Also, a continuous economic analysis is used to determine when to use premium transportation for consumable items.

RAND Shipment Data

Data provided by RAND to the SDMI Board of Directors were reviewed. Figure 1 was developed by RAND, while Figures 2 through 7 were developed by AFLMA using RAND data.

These data showed the Air Force used premium transportation for 75 percent of its shipments from air logistic centers. However, issues from air logistic centers represented only 3 percent of all shipments from Department of Defense (DoD) depots (Army, Navy, Air Force, and Defense Logistics Agency [DLA]) (Figure 1).

An examination of the movement of Air Force-managed items overseas during calendar year 2000 (CY00) by transportation control number (TCN) or total number of shipments showed that 90 percent of the TCNs moved via premium transportation while 9 percent moved via military airlift. Note that Commercial Air Lines of Communication, used mostly by the Army, moves palletized cargo via commercial aircraft. Military Air Lines of Communication is a similar system used primarily by the Army, except it uses military channel airlift instead of commercial aircraft (Figure 2).

By weight, 45 percent of all Air Force-managed items moved via premium transportation, while 55 percent were moved via military airlift (Figure 3).

The data for shipments of DLA-managed items to Air Force customers overseas during CY00 were also examined. By TCN or total number of shipments, 89 percent moved via premium transportation, while 11 percent moved via military airlift (Figure 4).

Examination of the data based on total weight showed 27 percent of the weight moved via premium transportation, while 73 percent moved via military airlift (Figure 5).

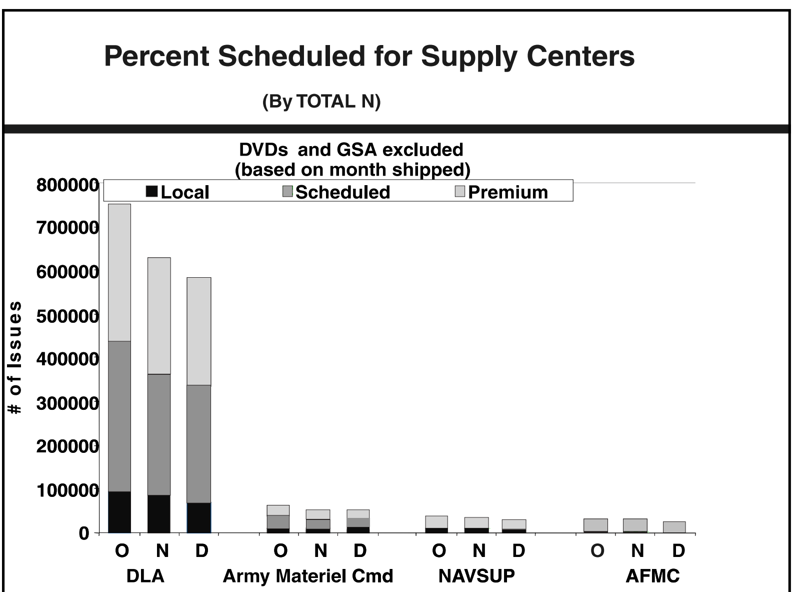


Figure 1. Revised RAND Chart—Movement by Number of Issues

Overall, shipments of Air Force-managed items represented a very small portion of the items shipped by the Services and DLA. Also, even though the majority of overseas shipments of both Air Force-managed items and DLA-managed items for Air Force customers were moved via premium air, the majority of the weight moved via military airlift. The weight numbers are a better measure of what was shipped because rates are determined by weight, not by application of a flat rate per shipment.

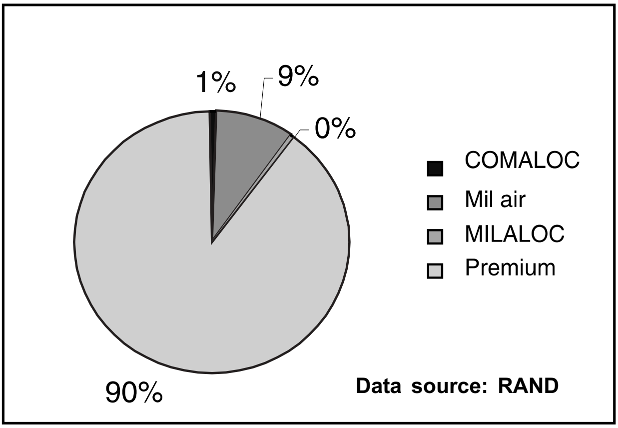


Figure 2. Overseas Movement of Air Force-Managed Items by TCN in CY00

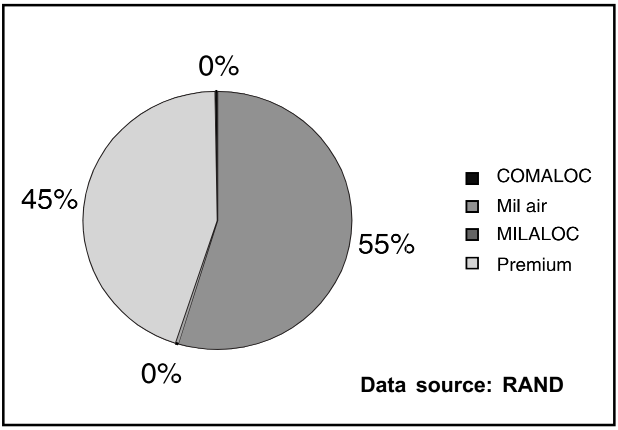


Figure 3. Overseas Movement of Air Force-Managed Items by Weight in CY00

WWX Versus SDMI

WWX was compared to the SDMI channel system to determine the better value. To do this, 892 WWX October 2001 shipments from air logistic centers to Ramstein and Spangdahlem Air Bases in Germany were examined. The analysis showed the volume of shipments was not conducive to movement via military airlift.

The average daily total weight shipped from an air logistics center to a base was 72.23 pounds. There was an

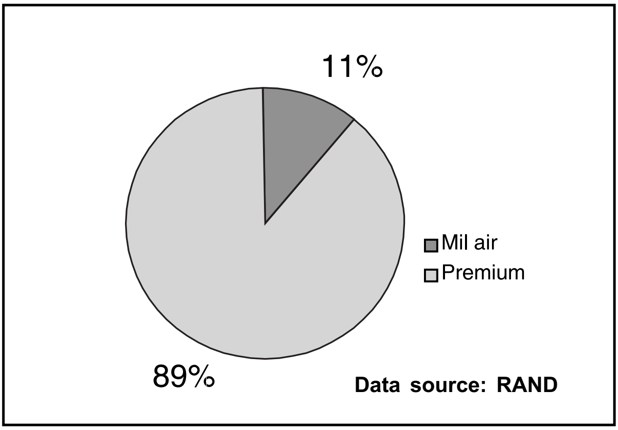


Figure 4. Overseas Movement of DLA-Managed Items to Air Force Customers by TCN in CY00

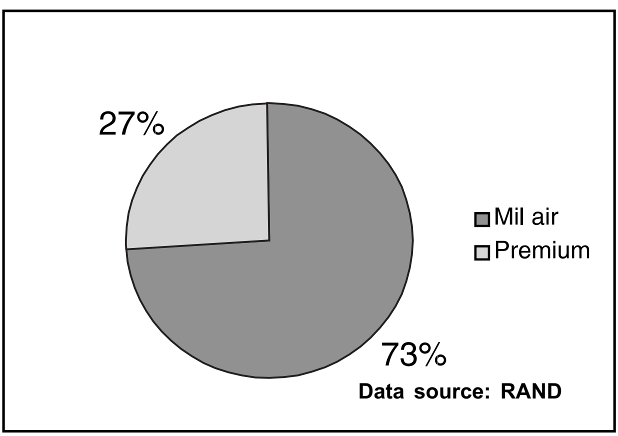


Figure 5. Overseas Movement of DLA-Managed Items to Air Force Customers by Weight in CY00

average of 4.56 shipments per day from an air logistics center to a base of 4.56.

From a cost perspective, WWX is a better choice than SDMI, except for shipments of 13 pounds or less or 2,200 pounds or greater. The WWX per-pound rate was calculated by dividing the rates for each weight from 1 to 150 pounds ($18,851.76) by the sum of the weights from 1 to 150 pounds (11,325 pounds), which equals $1.66 per pound. The Air Mobility Command (AMC) rate (they charge by the pound) is the rate charged to SDMI customers for transportation from the shipment's origin to its destination, not just between the aerial ports. It has a different per-pound rate for five different weight ranges: 0-439 pounds, 440-1,099 pounds, 1,100-2,199 pounds, 2,200-3,599 pounds, and 3,600 pounds or greater (Figure 6).

WWX carriers charge a rate for each weight from 1 to 150 pounds. The average of the rates between the three WWX carriers was compared to what AMC charges for shipments from 1 to 150 pounds. For shipments of 1 to 13 pounds, the AMC rates would be less expensive than the average of the three WWX carriers' rates. However, the average of the WWX carriers would be less expensive than AMC rates for shipments weighing 14-150 pounds. Overall, AMC would be less expensive than WWX if shipments were consolidated into loads of 2,200 pounds or greater (Figure 7).

The WWX process is more conducive to moving small shipments than is SDMI: simply package the shipment and give it to the carrier. SDMI requires consolidation into palletized loads, then movement to the aerial port of embarkation.

Overall, for WWX-eligible shipments (shipments weighing 150 pounds or less), the process and volume of shipments from air logistics centers to Ramstein and Spangdahlem favored using WWX over SDMI.

Concepts for the Future

Following discussions with RAND, they advocated the Air Force consider using alternative means of transportation *that would not degrade service or negatively impact readiness*. There are opportunities to evaluate alternative means of transportation (for example, scheduled truck routes) within the CONUS. Also, RAND suggested that the Air Force reposition some assets to DLA depots where it makes the best sense to do so. The Air Force Directorate of Logistics Readiness and AFLMA are considering several alternatives to improve the customer and supplier relationship with DLA. The Air Force Stockage Policy

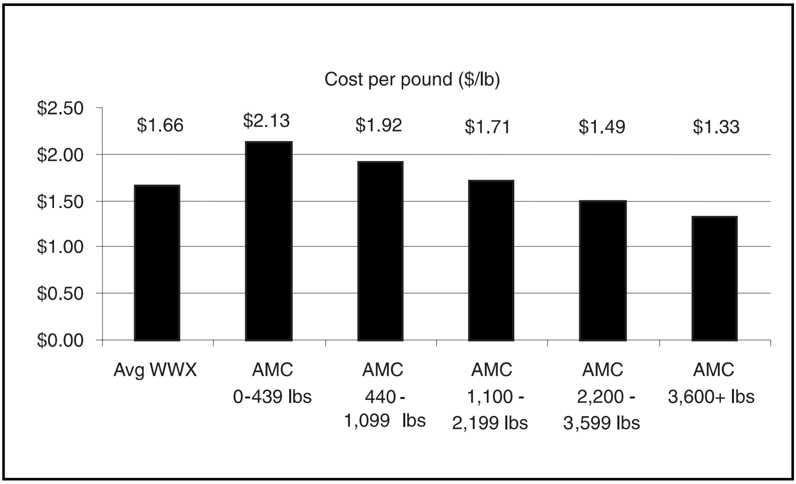


Figure 6. Cost per Pound for WWX and SDMI/AMC Shipments

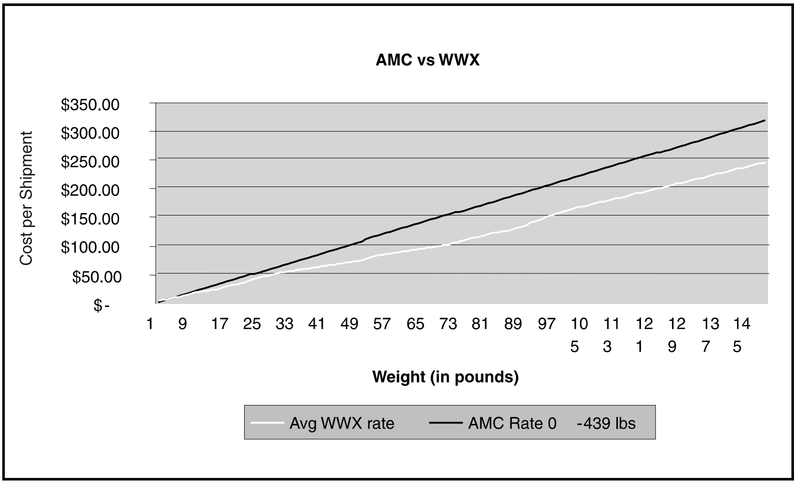


Figure 7. Cost per Shipment Between AMC 0-439 Pound Rate and Average of WWX Carriers' Rates for Shipments 0-150 Pounds

Using premium transportation is still a wise, economical decision for the Air Force. For WWX-eligible shipments, the Air Force should continue to use WWX to and from overseas locations.

Working Group is currently considering several alternatives, which include regional stockage policies and repositioning of assets.

Conclusions

Using premium transportation is still a wise, economical decision for the Air Force. For WWX-eligible shipments, the Air Force should continue to use WWX to and from overseas locations.

Opportunities, such as scheduled truck routes, may exist for using alternatives to premium transportation in the CONUS and should be assessed.

Recommendations

The Air Force should continue to be engaged with SDMI. AFLMA should be tasked to study SDMI and RAND proposals for applicability and benefit to the Air Force by evaluating alternatives to premium transportation in the CONUS and evaluating repositioning wholesale stock where it makes sense to do so.

Notes

1. SDMI was established to better streamline DoD distribution and logistics and is a joint venture of the US Transportation Command and DLA.

Shaping Logistics—Just-in-Time Logistics

Geostrategic, economic, and technological changes will make support of air operations, both at home and overseas, increasingly dependent on the flexibility and responsiveness of the military logistic organization. This requires the creation of a highly integrated and agile support chain with global reach. The most promising strategy to achieve these aims is based on a joint management approach, teaming the public and private sectors, under long-term partnering arrangements. While it is probable that organic military maintenance capabilities will be retained, particularly to address life-extension and fleet-upgrade requirements, the alliance partners will largely determine the size and shape of the military logistic organization as part of their wider responsibilities for shaping the overall support chain. Success will be measured by a reduction in inventories, faster turn-round times, more rapid modification embodiment, swifter deployment of new technologies, a smaller expeditionary footprint, lower support costs, and greater operational output.

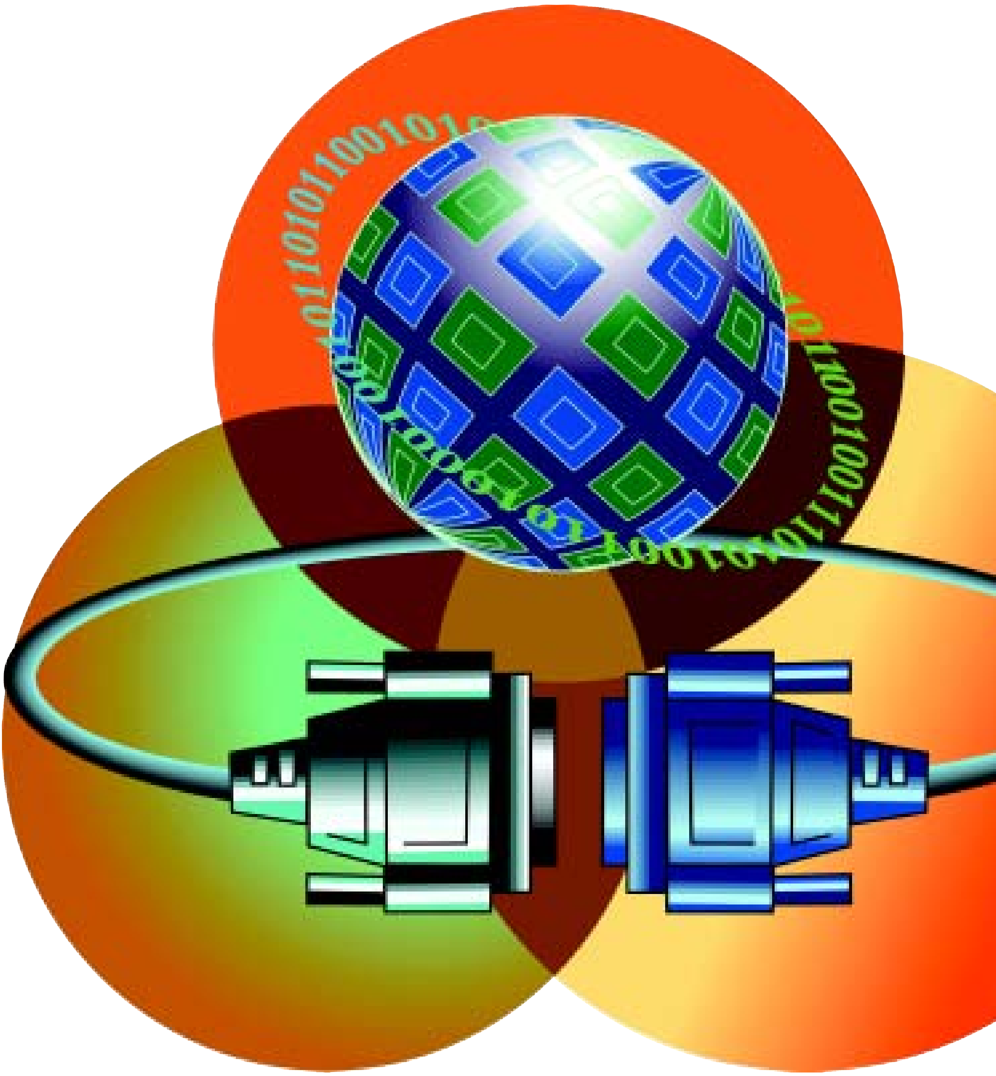
This strategy requires more, however, than the application of just-in-time principles. It embraces commercial express transportation; innovative contracting arrangements including spares-inclusive packages; the application of commercial information technology solutions to support materiel planning and inventory management; collective decision making involving all stake-holders; an overriding emphasis on operational output; and most important, a high level of trust between all the parties. These changes may well result in smaller organic military repair facilities and the greater use of contractors at all maintenance levels, including overseas. Most important, it will require the military aviation maintenance organization to move away from an internal focus on efficiency and utilization to a holistic approach that puts customer needs, in the form of operational output, first and foremost.

As with any new strategy, there are risks. The fundamental building block in determining a successful partnership with industry is *trust*. As one commentator has observed, "Trust is the currency that makes the supply chain work. If it's not there, the supply chain falls apart."[1] As support chains are more closely integrated and maintenance strategies are better aligned, the more vulnerable is the logistic organization to the impact of inappropriate behaviour. In the past, the risk might have been minimized and resilience enhanced by providing duplicate or alternative in-house capabilities backed up by large inventories. This is neither affordable nor compatible with today's operational needs. In the future, therefore, the main safeguard will be the creation of an environment in which government and industry, both primes and subcontractors, can function coherently, effectively, and harmoniously.

Notes

1. *AW&ST*, 13 Sep 99, 75-82.

Air Commodore Peter J. Dye, RAF



Imagine you are fresh out of high school and start work at a fast-food chain as a clerk processing food orders. The job description states that you will learn how to efficiently operate the computer system that processes customer transactions and provide a consolidated report that shows a complete accounting of all customer transactions at the end of the day. The job description also reads that you will spend 90 percent of your time processing orders at the walk-in counter and 10 percent of your time working the drive-through window. After 2 months on the job, you have become an expert at using the computer system at the walk-in counter. The very next day, you are asked to work the drive-through window for a day. You think, "No problem, I have the system down; what's the big deal about a little change in location?" Once you arrive at your station near the window, you realize the computer system at the drive-through window is totally different from the computer system at the walk-in counter. After 2 hours of pulling your hair out and several inaccurate transactions, you ask the manager to please explain how to use the different system. So the worst is over. Not quite, at the end of the day, you sit down to begin accounting for all the customer transactions, and you print a report from one of the computers to get a transaction list to match up with the money collected. However,

CMOS and GATES

Integration Action Planning

Captain John W. Winkler
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Captain Scott M. Cornette
Master Sergeant Joel Doran

you find that you must print a report from both the drive-through computer and the walk-in computer since the two systems work off different databases. Finally, to provide the consolidated report, you must manually input transactions from one system into the other, as this is the only way to provide a consolidated report of all the transactions.

CMOS and GATES Integration Action Planning

While this scenario seems almost unbelievable, the Air Force also uses two different systems to manage routine or day-to-day cargo shipments and process cargo and passengers during Air Force contingencies. These two systems are the Global Air Transportation and Execution System (GATES) and the Cargo Movement Operations System (CMOS). GATES is the Air Mobility Command (AMC) corporate system providing the air-transportation portion of passenger and cargo intransit visibility to the Global Transportation Network. CMOS is the Air Force day-to-day surface cargo movement system and serves as its passenger and cargo-movement system during contingencies. GATES is used primarily by air-transportation personnel (2T2XX), day to day, to manage cargo and passengers that travel through the airlift system. CMOS is used, day to day, by traffic management personnel (2T0XX) to initiate or terminate cargo in the Defense Transportation System. CMOS contingency usage, a separate module from day-to-day use of CMOS, is used by transportation squadrons, combat readiness, resources flights, and in some cases, aerial port squadrons at AMC bases. At most bases, air-transportation personnel are the primary deployment module users of CMOS.

Background

Unlike our fast food computer-system problem above, GATES and CMOS electronically pass day-to-day cargo data between systems, effectively minimizing manual input to maintain visibility of the data. However, during Air Force contingencies, GATES and CMOS passenger data do not flow. Thus, to maintain intransit visibility of passengers traveling through the Defense Transportation System, manual input of passenger data is necessary to maintain intransit visibility over passengers. This is much like the fast-food clerk having to manually input data from one system to the other to obtain a consolidated report of all transactions. To compound this issue, many of our air-transportation people, roughly 80 percent of which are assigned to AMC, are faced with learning two systems. GATES is used for routine cargo and passenger movement, since GATES serves as the AMC corporate system for cargo and passenger movement, and CMOS infrequently

GATES and CMOS electronically pass day-to-day cargo data between systems, effectively minimizing manual input to maintain visibility of the data. However, during Air Force contingencies, GATES and CMOS passenger data do not flow.

for Air Force contingency cargo and passenger movement. Just as with the fast-food clerk in the example, many air transporters at AMC bases use GATES about 90 percent of the time for day-to-day passenger and cargo movement and CMOS about 10 percent of the time for contingency cargo and passenger movement. The impact for many of our air-transportation people is that they train day to day on one system (GATES) and use a separate system (CMOS) during Air Force contingencies.

The Department of Defense has labored extensively over the last several years to eliminate unnecessary duplication among logistics information systems. An October 1993 memorandum signed by Secretary of Defense William Perry highlights this effort:

> My May 7, 1993, memorandum reiterated the full commitment of the Department of Defense to the '…improvements, efficiencies, and productivity that are the essence of CIM.' The focus of Corporate Information Management (CIM) on functional process improvement, migration systems, and data standardization has my full support.

In parallel with the CIM effort, in November 2000, the Air Force Logistics Management Agency (AFLMA) Transportation Division was asked by the Air Force Directorate of Transportation to evaluate the integration potential of GATES and CMOS.

Specifically, AFLMA was asked to study the following objectives:

- Determine differences and similarities between GATES and CMOS. To make this determination, AFLMA looked at the systems strictly from a functional standpoint. Using current source documents from the both program management offices, a functional point analysis was created that provided a broad look at the functions of both systems.
- Determine the appropriate uses for each system at base level. The focus was to determine whether the systems performed the necessary functions day to day and during contingencies to effectively accomplish the mission. To properly evaluate this objective, select bases were visited and personal interviews were

Feedback clearly indicated that, for day-to-day use, GATES and CMOS are appropriate and perform required functions. However, feedback also pointed out the limitations of using one system for routine use and another for contingencies.

conducted with system experts to obtain firsthand feedback on appropriate uses.

- The ultimate objective of the study was to evaluate system functions and determine the ability to merge the two systems. The functional point analysis and feedback from the field were used to determine the ability to merge the systems.

Analysis

After a thorough review of the functional point analysis by system experts, coupled with conference calls to gain agreement on the degree of similarity between the systems, it was identified that 153 of 290 functions were similar, with 53-percent overall similarity between GATES and CMOS. This was not surprising since both systems support a similar mission—routine cargo movement. Overall, air and surface cargo-processing functions represented 30 percent of system functions. However, GATES is also a day-to-day passenger movement system, whereas CMOS is not. The functional point analysis showed that GATES performs many passenger functions that CMOS does not. System administration, resource management, and decision support functions, which support daily operations and provide advance planning capabilities, showed great similarity between the two systems. A particular concern was the dissimilarity in systems communication, which points toward a lack of system integration and use of exchange technology. Lack of exchange technology between GATES and CMOS to flow contingency passenger data has resulted in the need for manual data input. A complete list of functional headings used in the analysis and the level of similarity between systems within each heading is provided in Table 1.

Feedback clearly indicated that, for day-to-day use, GATES and CMOS are appropriate and perform required functions. However, feedback also pointed out the limitations of using one system for routine use and another for contingencies. The most frequent complaint from the field was, “We don’t train like we fight.” As stated earlier, most CMOS contingency users and air-transportation people use a separate system (GATES) day to day. This presents a significant training problem for air transporters since they use CMOS only for Air Force contingencies, usually once or twice a quarter. Training proficiency on just one system is demanding and on two, even more so. This situation is exacerbated since the CMOS deployment module is not taught in either 2T2 or 2T0 three-level technical training courses; training is left to the individual bases.

CMOS and GATES Integration Action Planning

In addition to the problems associated with air-transportation personnel learning two separate systems during Air Force contingencies, lack of electronic data interchange between GATES and CMOS presents a significant problem during contingency operations. Exchange technology enables the direct transmission of data from one system to another. Since contingency passenger data do not electronically flow from CMOS to GATES, they must be manually entered from one system to another. The manual input of data is necessary because CMOS manages the data from home station. Once the mission arrives in the AMC en route or transiting locations and the aerial port of debarkation, GATES manages the data. Since current business processes have contingency data managed by two systems, electronic flow of data is

Lack of electronic data interchange between GATES and CMOS presents a significant problem during contingency operations.

FPA Headings	Percentage Similarities
System Administration	88
Surface Cargo Processing	53
Air Cargo Processing	83
Automated Identification Technology	86
Deployment Management	25
Passenger Processing	19
Resource Management	50
Decision Support	65
System Communication	23
World Wide Web	23
Mission Status	0
Overall System Similarity	53

Figure 1. Similarity Between Systems

Based on the great level of similarity, albeit at a general level, 53 percent between GATES and CMOS and unequivocal support for a single cargo and passenger movement system, the preliminary recommendation demonstrated the need for greater data integration.

necessary to alleviate extensive manual input of data to maintain intransit visibility.

Based on the great level of similarity, albeit at a general level, 53 percent between GATES and CMOS and unequivocal support for a single cargo and passenger movement system, the preliminary recommendation demonstrated the need for greater data integration. It was recommended to accomplish this by leveraging exchange technology to integrate data as if GATES and CMOS were a single system. In addition, a recommendation was made to ensure coordination between the program management offices and contractors developing future builds of GATES and CMOS. Last, a recommendation was made to include the Air Force deployment system in technical school training.

The Air Force Transportation Directorate and the AMC Directorate of Operations cosponsored a follow-on study to the original GATES and CMOS that asked the AFLMA to develop an integrated action plan.

Action Plan Analysis

The analysis to develop the action plan consisted of the following:

- Categorization of each action item (Policy and Procedures, Data Sharing, and Management)
  - Title or short description of the problem
  - Parties responsible for implementing each action item or the office of primary responsibility (OPR) and office of coordinating responsibility (OCR)
- Priority of each action item (high, medium, and low)
- Timeframe to implement (near < 2 years; mid 2-4 years; long > 4 years)
- Comments or real-world examples of the problem
- Preliminary solutions

Scope

Phase one of the study completed examination of the current distribution process, identified shortfalls throughout the distribution process, and provided monthly progress reports. Phase two would build on phase one's analysis to create the action plan to integrate CMOS and GATES.

Analysis Results

To examine and define the general distribution process for CMOS and GATES, experts assigned to the study developed a general distribution map to explain the process.

The team was asked to identify problem areas or action items preventing integration of CMOS and GATES. Action items were developed in accordance with the Air Force Installations and Logistics Information Systems Strategic Architecture Plan.

Explanation of the General Distribution Process

At a general level, both systems, whether in a day-to-day or contingency scenario, flow transportation data through the same key points in the distribution process. The key points are origin or home station, port of embarkation, en route, and port of debarkation. Through each point in the process, similar functions are performed at a general level. The functions include generation of an advanced transportation control and movement document (ATCMD); receipt for cargo from base supply, unit, or shipper; in check of data into the system (establishes visibility in the system); decision on mode of transport; creation of the appropriate transportation documentation (air manifest for air or bill of lading for surface movement); and onward movement.

Action Items

The team was asked to identify problem areas or action items preventing integration of CMOS and GATES. Action items were developed in accordance with the Air Force Installations and Logistics Information Systems Strategic Architecture Plan. Overall, there were nine high-priority action items, with six in *Policy and Procedures* and three in *Data Sharing and Management*. There were nine medium-priority action items, five in *Data Sharing and Management*, three in *Policy and Procedures*, and one in *User Interfaces*. Finally, there were two low-priority action items, both in *Data Sharing and Management*.

The action items were organized by category, with the high-priority *Policy and Procedures* action items listed first, followed by the highest priority *Data Sharing and Management* action items. The medium-priority action items were organized in the same way as the high-priority action items. Only a brief description of each medium- and low-priority action item will be given.

High-Priority Action Items: Policy and Procedures

Intertheater Intransit Visibility Policy

Priority: High 2

Description of Problem: lack of definitive Air Force policy guidance that establishes ITV at all sites.

Timeframe to Implement: Near

Example: The real-world example was provided by Major Ed Yates, 436th Aerial Port Squadron (APS) operations officer. The Dover AFB, Delaware, aerial port puts a piece of cargo on a C-17 destined for Haiti, but Brown and Root, the contractor receipting for cargo at Haiti, has no way to receipt for cargo electronically. CAFI 24-201 states "CMOS provides intransit visibility data to GTN." AFI 10-403 states that GATES may be used only if CMOS is not available. This policy does not reflect current business processes that require both CMOS and GATES to manage ITV data throughout the transportation distribution process. Policy should articulate use of both the electronic manifest interface and diskette to eliminate manual processing procedures.

No Receipt Policy for ITV for Deployments and Redeployments

Priority: High 2

Description of Problem: Lack of definitive Air Force policy to receipt for cargo in either system for deployments and redeployments.

Timeframe to Implement: Near

Example: The real-world example comes from Exercise Bright Star where there was confusion over which system to use at the deployed location to receipt for cargo. In other words, policy does not clearly articulate which system to use at a particular location to maintain ITV. At the port of debarkation, there may be more than one system or no system at all to receipt for data, leading to confusion and a lack of closure to provide the warfighter with ITV.

ATCMDs Directly to GATES

Priority: High 4 (*Policy and Procedures* and *Data Sharing and Management*)

Description of Problem: Inefficient ATCMD processes impact advanced modal decision making.
Timeframe to Implement: Near
Example: The Theater Distribution and Management Cell (TDMC) at Ramstein Air Base, Germany, needs advance data to make timely and accurate modal. The TDMC is set up to make timely and accurate advance modal decisions to move cargo via air or surface efficiently. If data can be provided from CMOS and GATES in a more timely fashion, the TDMC could more efficiently gather information needed to make decisions. The team has formulated two ways to proceed with this policy. Option one is to articulate clearly in policy that the aerial port, upon receiving the ATCMD, will use the data for planning purposes only. There is no intention to bypass the airlift clearance authority (ACA), only to provide advance data in a more timely fashion to the aerial port. Option two places the ACA responsibility at the aerial port. However, this is a much more costly approach. Funding would be needed to ensure the proper up-front data edit checks were in place prior to the port receiving ACA responsibility.

ITV Update for Passengers After Origin (Home Station)

Priority: High 5
Description of Problem: Disconnect between AMC instruction to remanifest passengers and use of electronic interface for remanifesting.
Timeframe to Implement: Near
Example: If CMOS is used to generate the initial ITV feed during Air Force contingencies, the last ITV feed received from CMOS, most of the time, is from home-station origination. This occurs because GATES is used at the AMC en route and, in many cases, at the port of debarkation to receipt electronically for cargo and passenger manifests. Air Force policy does not direct the exchange of data between the two systems. Furthermore, through AMC Instruction (AMCI) 24-101*,* ITV is gained by receipting for the *bumped* passenger and in-checking manually and lifting in GATES. Gaining ITV over a *bumped* passenger with this procedure could take hours or days, depending on when the next mission is scheduled

to depart. By directing policy to electronically receipt for passengers, warfighters would receive timely updates over their resources.

One caveat to the team's policy recommendation is that the means to exchange data electronically from CMOS to GATES does not currently exist. The electronic passenger interface is scheduled for completion in the first quarter 2003. However, both systems can receive the manpower (MANPER) disk electronically. MANPER is the personnel source system that can feed CMOS or GATES with passenger information during Air Force contingencies. AMCI policy reflects the concern of delaying missions with manually remanifesting of passengers into the system for ITV. With this policy recommendation, there is no intent for transportation personnel to input data manually to remanifest passengers. Policy should articulate use of both the electronic manifest interface and diskette to eliminate manual procedures.

ITV Update for Cargo After Origin (Home Station)

Priority: High 6
Description of Problem: Disconnect between AMCI policy to remanifest cargo and use of electronic interface for remanifesting cargo.
Timeframe to Implement: Near
Example: This action item mirrors priority H5, with one exception: capability exists for CMOS-to-GATES electronic manifesting of cargo. However, AMCI 24-101 for cargo, as for passengers, does not direct electronic remanifesting. If the original manifest was generated in CMOS, there is only a manual annotation of the change (for example, bumped cargo) made on the manifest. According to AMCI 24-101, receipting for the *bumped* cargo and in-checking it manually, then sending it electronically in GATES, achieves ITV. However, gaining ITV over *bumped* cargo with this procedure could take hours or days depending on when the next mission is scheduled to depart. If the data are not electronically remanifested from CMOS to GATES, there are delays in ITV. For example, when a C-5 arrives with a CMOS manifest at an AMC en route location and the cargo is to be dispersed intratheater via C-130s, all the manifest data should

electronically feed the GATES database for ease of remanifesting, but this does not always occur. As identified in the *Data Sharing and Management* action items, there have been problems with manifesting cargo electronically between the systems (for example, data latency). AMCI policy reflects the concern of delaying missions with manually remanifesting of cargo into the system for ITV.

As with priority H5, the intent of this policy recommendation is not for transportation personnel to manually input data to remanifest cargo for maintaining ITV. Policy should articulate use of both the electronic manifest interface and diskette to eliminate manual procedures.

Training Deficiencies

Priority: High 7
Description of Problem: Training on separate systems results in a lack of proficiency.
Timeframe to Implement: Near
Example: Air transportation personnel (2T2XX), 80 percent of whom are assigned to AMC, primarily use GATES on a day-to-day basis to accomplish the mission. However, in accordance with policy they use CMOS for Air Force deployments. Essentially, most 2T2XX personnel use one system, day-to-day (GATES), and another for Air Force contingencies (CMOS). Training for proficiency on just one system is demanding and on two, even more so. The lack of proficiency causes manual input errors that lead to a loss of ITV.

Policy should enable either system to be used to maintain ITV over transportation resources efficiently. Furthermore, the team agreed that deployment personnel should use the same system day-to-day as they use during Air Force contingencies.

High-Priority Action Items: Data Sharing and Management

Data Latency

Priority: High 3
Description of Problem: Ineffective movement of cargo data between CMOS (air/ground) and GATES.

Timeframe to Implement: Near
Example: The real-world example was provided by Major Ed Yates, 436 APS operations officer. During an aerospace expeditionary force test, Dover AFB served as a hub-and-spoke operation with multiple C-17s aggregating to place cargo on a C-5 for onward movement. The C-17s arrived with cargo manifested in CMOS; however, due to data latency issues (communication delays from host base), the data did not arrive in time to populate Dover's CMOS database electronically. To ensure on-time mission execution, the information was entered into GATES manually. The 436 APS uses GATES on a day-to-day basis.

The *Data Sharing and Management* issue the team identified to resolve this problem is to ensure that up-front data edit checks are in place for the data to flow efficiently between the two systems.

Efficient Data Exchange

Priority: High 8/9
Description of Problem: GATES and CMOS do not send all manifest information to down line locations.
Timeframe to Implement: Near
Example: The team identified two alternatives to ensure manifests are sent to the appropriate down-line locations. Option one is to look at the capability of the two systems sending all manifest data to respective systems. The second option is for CMOS and GATES to use the same data reference tables to ensure a standard format for sending data. CMOS users must enter a Department of Defense Account Activity Code (DODAAC) for the AMC location, flag that DODACC as a GATES location, and press a *send to GATES* button to send data to GATES electronically. GATES then converts the DODAAC into the associated aerial port code (APC) to send to the appropriate down-line location. Instead of flagging DODAAC or APC codes, both systems could pick out a standard and embedded data element from a common data reference table and transmit the data to the appropriate location.

Medium-Priority Items: Policy and Procedures

Lack of GATES/CMOS Program Management Office (PMO) Cross-Coordination

Priority: Medium 3
Description of Problem: Lack of PMO coordination results in out-of-sync systems development.
Timeframe to Implement: Near
Example: There is no passenger interface capability (electronic or diskette) between systems. GATES will be able to send and receive passenger manifests from CMOS in the next release of GATES (2.06) in June 2002. However, CMOS will not be able to send and receive passenger manifests from GATES until early 2003. The team's preliminary recommendation is for members of the CMOS PMO to attend GATES development board meetings and vice versa. This type of coordination can ensure requirements from one PMO are not out-of-sync or counter to the other's. Furthermore, clear coordination guidelines should be written into any interface agreements already established between the systems.

Manual Data Entry and Effects on Intransit Visibility

Priority: Medium 6
Description of Problem: Policy does not address automated data exchange.
Timeframe to Implement: Midterm
Example: The Air Force needs to establish clear policy that reflects automated data exchange and eliminates the need to input data manually more than once anywhere throughout the Defense Transportation System. Manual input of data is time-consuming and can cause mission delays. In addition, manual input can result in loss of intransit visibility due to data-entry errors.

Provide Intransit Visibility Feed Through Each Segment of the Distribution Process

Priority: Medium 8

Description of Problem: During Air Force contingencies, using CMOS and GATES to manage data, there is little or no capability to provide the warfighter with mission arrival times throughout the distribution process.

Timeframe to Implement: Midterm

Example: Data generated in CMOS is, in many cases, the last intransit visibility feed the warfighter receives on the manifest because GATES is used at AMC en route locations and, in many cases, at ports of debarkation to receipt for data electronically. Air Force policy does not direct the exchange of data between the two systems, and AMCI does not direct remanifesting intransit missions to gain intransit visibility. This action item would provide the warfighter with mission arrival times throughout the distribution process.

Medium-Priority Items: Data Sharing and Management

Command and Control (C2) of Deployment Data

Priority: Medium 1

Description of Problem: CMOS does not interface with C2 systems, causing mission monitoring and advanced mission-planning problems.

Timeframe to Implement: Midterm

Example: During Air Force deployments, personnel in the deployment process using CMOS receive inbound arrival data (for example, load planning data) manually (for example, fax, e-mail, and phone). Automated inbound arrival data through tie-ins to C2 systems (GDSS II) would facilitate mission planning through timely and accurate receipt of C2 data feeds, eliminate the need to search for advance arrival data manually, and give deployment personnel more time to prepare cargo and passengers for deployment. The team provided cost estimates for CMOS to receive feeds from the GDSS II.

Problem Identification and Resolution

Priority: Medium 2

Description of Problem: Currently, there is little coordination between PMOs working trouble ticket issues that affect both systems.
Timeframe to Implement: Near
Example: System problem affecting CMOS can also affect GATES, specifically with data exchange issues between the two systems. Problems are worked in isolation, causing rework for PMOs of both systems. Preliminary recommendations focus on flagging transactions containing keywords *CMOS* or *GATES* that would automatically forward the problem to both systems for a collaborative solution. Both the GATES and CMOS use the same trouble ticket system (REMEDY).

Common Data Outputs

Priority: Medium 4
Description of Problem: Lack of common data reference tables and data edit procedures result in failed transactions.
Timeframe to Implement: Midterm
Example: Because CMOS and GATES use different data reference tables, they can prevent data from being integrated seamlessly to perform post-movement processes. If standard data reference tables were used, transactions could flow seamlessly for post-movement processes such as billing.

Common Processes Need to Have Common Input Methods

Description of Problem: Use of separate systems with different data entry and query methods causes data entry errors.
Priority: Medium 5
Timeframe to Implement: Midterm
Example: The team determined there is value in trying to eliminate differences in some of the more common data entry and query methods but little value in trying to eliminate every different data entry or query method. A common data-entry example would be use of wild cards to search for transportation data within the CMOS or GATES database.

Efficient Data Exchange

Priority: Medium 9

Description of Problem: No passenger interface between CMOS and GATES.
Timeframe to Implement: Near
Example: This requirement would have been designated a high-priority item if funding and development had not already taken place. Electronic passenger-manifest capability will be resident in GATES with release 2.06 (June 2002) and in CMOS 6.1 (January 2003). This capability is of vital importance in eliminating manual duplication and maintaining intransit visibility over passengers. It is also important from the standpoint that policy, both Air Force and AMC, clearly articulate the need for electronic exchange and the electronic remanifesting of passengers throughout the distribution process.

Medium-Priority Items: User Interfaces

Common Automated Identification Technology (AIT)

Priority: Medium 7
Description of Problem: Lack of common AIT creates work-arounds through creation and funding of software to integrate AIT hardware.
Timeframe to Implement: Midterm
Example: Ensure that a DoD standard military shipping label generated in either system is readable. Furthermore, there should be the capability to use multiple devices with GATES/CMOS (like multiple keyboards with different PCs) without having to spend resources to modify the hardware through development of software to ensure AIT is integrated.

Functional Acknowledgments

Priority: Low 1
Description of Problem: No capability for sending functional acknowledgments back to source systems to validate data receipt and accuracy.
Timeframe to Implement: Long
Example: Functional acknowledgments are notifications to the source systems (CMOS and GATES) from the destination system (for example, Global Transportation Network), in a plain text format, of receipt and accuracy of

data. The acknowledgment gives the source system timely feedback in order to reprocess bad data.

Differences in File Formats

Priority: Low 2
Description of Problem: Differences in file formats can cause implementation delays in fielding the software.
Timeframe to Implement: Near
Example: PMOs need to ensure file formats are clearly annotated in integration documents to avoid implementation delays caused by having to resolve differences in file formats.

Conclusions

At a general level, both systems, whether in a day-to-day or contingency scenario, perform similar functions and flow transportation data through the same key points in the general distribution process.

Air Force policy (AFI 24-201 and 10-403) does not match current contingency processes that require use of both CMOS and GATES to manage and maintain intransit visibility over cargo and passengers transiting the Defense Transportation System. For efficient management and visibility of resources, policy must clearly articulate electronic data exchange between the two systems. Electronic data exchange facilitates processing of data by eliminating manual input and results in near real-time visibility over Air Force resources. Furthermore, AMCI does not direct electronically remanifesting passengers or cargo intransit through the AMC en route system. This policy was established so intransit missions would not be delayed because of manual data input from one system to another to maintain intransit visibility.

Poor data management or inefficiencies with flowing data electronically between CMOS and GATES causes manual input of data to manage and maintain visibility of resources.

Currently, there is no electronic data-exchange capability between CMOS and GATES for passenger manifests. There is an electronic interface for cargo manifests; however, greater improvements must take place to eliminate inefficiencies to ensure data flows

Currently, there is no electronic data-exchange capability between CMOS and GATES for passenger manifests. There is an electronic interface for cargo manifests; however, greater improvements must take place to eliminate inefficiencies to ensure data flows electronically. This will ensure personnel are not required to input data manually to manage and maintain visibility over resources.

electronically. This will ensure personnel are not required to input data manually to manage and maintain visibility over resources.

Billing for Services was outside the scope of this analysis and should be studied separately. While transportation personnel add value to the discussion, the finance community should take the lead in developing requirements to streamline billing procedures. The team did not come up with many action items in the shortfall category, *User Interfaces*. Team members agreed there would be insufficient value in making the systems look the same. Furthermore, the team concluded funding for systems development should be spent on efficient data exchange to eliminate manual input of data. Finally, *Deployment System Development* action items were determined to duplicate action items already created under the *Policy and Procedures* and *Data Sharing and Management* categories.

Recommendations

- Proceed with phase two of the study to develop requirements and create action plan.
- Program management offices and system developers provide technical solution and cost for implementation.
- Task a separate study to streamline the transportation billing procedures.

Shaping Logistics—Wargames

As you can well imagine, this is not an easy task or one that creates universal consensus in the Air Force logistics community. However, the utility of exploring new logistical concepts in wargames versus real life quickly becomes obvious when you look at the funds, personnel, and equipment impacts associated with live exercises. In exercises such as Foal Eagle or Cope Thunder, or older exercises like Reforger or Bright Star, you discover the manpower, financial, and equipment costs are extremely high. In these exercises, we deploy up to 10,000 people and their equipment for a month or more to distant parts of the earth. With preparation, the actual exercise, and reconstitution, these personnel and their units are often unavailable to respond to other taskings for 3 to 4 months. In terms of financial cost, live exercise costs often run into millions of dollars and contribute to increased wear and tear on critical weapon systems and our airlift fleet. These were valuable exercises, and we learned a great deal from them, but there was certainly a sizable bill to pay for each.

Wargames cannot completely reflect the real world; however, you can draw close parallels with sufficient fidelity to allow functional experts to determine if concepts are feasible and workable and if other advanced testing methods, such as live exercises, are appropriate. Or you may determine a concept is simply unworkable and unrealistic and should be sent back for rework or totally scrapped. Further, in a wargame, you don't require massive numbers of troops, you don't wear out weapon systems, and you require only a fraction of the dollar outlay that live testing requires.

In games such as the Focused Logistics Wargame, Global Engagement, and Futures, a broad range of logistical concepts are being explored that will allow us to better support the warfighter and the expeditionary air force. Concepts such as forward operating locations, forward support locations, various types of prepositioning (including prepositioning ships), redesigned maintenance and support kits, ways to increase the velocity of the resupply pipeline, and intermediate depot-repair sites are typical of what's being examined and evaluated.

Wargames have the added advantage and flexibility of being able to explore today's concepts or those 25 years in the future. With today's concepts, we can validate the outcome with an increased level of fidelity because the reliability of the data is high. Even with concepts set many years in the future, we can determine if the concept is feasible with envisioned technology.

Wargaming is a valuable force multiplier for the Air Force. We can explore concepts and determine outcomes for a fraction of the cost of live exercises and not lose or damage a single aircraft or put the first airman in harms way. It's a valuable tool in the logisticians' toolbox, and its use will grow in importance.

Captain Timothy W. Gillaspie
Colonel Kenneth P. Knapp

Most DMSMS problems occur within the area of electronic components, primarily Federal Stock Class 5961, semiconductors, and FSC 5962, microcircuits.

Process Mapping

diminishing manufacturing sources and materiel shortages reactive management strategy

In 1975, the military's percentage of the microelectronics market was 17 percent. The consumer demand for electronics such as cellular telephones, home computers, and other electronic devices has dwarfed military requirements for microelectronics. By 1995, the total military percentage of the microelectronics market represented less than 1 percent and is projected to further decline.

First Lieutenant Robert E. Overstreet
Lieutenant Colonel Stephen M. Swartz
William A. Cunningham, PhD

Background

Diminishing manufacturing sources and materiel shortages (DMSMS) is the loss or impending loss of the last known manufacturer or supplier of an item or the shortage of raw materiel needed to support a weapon system. DMSMS can happen at any time in the life cycle of a system, from design to operations and support, jeopardizing readiness and drastically increasing total ownership costs. DMSMS is not limited to individual items or parts. It can affect weapon systems at any level of indenture. The Air Force Materiel Command (AFMC) DMSMS *Case Resolution Guide* states that most DMSMS problems occur within the area of electronic components, primarily Federal Stock Class (FSC) 5961,

The US Government is a unique consumer of electronic components. Its requirements begin as the commercial market demand is reaching maturity and end well beyond the commercial market's 4-7 year life cycle, which can exceed 25 years.

semiconductors, and FSC 5962, microcircuits; however, DMSMS can and does affect all other FSCs.[1]

Military and Electronic Environment. Before discussing Department of Defense (DoD) management of DMSMS, it is necessary to explain why the US military, especially in the area of electronics, is highly susceptible to DMSMS (sometimes called parts obsolescence). There are three main reasons for the electronic DMSMS problem within the DoD: long acquisition lead times and extended lifecycles, decreasing market share, and the commercial profit motive.

The US Government is a unique consumer of electronic components. Its requirements begin as the commercial market demand is reaching maturity and end well beyond the commercial market's 4-7 year life cycle, which can exceed 25 years. Current life-cycle extensions include the Army's UH-1 to more than 44 years, the Navy's F-14 to more than 41 years, and the Air Force's B-52 to more than 94 years.

In 1975, the military's percentage of the microelectronics market was 17 percent. The consumer demand for electronics such as cellular telephones, home computers, and other electronic devices has dwarfed military requirements for microelectronics. By 1995, the total military percentage of the microelectronics market represented less than 1 percent and is projected to further decline. One organization that reports the customers of electronics is the Semiconductor Industry Association. According to one Defense Support Center Columbus (DSCC) engineer, they will no longer report the Government separately as an electronics consumer.[2]

The single most important factor in DMSMS is the commercial profit motive. Companies focus their efforts on producing items that are profitable. To understand their motive, an explanation of Moore's law is necessary. Moore's law states, "Circuit density or capacity of semiconductors doubles every eighteen months or quadruples every three years."[3] The mathematical formulation is:

$$\textbf{(Circuits per chip)} = \textbf{2 (year-1975) / 1.5} \quad \textbf{(1)}$$

With technology changing so rapidly and more than 99 percent of the market representing commercial demand, there is little, if any, incentive for manufacture's to dedicate resources to the production of microcircuits primarily used by the military. It is logical to assume that the rapid changes in technology will increase the obsolescence of parts. Older electronic components, while still functional, use older technology, making them prime candidates for discontinuance.[4]

DMSMS Responsibilities. DoD Regulation 4140.1-R states that the Deputy Under Secretary of Defense for Logistics (DUSD [L]) shall exercise authority for direction and management of the DMSMS program, to include the establishment and maintenance of implementing regulations.[5] It also states that each DoD component will designate a focal point for DMSMS issues. The Army assigned overall management of the DMSMS program to its Deputy Chief of Staff for Research, Development, and Acquisition. The Navy assigned DMSMS management responsibility to its Naval Sea Systems Command. Air Force DMSMS responsibilities have been assumed by AFMC. Specifically, the Air Force Research Laboratory (AFRL) Manufacturing Technologies Division manages the DMSMS program.

Commanders of activities with responsibility for design control, acquisition, and management of any centrally managed item used within a weapon system or equivalent shall implement a DMSMS program.[6] The DSCC is one such activity. Responsibility for managing DMSMS had been pushed down to individual managers. As of 1 year ago, the DSCC DMSMS program is once again centrally located and managed.[7] The Defense Microelectronics Agency (DMEA) has been designated by the DUSD (L) as the executive agent for DoD microelectronics DMSMS. As such, DMEA is a key player in the development and coordination of solutions to the DoD's obsolescence problems and responsible for issues relating to integrated circuit microelectronics.[8] Responsibilities cut across the full spectrum of advanced microcircuit technology and DMSMS issues. Funding for parts is the responsibility of the program manager, Defense Logistics Agency (DLA), or the country. Spare or repair parts for fielded weapon systems are funded up front by the DLA activity. This funding system provides little incentive for Services to

Numerous initiatives at both the DoD and Service level have been implemented to combat DMSMS.

provide accurate estimates of item demand. Because the Services are not penalized for overestimations, that gives them an incentive to overestimate requirements. Further, because the DLA has the overwhelming responsibility to provide the part, regardless if the service forecasts demand or not, there is little incentive to forecast accurately at all.[9]

DoD and Service DMSMS Initiatives. Because of the increasing challenges faced by the DoD in procuring military grade components and the impact those challenges have on both new system procurement and spare part procurement for fielded systems, DoD developed the Diminishing Manufacturing Sources/Materiel Shortages mission.[10] Numerous initiatives at both the DoD and Service level have been implemented to combat DMSMS. A partial list of the programs implemented to identify, track, and help manage this growing problem includes the Government Industry Data Exchange Program (GIDEP), Shared Data Warehouse (SDW), Teaming Group Initiative, Type Designation Automated System, Virtual Parts Supply Base, Rapid Retargeting, Obsolescence Prediction Tool, Virtual System Implementation Plan, Compatible Processor Upgrade Program, Rapid Response to Critical System Requirements, Modernization Through Spares, Radiation Tolerance Assured Supply and Support Center, Affordable Sustainment of Army Systems, Plastic Encapsulated Microcircuit, Army DMSMS Information System, Parts Obsolescence Initiative, Viable Combat Avionics, and Electronic Parts Obsolescence Initiative.

Civilian Work in the Area of DMSMS. As with many large projects within the DoD, civilian industry provides invaluable assistance to the government in the management of DMSMS. Three of the more prominent civilian companies assisting the DoD in its war against obsolescence are Manufacturing Technologies, Inc; PartMiner Free Trade Zone; and Transition Analysis of Component Technology.

DMSMS Mitigation Strategies. DMSMS mitigation strategies generally can be considered proactive or reactive in nature. The two may not be mutually exclusive and may be used in concert to correct a current DMSMS issue while simultaneously planning for future obsolescence issues.

Proactive Strategies. Proactive strategies address DMSMS issues early during system development and are the responsibility of the systems program office (SPO). Program managers must balance the risk of obsolescence with the need to remain on schedule and within budget and provide the capabilities requested in the operational requirements document. The three proactive strategies represent the highest level of agency involvement. They are Open Systems Architecture, Preplanned Product Improvements, and Very High-Speed Integrated Circuit Hardware Description Language.

Reactive Strategies. Many resolution alternatives exist that can be used individually or in concert to respond reactively to DMSMS occurrences. DoD Regulation 4140.1-R requires each component's focal point and integrated materiel managers (IMM) to implement the most cost-effective solution consistent with mission requirements when an item is identified as DMSMS.[11] There are 14 DoD DMSMS resolution alternatives. In order of preference, they are encourage existing source, find another source, substitute, limited substitute, redefine military specifications, produce a substitute item (form, fit, function), bridge buy, LOT buy, change *prime* sources if item uses government-furnished equipment, reclamation, modify or redesign the end item to replace or eliminate, replace system, require the using contractor to maintain inventory, and obtain production warranty.

Analysis and Research

In DoD, there is increased interest in reducing total ownership costs and increasing the availability of its aging weapon systems. DoD is continually forced to extend weapon-system service life well beyond the intended service life. Effective program management that incorporates proactive approaches such as open architecture and the use of commercial off-the-shelf items during the first stages of a program's life cycle can reduce some of the effects of later DMSMS issues.

DoD is continually forced to extend weapon-system service life well beyond the intended service life. Effective program management that incorporates proactive approaches such as open architecture and the use of commercial off-the-shelf items during the first stages of a program's life cycle can reduce some of the effects of later DMSMS issues.

For mature programs in the operation and support phase, the IMM must counter DMSMS problems with the most cost-effective reactive approach or resolution alternative that ensures program viability. As the primary IMM for FSC

The specific objective of the research for this article was to formally document the DSCC DMSMS management process and provide suggestions to improve their DMSMS reactive management strategy.

5961 and FSC 5962, the DSCC confronts the largest number of DMSMS cases. Their resolution of DMSMS cases affects nearly every fielded weapon system. Because of the realignment of DMSMS responsibilities within DSCC nearly a year ago, there is currently no formally documented DSCC DMSMS reactive management strategy.

Research Questions

The purpose of this article is contained within the question, "Can the current DMSMS management strategy used by DSCC be improved?" To answer this high-level, overarching question, several subquestions must first be answered.

- What is the current DSCC DMSMS management strategy?
- What agencies, initiatives, and tools are being incorporated in their strategy?
- What are the current issues/problems/limitations with their strategy?
- How could their strategy be improved?
- Specific investigative questions will further refine the areas of inquiry and provide the necessary information to answer each subquestion.

Research Objective

The specific objective of the research for this article was to formally document the DSCC DMSMS management process and provide suggestions to improve their DMSMS reactive management strategy. In a more general sense, this research will add to the DMSMS body of knowledge. By studying the DSCC DMSMS management processes and formally documenting its strategy, the research provides information that other IMMs can use to make better decisions about their own DMSMS reactive management strategy.

Methodology

In the main, there are two research paradigms: quantitative research and the qualitative research. The quantitative paradigm is based on testing theory, measuring with numbers, and analyzing with statistics to determine whether the predictive generalizations of a theory hold true.[12] Conversely, the qualitative paradigm is an inquiry process of understanding a problem or process by building a complex, holistic picture by conducting research in the natural setting and expressing the results in narrative form.[13]

Justification of Qualitative Design. The basic characteristics and assumptions of qualitative research are met by this problem. Specifically, qualitative research is descriptive and inductive in nature and involves fieldwork. The author was primarily concerned with the process, personal meaning, and primary instrument for data collection and analysis.[14] This article seeks to map the DSCC DMSMS reactive management strategy by interviewing and observing the participants in the process. The conclusions and recommendations are descriptive and result from inductive logic.

A case study is used to study indepth the DSCC's DMSMS reactive management strategy over a 4-month timeframe, September-December 2001.

Types of Qualitative Designs. Although authors have written as many as 20 qualitative design types (with origins in fields such as anthropology, education, history, human ethnology, psychology, and sociology), commonly qualitative research is conducted using one of five designs. These designs are the case study, ethnography, phenomenological study, grounded theory study, and content analysis.[15] A case study is used to study indepth the DSCC's DMSMS reactive management strategy over a 4-month timeframe, September-December 2001. The data for this case study were collected via observations, interviews, and content analysis of archival data.

Disciplines Using the Case Study Design. Although the case study design is generally characterized as a weak sibling among social science methods, it is used extensively in social science research. The fields using case study methodology include psychology, sociology, political science, anthropology, history, economics, public administration, and education. Dr Robert K. Yin proposes that the reason the case study methodology is so prevalent in social sciences (despite the stereotype) is that the stereotype is wrong. This proclaimed leader of the nonlaboratory social science methodology describes the case study strategy as a rigorous method of research.[16]

"A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used."

Definition of the Case Study Design. Yin offers a technical definition of the case study strategy. He states,

> A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context when the boundaries between phenomenon and context are not clearly evident and in which multiple sources of evidence are used.[17]

Case study designs are generally used when questions such as why and how are being answered and the author has little or no control over the events.

Explication of Participants and Relationships. Because qualitative research is interpretative in nature, it is recommended that the values, biases, and judgment of the author be explicitly stated in the report.[18] To that end, listed below is an explication of the DSCC DMSMS office, an explanation of how entry into the DSCC DMSMS office was gained, an introduction to the gatekeeper, a description of the author's experience, and level of involvement.

DSCC. DSCC's organizational chart lists the many specialties within the DSCC DMSMS office. These specialties are program management, systems analyst, contracting, engineering, system administrator, supply system analyst, and equipment specialists.

Gaining Entry. According to qualitative researchers, the steps taken to gain entry into the DSCC DMSMS office and secure permission to study the informants and DMSMS management procedures should be discussed.[19] David G. Robinson, the DSCC DMSMS program manager, stated that they would be interested in helping with the research and the point of contact would be George L. Shkane. The initial meeting was made with the DMSMS staff, and the questions were kept generic and open-ended. The initial contact with DSCC ended with the attainment of a sponsor, a desired product from the research, and an invitation to return as often as possible.

Gatekeeper. It is important to gain access to research or archival sites by seeking the approval of a gatekeeper.[20] Shkane, the DMSMS systems administrator, was the gatekeeper for the research and provided an extensive introduction into the DSCC DMSMS reactive management strategy and established times to interview and observe the other members of the DMSMS office. He also provided access to archival records and was the primary point of contact between DSCC and the author.

Experience of the Author. Much of the DSMS background came from reviewing literature and interviewing James A. Neely and Monica Poelking of AFRL. Their office serves as the Air Force DMSMS hub. Both sources of information identified electronic components as the core of DMSMS problems. If electronics were the core of DMSMS problems, then DSCC as the primary electronic component manager for fielded weapon system spares would be the logical place to start asking questions. With nearly 10 years of medical supply experience, the author was familiar with many of the tools used by DSCC to conduct item research. Much of the supply language is the same, whether the item being referred to is a box of Band-Aids or a piece of complex avionics (national stock number, FSC, and UI). However, the author had never been exposed to DMSMS or the management strategies used to combat it.

Much of the DSMS background came from reviewing literature and interviewing James A. Neely and Monica Poelking of AFRL. Their office serves as the Air Force DMSMS hub. Both sources of information identified electronic components as the core of DMSMS problems.

Level of Involvement. Extensive fieldwork was used to gather the information needed for the research, which began as an independent effort without sponsorship. Early interviews with Air Force DMSMS management specialists provided a place from which to start. Once entry had been made and a gatekeeper established at DSCC, the process of getting information became straightforward. While conducting interviews and observing the DMSMS reactive management process, the author was given the opportunity to conduct in-depth research on several items. The overall level of involvement would best be described as that of a participant observer.[21]

Description of Methodology. A case study method was used to explore the questions. Research was initiated with a review of literature, which provided the basis of understanding to conduct interviews and make observations.

Listed below is an explanation of how the data were collected and analyzed. In addition, a brief section on human subject information is included for clarity.

Data Collection. As described by Paul D. Leedy, Jeanne E. Ormrod, and John W. Creswell, there are three methods of data collection in a case study. These methods are observations, interviews, and content analysis of the appropriate written documents and/or audiovisual material. However, it has been said that, in qualitative research, the author's quest for potential data sources is limited only by a lack of an open mind and creativity.[22]

Observations. Of the two types of observation techniques, as a relative outsider or as a participant, the author opted for the latter.[23] The gatekeeper introduced the author to the DMSMS staff and briefly described the study. Despite the major disadvantage of the author's presence, the DMSMS professionals were open to discussion and willing to be observed while conducting business. Written notes were taken during each session.

Interviews. Informant interviews were conducted concurrently with the observations of their processes. Shkane arranged for the interviews, along with the observations, and briefed the informants on the focus of the research and desired end product. Questions were open-ended at the beginning of the fieldwork and became more structured as the research evolved.

Content Analysis of Archival Data. Content analysis conducted early in the research differs significantly from that conducted during the fieldwork portion. Early content analysis focused on the author's understanding the DMSMS phenomenon and the DoD DMSMS management framework. The content analysis conducted during the fieldwork focused on materials obtained from the gatekeeper. This archival data included the past DMSMS guidance and a process flowchart, both of which became obsolete in 2000 when DMSMS management responsibility shifted from the item managers at DSCC to the DMSMS office.

Data Analysis. It has been said of data analysis for qualitative research that there is no right way to do it.[24] For this research, data analysis occurred simultaneously with data collection. The primary methods of data analysis for case study designs are categorization and synthesis.[25]

Human Subject Information. The participants in this research were all government civilian employees.[26]

Description of the Process Mapping Tool. Once an understanding of DSCC DMSMS reactive management strategy was attained, a cross-functional process map of the process was developed using Microsoft Visio. A cross-functional process map is a graphical representation of the sequence of steps that make up a process. They make work visible, providing improved communication, understanding, and a common frame of reference for those involved in the work process.[27] Microsoft Visio is a software application designed to help the user visualize, document, and share ideas with attention-grabbing flowcharts, organization charts, and office layouts. Process maps were developed and sent or taken to DSCC for their critiques. Multiple iterations were accomplished to ensure the process was captured completely.

Process Mapping

Validity and reliability in qualitative research is controversial.

Validity and Reliability. Validity and reliability in qualitative research is controversial. Some posit that qualitative researchers have no single stance or consensus concerning validity and reliability. In this research, internal validity was sought among the data gathered through convergence. Internal validity ensures the accuracy of what is being recorded and how well it matches reality. Additional strategies such as extensive time in the field and respondent validation are used to support the internal validity of the research.[28]

Case studies using multiple sources of information were rated higher in overall quality than studies relying only on a single source of information.[29] External validity is somewhat more problematic. The nature of the case study limits the generalization of this article, threatening external validity. No special technique exists for assessing external validity of quantitative research, which means qualitative research is at no disadvantage.[30] Reliability or the exact replication of the results in other settings may not be possible, but every effort has been made to describe the author's knowledge of the subject, the assumptions, and how and why the DSCC was chosen. By providing this information, the chances of replicating the findings of this research in another setting are enhanced.[31]

Scope and Limitations

DMSMS data were gathered on items managed by DLA, specifically DSCC. DSCC manages more than 1.74 million national stock numbers and has annual sales in excess of $1.8B. DSCC-managed items affect nearly every fielded

Last year, the DSCC DMSMS office received discontinuance notices for more than13,000 part numbers, which resulted in the creation of 119 DMSMS case files.

DoD weapon system. The chief limitation of this article is that it does not include items for new production weapon systems or next higher assemblies. Those items are managed and funded by one of the Services or the affected system program office; however, it is hoped that the results of this study could add significantly to understanding of their own DMSMS reactive management strategy. Because this effort is focused on the main problem class of DMSMS electronic items, inference to other materiel categories may not be appropriate.

Relevance

This topic applies to the current DoD efforts to minimize DMSMS effects on aging systems, which have become aggravated due to dwindling military budgets, decreased microelectronic market share, and high-operations tempo. As item managers attempt to solve rapidly growing DMSMS problems, many of their decisions are made using fragmented data.[32] Last year, the DSCC DMSMS office received discontinuance notices for more than13,000 part numbers, which resulted in the creation of 119 DMSMS case files.

Context of Data Presented

To fully understand the context of the data, the first two steps of theory of constraints (TOC) integration were applied to the DSCC DMSMS office. The TOC is an overall philosophy for running or improving an organization.[33] It was developed by Dr Eliyahu M. Goldratt and introduced to the world in his 1984 book, *The Goal: A Process of Ongoing Improvement.* The first step of TOC integration is to "define and scope the system (who are we in relationship to our environment?)."[34] This step involves identifying the boundaries, inputs, processes, and outputs of the system. The boundary is a dotted line that separates the DMSMS office from its environment. By establishing a clear boundary, the system can be improved, which is the ultimate goal of the research. The primary input into this system is an item discontinuance notice.

Discontinuance notices can originate from the manufacturer, supplier, or customer, or they can come from other DMSMS management agencies; namely, GIDEP.

Secondary inputs are the data needed to achieve a DMSMS solution. These include the lifetime requirement estimates that customers provide and DSCC uses to compute LOT-buy quantities, the engineering advice from the customers, Engineering Support Activity (ESA), and the information taken from government and industry-managed databases. The primary output of the system is DMSMS solutions for DSCC-managed items. Secondary outputs consist of advice given to other DMSMS-management agencies at both the service and SPO level and DMSMS solutions for items not federally stock listed.[35] The last secondary output originally stated DMSMS solutions for non-DSCC-managed items but was changed after consultation with members of the DMSMS office.

Not-for-profit organizations are different and require careful examination of their purpose and goal. For this system, the goal is clear, and throughput is defined as a DMSMS solution.

In the second step of TOC integration, performance measures must be specified and quantified to determine if things are getting better or worse.[36] A clear understanding of the goal is requisite before attempting to define these metrics. In its previous guidance, the DMSMS office had stated its goal as "to assure ongoing availability of electronic/construction parts to all customers, including foreign military services (FMS), irrespective of their availability in the marketplace and to provide this service as cost effectively as possible." Discussion of the goal with Shkane led to the elimination of the redundant phrase, "including foreign military service," and the elimination of the necessary condition of providing the service in a cost-effective manner. The revised goal agreed upon was "assure ongoing availability of DSCC-managed items to all customers irrespective of their availability in the marketplace."[37] Having a clear picture of the system and a concise goal allowed for the definition of system metrics. The TOC uses three primary system metrics: throughput, inventory, and operating expense. Throughput is best defined as "the rate of goal attainment." For companies to make a profit, the goal is clear: make money now and in the future.[38] Not-for-profit organizations are different and require careful examination of their purpose and goal. For this system, the goal is clear, and throughput is defined as a DMSMS solution. This took considerable time to comprehend because the output is not a physical item;

rather the output is an item's status. Inventory is comprised of the inputs received by the system that have not been converted into throughput.

Operating expense is the cost of converting an item discontinuance notice into a DMSMS solution. For this system, operating expense is almost entirely fixed.

The third and final step of TOC integration is to attack the system on two fronts. The first front is fought from within the system, and the second front is fought between the system and its environment. These attacks apply both application tools (Total Quality Management) and logic tools (Goldratt's Thinking Processes).[39] Application of these tools to this research is beyond the scope of this current research, but it was added to the recommendations for future research.

Presentation of Data

Three methods of data collection were used in this case study. These methods were observations, interviews, and content analysis of the appropriate archival data. Questions were open-ended at the beginning of the field work and became more structured as the research evolved. As such, this section can easily be divided into two phases: data gathering and data refinement.

Data-Gathering Phase. During this phase, the author asked a few open-ended questions. This was done in an attempt to draw out information without stifling or leading the informants. Interviews and observations were conducted, and data were also gathered and analyzed during this phase.

Observations and Interviews. Informant interviews were conducted concurrently with the observations of their processes. Despite the major disadvantage of the author's presence, the DMSMS professionals were open to discussion and willing to be interviewed and observed while conducting business. Written notes were taken during each session. The gatekeeper introduced the author to the DMSMS staff; arranged for the interviews, along with the observations; and briefed the informants on the focus of the research and the desired final product. The author's initial contact was with Shkane and then Robinson to discuss the research and its focus. As this effort was exploratory in nature, the initial focus was later adapted to meet the needs of the DSCC, the newly garnered sponsor. Robinson stated the need for updated guidance and an objective analysis of their office's processes.

Interviews and observations of other DMSMS functions followed. The first interview was with the system administrator. He explained the various sources of discontinuance notices. GIDEP is the primary source, but notices can come from manufacturers, suppliers, other DMSMS management agencies, and customers.[40] The multiple overlapping sources of information require the careful screening of notices to prevent duplication. His primary responsibility is to determine the validity of the notice, assign a case number based on the last-time buy date, update the GIDEP database, and work with the rest of the office to assign an engineer to the case and establish milestones. He allowed the author into the database to check for duplicate cases and granted access to the SDW.

Next was the interview with Tom Beckstedt, General Emulation of Microcircuits (GEM) manager. The GEM program was in the research and development phase in 1987, was validated between 1992 and 1997, and started production in 1997. The contract with Sarnoff allows the GEM program access to a flexible foundry at an annual investment of $2M. Unfortunately, the complexity of microcircuits limits what GEM can produce. Currently, GEM is not capable of emulating microcircuits produced after the early 1980s.[41] With the average cost of emulation around $250,000, not including the time investment, GEM is discouraged for most parts.

The third interview was with Charles E. Besore, one of the three engineers within the DMSMS office. He explained what actions are taken when a case is assigned to an engineer. The engineer is responsible for creating and completing the technical spreadsheet. Various sources of information are used to fill in the spreadsheet. The Federal Logistics Information System is used to determine if the item is stock listed and, if it is stock listed, who the primary inventory control authority (PICA) is. The PICA is a two-digit code that identifies the agency responsible for the item. The PICA for DSCC is Texas. Another system used in completing the spreadsheet is PartMiner. For the DSCC-managed items, the engineers check for substitutes and alternate sources of supply (also called continuing alternate source). If the item is coded as critical, coordination of a substitute is required with the customer's ESA via Form 339. When the spreadsheet is completed, it is forwarded to the supply systems specialist. The engineer also generates a DMS technical data-certification sheet. The last of the initial interviews was with Bob C. Peyton, the supply systems specialist, who provides interface between DSCC customers and the DMSMS office and reviews the technical spreadsheet. No action is taken for DUP and Federal Logistics Information System items. For the others, he generates two types of notifications based on the information contained on the spreadsheet.[12] The first notification is sent to Services for service-managed DMSMS items alerting them to the item's discontinuance. The second notification is the initial alert notification letter for DSCC-managed items, which notifies the service of the item's discontinuance and requests projected lifetime requirements. This notification is sent to the entire DMSMS points-of-contact mail group. Peyton builds the requirements spreadsheet and initiates a DMS manual purchase request for 2 years of stock (if required) based on the item's historical file. When lifetime requirements are received from the service, they are checked for congruence with the item's demand history. If the estimates appear illogical, the service is required to justify its computation. Purchase request quantities are then recomputed based on service estimates.

Based on order size, the item is evaluated using the GEM checklist for possible emulation. The DMS-certification document is produced to document the exercise of the National Defense Authorization Act, which grants authority for the purchase of excess inventory in the interest of national security.

Another trip to DSCC provided an opportunity to receive documentation from Shkane. During the third trip to DSCC, he and Besore were interviewed to ensure their portions of the process were understood. Shkane again explained his steps and allowed the author to work several discontinuance notices. He also detailed the management assistant's contribution to the process and how the various databases are updated. Besore did the same for the engineering steps of the process. When questioned about the extent of their research, He stated that much of the same research was conducted for non-DSCC-managed items. Follow-up to that question revealed that even though the information was being placed on the spreadsheet, it was not being forwarded to the Services.

Archival Data. After the initial visit to DSCC, Shkane compiled an extensive set of DMSMS guidance, both external and internal to DSCC. The external guidance consisted of DoD Regulation 4140.1-R, *DoD Materiel Management Regulatio*n; DLA Regulation 4005.6, *Diminishing Manufacturing Sources and Materiel Shortages Progra*m; and DLA Integrated Policy Memorandum No 97-0003A, *Diminishing Manufacturing Sources and Materiel Shortages Progra*m. The internal guidance included the *IM Desk Guide for DMS Case Processin*g, a checklist entitled DMS Internal Process Flow, and a draft copy of intraoffice guidance. Unlike the focus of the initial literature review, this material was analyzed for specific insight into the DSCC processes. The focus of the external documentation centers on what must be done rather than how things are done, which is the focus of the research.

However, the internal guidance provided a detailed account of how DMSMS management tasks are accomplished. Much of it is no longer valid because of the reassignment of DMSMS responsibilities. In 2000, the responsibility for DMSMS management at DSCC shifted from the item manager to the DMSMS office. The draft copy of intraoffice guidance written by Huy Dang provided a better picture of DMSMS processes within DSCC; however, it did not include GEM or the management assistant in the DMSMS management strategy.

Data Refinement Phase. During this phase, the author asked very pointed questions to fill in gaps in knowledge from the data-gathering phase and completed and validated the cross-functional process map. Archival data were relied on to provide the framework to construct updated DMSMS office guidance during this phase.

The Cross-Functional Process Map. After the first attempt at constructing a cross-functional process map, it was taken to DSCC for review. Shkane reviewed the cross-functional process map. One of the objectives of that trip was to receive support for the cross-functional, process-map method rather than the flowchart method, which provides a disjointed picture of the DMSMS management process. The cross-functional process map is more suited to the DMSMS office because its focus is on the process/people interface, and it shows the functions, steps, inputs, and outputs of a process.[42] He readily accepted the design and reviewed the process map. The following recommendations were received:

- Management assistant updates the SDW and DMS database only after the engineer has completed the technical spreadsheet.
- After the engineer checks to see if the item is stock listed, only DSCC-managed items are reviewed for substitutes and alternate sources.
- Add 2-year purchase request step in the supply system analyst section.
- Add in that engineering notifies provisioning engineers that the item is being discontinued.[43]

These recommendations were incorporated, and the process map was completed. Several members of the DMSMS office critiqued the updated cross-functional process map. The objective was to ensure each step of the process was captured accurately and sequenced appropriately. The following recommendations were received:

- The systems administrator updates GIDEP after the initial alert notification letter is sent.
- Add decision step after contract is solicited to account for no-bid contracts.[44]

With those minor corrections, Robinson and Shkane accepted the cross-functional process map.

The Updated DMSMS Office Guidance. The new guidance relied heavily on past guidance for structure and incorporated all the steps listed in the cross-functional process map. The guidance was created in an iterative process. It was drafted and sent to DSCC via e-mail and reviewed during the 17 December 2001 visit. During that time, the draft guidance was critiqued and returned for changes. The following recommendations were received:

- In the background section, change also called an after-market manufacturer to like an after-market manufacturer.
- Eliminate the discussion of GEM in the produce-a-substitute item paragraph.
- Under the responsibilities of the chief, DSCC-CCD, add GEM program
- manager.
- Keep all appendices and add an appendix for the GEM checklist.
- Where appropriate, make reference to the applicable appendix.[45]

The changes were incorporated, and the guidance was resent to DSCC. With those minor corrections, Robinson and Shkane accepted the guidance. This iterative process was intended to add validity to the product, and it provided an excellent feedback loop.

Research Questions Answered

The purpose of this article is contained in the overall research question: "Can the current DMSMS-management strategy used by DSCC be improved?" To answer this high-level, overarching question, several subquestions were answered. Some of these subquestions are broken down further by using investigative questions.

What is the current DSCC DMSMS management strategy? At the request of the sponsor, a process map of the current process and a supplement to the applicable DLA were produced. As described above, the information necessary to produce these products was gathered via observations, interviews, and content analysis of written material. The following questions were developed and answered to shed light on the DMSMS-management process.

Is the strategy predominately proactive or reactive? As described in the literature review, DMSMS mitigation strategies generally can be considered proactive or reactive in nature. Proactive strategies address DMSMS issues early during system development. Reactive management

DMSMS mitigation strategies can generally be considered proactive or reactive in nature. Proactive strategies address DMSMS issues early during system development. Reactive management strategies are used when reacting to manufacturer's intent to discontinue production of an item needed to support a weapon system.

strategies are used when reacting to the manufacturer's intent to discontinue production of an item needed to support a weapon system. As the PICA for most electronic parts, DSCC, through the use of the reactive strategies, must ensure availability of DSCC-managed items, regardless of their availability in the marketplace.

Who are the members and what are their specialties? Their organizational chart lists the many specialties within the DSCC DMSMS office. These specialties are program management, systems analyst, contracting, engineering, system administrator, supply system analyst, and equipment specialists. Individuals from each of these specialties were interviewed and observed to better understand their contribution to the DMSMS management process.

How is information transferred? The system administrator explained the various sources of discontinuance notices. GIDEP is the primary source, but notices can come from manufacturers, suppliers, other DMSMS management agencies, and customers.[46] During regularly held office meetings, new cases are assigned to one of three engineers, and milestones for the cases are established. After case assignments, he updates the GIDEP database and maintains a spreadsheet to monitor milestones. At various points in the process, the management assistant updates the SDW and the DSCC DMS database.

How are records stored? DMSMS files are maintained in both electronic file and paper file. Folders in the shared drive are maintained by Shkane. These files are separated by year and case number. Each case file contains all the information for that case, such as the discontinuance notice, any duplicate notices, all e-mail correspondence, the technical spreadsheet, the initial alert message, and any other pertinent data. Paper files are kept for backup purposes and contain the same information.

What agencies, initiatives, and tools are being incorporated in their strategy? In conducting the initial literature review, numerous agencies, initiatives, and tools were found that deal with DMSMS. To understand how

DSCC incorporated them into their DMSMS strategy, the following questions were developed and answered.

What agencies provide inputs to the DMSMS Office? GIDEP is the primary source of discontinuance notices, but notices can come from manufacturers, suppliers, other DMSMS management agencies, and customers.[47] Agencies that provide procedural inputs to DSCC include the DoD, DLA, and DMEA.

What agencies require the output of the DMSMS office? Although the actual item status is not desired by the customer, the availability of the DSCC- managed item at the time of request is important and paramount to maintaining the availability of an aging arsenal.

What initiatives are used by DSCC to combat DMSMS? Members of the DSCC actively participate in DMSMS conferences and other events providing avenues of crosstalk between DMSMS management specialist. Besore is the DSCC representative to the DMSMS teaming group.

What tools are part of their DMSMS management strategy? The tools used by the DMSMS office include PartMiner, the Federal Logistics Information System, and many of the typical Microsoft Office applications.

What are the current issues/problems/limitations with their strategy? As the intermediary between the marketplace and the Services, DSCC issues, problems, and limitations can be listed accordingly: those they face with companies that supply electronic parts and those they face with the Services.

What are these with respect to companies? There is no industry standard for notifying customers that a company wishes to discontinue a product line. Companies wishing to discontinue a product can simply stop production. However, companies generally provide notification of their intent. This notification might take a circuitous route before finding its way to DSCC. GIDEP is the primary source of discontinuance notices, but notices can come from manufacturers, suppliers, other DMSMS-management agencies, and customers. Frequently, these notices provide a short lead time and may not provide a last-time buy opportunity at all.

There is no industry standard for notifying customers that a company wishes to discontinue a product line. Companies wishing to discontinue a product can simply stop production.

What are these with respect to the Services? If a notice is received with a shot lead time, the time given to the Services to calculate future requirements is also limited.

The FSCs hardest hit are 5961 and 5962, which are both primarily managed by DSCC.

The Services are asked to predict requirements for the remainder of the weapon system's projected service life, which could exceed 20 years. This long-range forecasting done under a time constraint can lead to inaccurate forecasts. For those forecasts, DSCC bears full responsibility (to include losses if inventory is not used) of ensuring stocks are on hand.

The DMSMS engineers frequently work with engineers within the system program offices when evaluating substitute parts. This relationship works well for the noncritical items. During interviews, the ESA process in place for critical items was described as bureaucratic and time consuming.

How could their strategy be improved? The following recommedations were made during the data-gathering phase of the research:

- Focus on primary output and work to decrease the call for secondary output.
- Perform *as requested* services for non-DSCC items.
- Reduce the bureaucracy between DLA and ESA.
- Provide case resolution information to the customer.

Research Findings

A thorough review of the literature reinforced the early findings that most DMSMS cases involve electronic components, especially semiconductors and microcircuits. The FSCs hardest hit are 5961 and 5962, which are both primarily managed by DSCC. There are three main reasons for the electronic DMSMS problem within the DoD: long acquisition lead times and extended life cycles, decreasing market share, and the commercial profit motive. While the DMSMS initiatives, proactive and reactive strategies, and civilian tools provide a spectrum of management alternatives for developing systems, managers of fielded weapon system spares are limited in their choices. As the primary source of supply for most electronic components, the DSCC must rely almost solely on reactive management strategies.

Through observations, interviews, and content analysis of their office guidance, a cross-functional process map was drafted to represent the DSCC DMSMS management strategy from notification of discontinuance to ensured availability of the part. Using visual representation of this process as a guide, a supplement to DLA Regulation 4005.6, *Diminishing Manufacturing Sources and Materiel Shortages Program,* was written.

DSCC manages nearly 2 million spare parts. Over the last decade, DSCC has received and managed more than 2,000 DMSMS cases involving nearly 90,000 part numbers.

Significance of Findings

There is increased interest in DoD for reducing total ownership costs and increasing the availability of the aging weapon systems. DoD is continually forced to extend weapon-system service life well beyond the intended service life. Effective program management that incorporates proactive approaches such as open architecture and the use of commercial-off-the-shelf items during the first stages of a program's life cycle can reduce some of the effects of later DMSMS issues. However, for mature programs in the operation and support phase, the IMM must counter DMSMS problems with the most cost-effective, reactive approach or resolution alternative that ensures program viability. As the IMM for most electronic spares, the DSCC confronts the largest number of DMSMS cases. Their resolution of DMSMS cases affects nearly every fielded weapon system.

DSCC manages nearly 2 million spare parts. Over the last decade, DSCC has received and managed more than 2,000 DMSMS cases involving nearly 90,000 part numbers. The continued availability of these items affects the ability of the US military to maintain its aging arsenal. Improving the DMSMS management strategy of DSCC (however slightly) will help ensure America's ability to project power.

Implications of Findings

Suggested by the list of initiatives and many offices of responsibility, DMSMS is a large problem that will pervade the US military. This article concentrates on the DSCC DMSMS reactive management strategy. Because of this specificity, the applicability of the findings may not be generalizable to other agencies within the DMSMS community. However, the complete case study of DSCC's DMSMS reactive management strategy may provide a methodology that others can use to improve their own

The bureaucracy that exists between DLA and ESA hampers the ability of the engineers to find solutions to DMSMS problems quickly.

DMSMS management strategy. For DSCC, the increased visibility of the process should improve communication and understanding, as well as provide a common frame of reference for those involved in the work process and their customers. It would be difficult to quantify and predict the end-state improvements in parts availability or cost at this time.

Recommendations for Action

Based on the research conducted to produce the requested products for the DSCC DMSMS office, the following recommendations are made to improve DMSMS management. These recommendations address three areas: DSCC, the Services, and the DMSMS community.

Within DSCC. Applying the first two steps of TOC integration to the DSCC DMSMS office graphically illustrates the need to focus on their primary output, DMSMS solutions. During the course of the fieldwork, no fewer than four trips were taken to brief various individuals and customers on DSCC DMSMS-management procedures. While this may be worthwhile, it is not in line with their goal. Although not represented on the cross-functional process map, considerable time had been devoted to finding DMSMS solutions for non-DSCC items. As the updated process map illustrates, only DSCC-managed items should be researched by engineers. If practical, the organization could provide as-requested help to services for non-DSCC-managed items.

The bureaucracy that exists between DLA and ESA hampers the ability of the engineers to find solutions to DMSMS problems quickly. With many discontinuance notices providing little time to alternatives, the time needed to coordinate solutions through the Form 339 process is too great. Engineers are forced to recommend LOT or bridge buys to ensure the part is available. During the second interview with Neely, he stated that the Services are not advised of the actions taken by DSCC to resolve DMSMS issues. A feedback loop was included in the cross-functional process map. Updates to the SDW and GIDEP are done following each major step in the DMSMS management strategy. Although identified for deletion by one of the reviewers, the last update to the SDW and GIDEP was approved by Robinson and is now part of their process.

Services. Service interaction with DSCC is vital to ensuring the availability of spare parts for DoD weapon systems. Of greatest importance is the need for the Services to provide accurate and timely forecasts when requested by DSCC. Knowledgeable and accessible engineers are needed at the ESAs to answer questions regarding items identified as DMSMS. Empirical evidence of the effectiveness of proactive measures have yet to be demonstrated; however, practicality would dictate that greater use of these proactive measures by the Services' system program will provide greater flexibility to DSCC when combating DMSMS.

Service interaction with DSCC is vital to ensuring the availability of spare parts for DoD weapon systems.

Throughout the DMSMS Community. Despite the high level of attention DMSMS is currently receiving, there appears to be no single DMSMS manager. With its plethora of initiatives, agencies, and tools, a single DMSMS management agency is needed to ensure each works in concert to ensure the viability of our fighting force.

Recommendations for Future Research

Several opportunities for future research into the DMSMS phenomena exist. The short list below represents the topics most interesting to this author.

- Conduct the same evaluation of the DMSMS management strategy of system program offices. Develop a process map of the proactive management of the DMSMS phenomenon. Comparative studies between the system program offices would also be beneficial to the understanding of the differences faced by newer weapon systems.
- Conduct a cost-versus-benefit analysis of the effects of proactive DMSMS strategies on the long-term availability of spare parts. Seek to identify the most effective proactive measures.
- Determine if the current SPO environment is conducive to decisions being made based on total ownership costs. With the different types of monies and the pressure to stay within budget, determine if program managers are rewarded for reducing system life-cycle costs. Investigation of the effectiveness of the storage and

Process Mapping

The bureaucracy that exists between DLA and ESA hampers the ability of the engineers to find solutions to DMSMS problems quickly.

dissemination of DMSMS data. Large amounts of time and money have been poured into programs like GIDEP and the SDW. Determine if the benefits of these systems outweigh their costs.

- Determine the contribution of the innumerable DMSMS programs and initiatives. There seems to be a DMSMS program or initiative for every aspect of the phenomenon. Research in this area would determine what contribution each makes to the management of this problem.
- Develop a process map of the ESA interface between DSCC and the Services to determine the areas of possible improvement. The ESA process has been identified as bureaucratic and time-consuming. If the process were mapped and evaluated, bottlenecks could be identified and eliminated. This could provide more time to resolve DMSMS issues involving critical items.
- Determine the effect the USC Title 10 limit on LOT-buy quantities has had on spare part availability. With the exceptions that immediately followed the LOT-buy quantity reductions, has there been a real decrease in LOT buys?

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Shaping Logistics—Purchasing and Supply Management

While the Air Force continues to do purchasing and materiel management in a very functional, vertical structure, many leading commercial firms have dramatically changed their purchasing and supply management (PSM) practices and earned some impressive cost savings and performance improvements for both the short and long term. Explained broadly, PSM is a horizontal, integrated process that encompasses all key areas of spending and core supplier networks. PSM's goal is to create continuous improvement in the performance and cost of purchased goods and services. For the Air Force to take advantage of the benefits achieved by innovative firms, it must change the way it purchases and sustains its weapon systems and commodities.

In 1988, there was no corporate visibility because there was no strategy, according to Terry Sueltman, Honeywell's Vice President of Supply Management. He also noted, "Nobody cared about the money being spent as long as manufacturing got what it needed to make the products. Purchasing people were viewed simply as the in-house group that expedited orders and sometimes solved material supply problems." Sueltman says, "When this operation was just purchasing, it was a tactical subset of manufacturing—its duties were transactional." The purchasing group has since evolved into a strategic part of the company's supply management, quality control, and cost-reduction systems. Among the internal changes necessary to manage the total supply chain was upgrading the personnel within supply management. Today, 90 percent of the staff members have 4-year degrees, and 27 percent have advanced degrees. Nearly 30 percent have become certified public accountants. Long-term relationships with cost-effective suppliers are a key piece of the company's global supply strategy, called Supplier Alliance. The results speak for themselves. From 1990 to 1996, product quality defects were reduced by 90 percent. Honeywell has more than halved the company's suppliers, with 55 key suppliers now providing 75 percent of all production components. Lead times for parts shipments have been reduced by 75 percent, and investments in materials for major products were reduced by 50 percent.[1]

The salient point from the organizational perspective is the transformation of the purchasing arena from a tactical to a strategic focus. Air Force PSM is very tactically oriented with many short-term contracts and adversarial relationships with suppliers. A change from the small, distributed low-skilled purchasing functions now prevalent in the Air Force must be made to centralized, multifunctional teams that include logisticians and create fewer, long-term partnerships with best suppliers. The pain involved in the change will be worth the effort to obtain the benefits and experience of PSM.

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Lieutenant Colonel Scott D. Chambers

Introduction

Order and ship time (O&ST) values reported to the readiness-based leveling (RBL) system increased from 9.2 days in October 2001 to 10.9 days in January 2002, an increase of 1.7 days. A review of base O&ST values revealed that many of the values from the January 2002 push were excessively high and probably inaccurate. Inaccurate O&ST can cause inaccurate Air Force spares requirements.

Background

Order and ship time is the time elapsed from the submission of a requisition to receipt of the item. At base level, the Standard Base Supply System (SBSS) computes O&ST for Air Force reparables (XD items) and feeds the data to the RBL

Order and Ship Time

accuracy of base-reported values

Senior Master Sergeant Robert A. Nicholson
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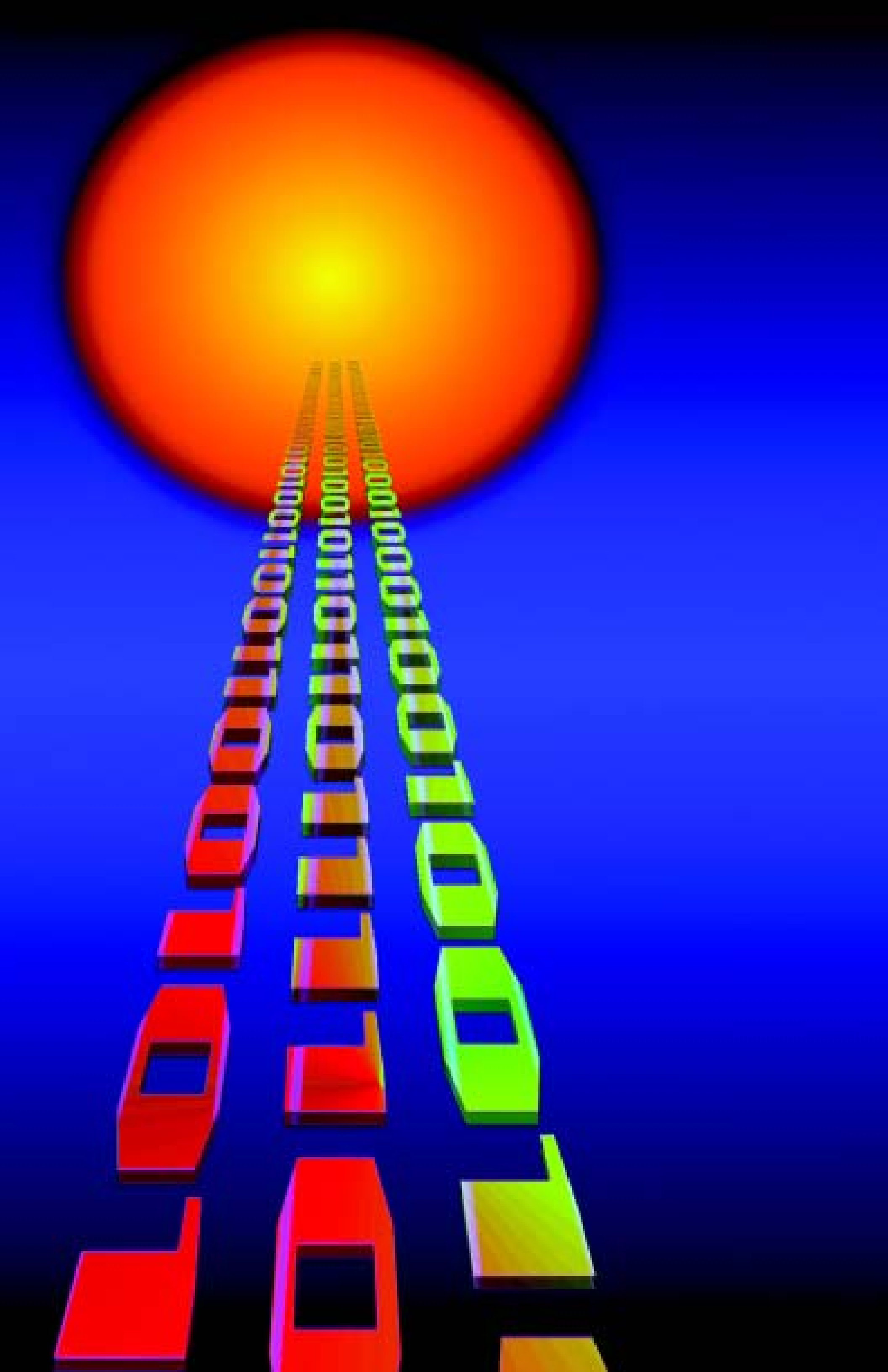
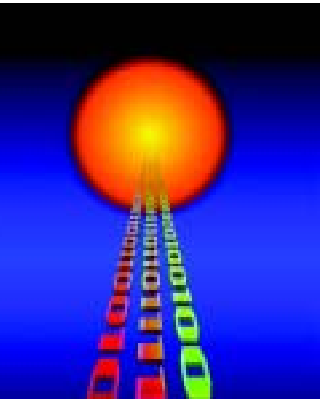
system (RBL/D035E). The D035K system also computes and reports O&ST for reparables to RBL at the Air Force Materiel Command (AFMC) retail supply accounts. RBL uses the SBSS and D035K O&ST to allocate base demand levels. It also passes base O&ST to the D200A system to use in the Air Force spares requirement computation process.

Air Force Policy

The SBSS computes O&ST quarterly, using cumulative fiscal year (FY) data. For example, at the end of December, the SBSS computes O&ST using 90 days of receipts (October-December). At the end of March, it used 180 days of receipt



Order and Ship Time—Accuracy of Base-Reported Values



data (October-March) and so on. Current Air Force policy for computing O&ST is to exclude (truncate) depot delay from O&ST computation and exclude receipts for airlift investment (AI) items. Depot delay is excluded from base O&ST computation since depot delay is already factored into the requirement computation. Figure 1 illustrates the current O&ST computation.

Air Force policy is to compute a median O&ST to compare to the computed quarterly average O&ST. The median is computed, using all receipts except AI receipts, while the O&ST average excludes AI receipts and truncated receipt occurrences (truncated receipts are excluded to remove depot delay time from the O&ST average). The greater of the two values is the O&ST reported to RBL. Some constraints must be taken into account when computing base O&ST average and median values. First, a new average O&ST is computed only when there are at least 100 receipts for each base from a specific source of supply (identified by a routing identifier or RID). Second, the median is used as the new average only when the median is greater than the average and at least 100

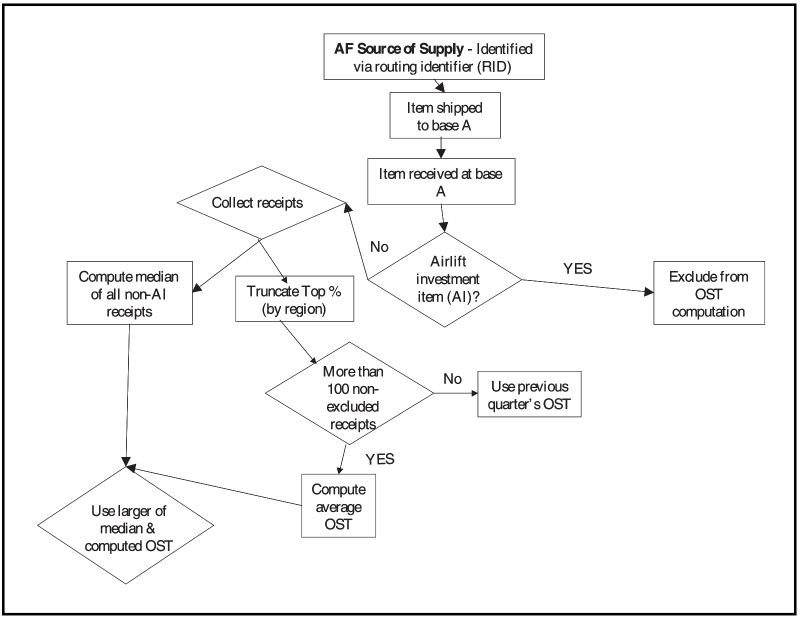


Figure 1. O&ST Computation Process

truncated receipts have accumulated. For cases where 100 receipts have not accumulated, the O&ST average from the previous quarter is used and reported.

Airlift Investment

Current Air Force policy excludes all receipts for AI-coded items from the base O&ST computation. Airlift investment was a pre-Lean Logistics[1] initiative for special handling of selected AFMC reparable items—those items in a buy or repair position. Fast transportation was used for retrograde and requisition shipments of AI-coded items. However, since *all* AFMC-reparable items are now moved via fast transportation, there is no need to exclude AI items. In fact, excluding the items may result in inaccurate or less accurate O&ST averages.

The Air Force-wide, item-record data from the Air Force Supply Databank revealed that 63,000 XD stock numbers were loaded at active duty bases in December 2001. Of those, 31,000 (49 percent) were coded as airlift investment. The results were more significant for Air Force-managed items. Table 1 shows the percentage of receipts Air Force-wide (active duty bases) for AI-coded items compared to all Air Force-managed items.

As Table 1 shows, receipts for AI items comprised 89 percent (93,478 AI receipts out of 105,478 total receipts) of all receipts for Air Force-managed reparable items, which means 89 percent of actual O&ST times were not used in the SBSS computation of average O&ST. Analysis determined whether including AI items in O&ST computation would change the base-reported O&ST.

Analysis

First, the errors in the O&ST computation were documented, the inaccuracy in the currently reported base O&ST was measured, and the SBSS programs were used to compute

Total XD NSNs (Dec 2001)	63,003
Total AI NSNs (Dec 2001)	31,345 (49%)
Total Receipts for XD NSNs (Oct – Dec 2001)	105,478
Total Receipts for AI NSNs (Oct – Dec 2001)	93,478 (89%)

Table 1. Comparison of O&ST Alternatives to Base O&ST

AFLMA used the Air Force Supply Databank as its data source and analyzed Air Force-wide base O&ST data from routing identifier records and receipt transaction history records.

and report the O&ST reviewed. Once the problems were isolated, analysis focused on ways to correct the errors. However, developing solutions to the problems was not a simple exercise because the ongoing supply modernization efforts make programming resources for correcting O&ST problems scarce. As a result, efforts focused on solutions that did not require SBSS programs changes.

Representatives from three activities (Standard Systems Group [SSG], AFLMA, and Logistics Management Institute [LMI]) conducted the analysis. SSG's analysis focused on reviewing current programs that compute and report base O&ST and finding the underlying reasons for inaccurate reporting. AFLMA's analysis focused on measuring the level of the inaccuracy in base-reported O&ST and developing feasible (that is, nonprogramming) solutions to the problems. LMI was heavily involved in both analyses. AFLMA used the Air Force Supply Databank as its data source and analyzed Air Force-wide base O&ST data from routing identifier records and receipt transaction history records. It also asked the AFMC Directorate of Supply to determine the cause of inaccurate D035K-reported O&ST. AFMC suspected the logic for default days (30 days for airlift investment and 90 days for nonairlift items), along with low or no usage data in D035K, caused some of the excessively high O&ST values. A review of the DO35K logic was ongoing at the time this article was written.

Data Sources

The active-duty base routing identifier records from September 2001 were examined since the SBSS uses routing identifier records to accumulate base O&ST data. Both the routing identifier record O&ST *group data* and actual receipt transaction data were used to compute an accurate O&ST that could be compared with the base-computed O&ST. The group data are the receipt occurrences distributed into *buckets* in frequency distribution tables based on O&ST days (for example, 20 receipts from 1 to 12 days, 30 receipts from 13 to 24 days). The current base routing identifier records were used to determine if the base median and truncation point computations were accurate.

Using April through September 2001 receipt data for four sample bases—Langley AFB, Virginia; Dover AFB, Delaware; Ramstein AB, Germany; and Kadena AB, Japan—the actual O&ST to be compared with the base O&ST reported to RBL and the O&ST data stored on base routing identifier records was computed. Truncation points and median values for comparison with truncation and median values currently loaded on the base routing identifier record were also computed. These comparisons showed whether O&ST, truncation, and median computations used by the SBSS caused the excessively high, base O&ST reported to RBL.

Order and Ship Time—Accuracy of Base-Reported Values

An analysis of the O&ST data being fed to RBL revealed nearly 30,000 excessive O&STs reported (19,533 for the SBSS accounts and 9,632 for D035K accounts).

Analysis Results

O&ST increased by almost 2 days from October 2001 to January 2002. The current base O&ST data and the programs used to compute and report O&ST revealed the cause of the increase. A computation of the O&ST (using receipt data and current policy), along with a comparison to the current base O&ST stored on the routing identifier record, showed just how inaccurate base O&STs really are. A nonprogramming method to compute and report accurate O&ST was developed.

Review for Causes of O&ST Increase in Base Data Reported to RBL

An analysis of the O&ST data being fed to RBL revealed nearly 30,000 excessive O&STs reported (19,533 for the SBSS accounts and 9,632 for D035K accounts). O&ST values that exceeded the truncation points were obviously all erroneous. For example, there were 3,734 cases (national stock number [NSN]-stock record account number [SRAN] combinations) reporting 96 days as the O&ST. A look at the actual routing identifier record from the accounts reporting excessive values showed excessive values were stored in the median field of the base routing identifier records. In all cases, fewer than 100 receipts were recorded. Therefore, SBSS should have reported the previous quarter's O&ST, but apparently, it compared the previous quarter's receipts to the values in the median field and used the larger of the two values.

O&ST Program Review Results

AFLMA worked with SSG and LMI analysts to examine the SBSS program code and found several O&ST computation discrepancies. Briefly these include:

Order and Ship Time—Accuracy of Base-Reported Values

Although excluding AI receipts was not a discrepancy (current policy excludes airlift investment receipts from O&ST computation), the current policy causes inaccurate O&ST values since so many receipts are excluded.

- Truncation points were computed incorrectly. For example, at continental United States (CONUS) bases, the SBSS should have truncated (excluded) the largest 33 percent of the O&ST values, from highest to lowest. However, the code truncated the largest 67 percent of O&ST values.
- XCB transactions were not created for XF items.
- Override O&ST values were not used. If the base loaded exception O&ST, the SBSS continued to report the O&ST in the routing identifier record (instead of the exception O&ST).
- High O&ST values on the routing identifier record will not be overlaid with correct values unless at least 100 receipts are processed.

Although excluding AI receipts was not a discrepancy (current policy excludes airlift investment receipts from O&ST computation), the current policy causes inaccurate O&ST values since so many receipts are excluded. Because of the truncation problems and exclusion of airlift investment, it was very difficult to get 100 receipts for some routing identifiers at a given base.

The SBSS uses truncation percentages to exclude receipts that, theoretically, include depot-delay time from O&ST computation. Table 2 shows the truncation percentages that should be used by area code (location):

Using Area Code 0 (CONUS bases) as an example, Table 2 shows 67 percent of all receipts should be used to compute new O&ST averages each quarter. The 33 percent of occurrences with the highest O&ST days should be excluded. Instead, for CONUS bases, the SBSS excluded 67 percent of the receipts from O&ST calculations and used only 33 percent. Thus, the SBSS erroneously excluded too high a percentage of receipts from O&ST computation. Using the wrong truncation point is a *difficulty report* condition that needs to be corrected. Including receipts for airlift investment would increase the number of receipts used in the O&ST computation. The result would be a more accurate O&ST. For airlift investment, SBSS programs do comply with policy, but the programs should be changed to include AI receipts, which requires a policy change. In addition, there were excessive O&ST values on the routing identifier record. These were cases where the fields needed

Area Code	Location	Truncation Percentage
0	CONUS	67
1	Alaska (Elmendorf AFB only), Hawaii, North Atlantic, Caribbean, or Central America	69
2	UK and Northern Europe	76
3	Japan (Yokota AB only), Okinawa, Korea (Osan AB only), Philippines, Guam, and Western Mediterranean	69
4	Hard-lift areas: all other destinations not included above (for example, South, America, Eastern Mediterranean, Africa, Diego Garcia, and so forth)	69

Table 2. O&ST Truncation Percentages—Air Force-Managed Items

Order and Ship Time—Accuracy of Base-Reported Values

These were cases where the fields needed by the SBSS to compute O&ST were apparently never properly initialized for use.

by the SBSS to compute O&ST were apparently never properly initialized for use. There were simply not enough receipts for these particular base/source of supply/priority group combinations to compute new O&ST or median values. In fact, there were cases where the median fields contained extremely high values (for example, 96), apparently due to improper initialization. These uninitialized O&ST values were eventually reported to RBL. Thus, the three main causes of erroneous O&ST values were:

- Truncation point error
- Uninitialized values reported as O&ST
- The exclusion of AI items (89 percent of the O&ST occurrences)

Measuring the Impact of Inaccurate O&ST

Accurate O&ST for AFMC items was computed to compare to the current, inaccurate, base-reported O&ST. Actual receipt data and current policy (excluded 33 percent of receipts for CONUS) were used to compute what the O&ST should have been. However, use of receipts for AI items helped attain a sufficient number of receipts for the computation. Table 3 compares the accurate O&ST to the current O&ST on the base routing identifier record.

Order and Ship Time—Accuracy of Base-Reported Values

Table 3 shows, for RID FGZ (a source of supply) at Langley AFB, 326 receipts were within the truncation exclusion and had a total of 1,979 O&ST days. The accurate, average O&ST was 6.07 days, but the current system showed an average of only 5 days. Comparing the current overall base average O&ST to the accurately computed O&ST showed the accurate average O&ST was generally higher than the current base O&ST (9.04 versus 8). The SBSS truncated too many receipts and, therefore, understated the base O&ST. In this case, low base O&ST was due to incorrect use of truncation percentages.

The base-reported O&ST from October 2001 to January 2002 actually increased because of extreme O&ST values

Base	RID	Receipts Within Truncation	OST Days	Accurate OST	Current OST	Difference
Langley	FGZ	326	1,979	6.07	5	1.07
	FHZ	2,075	13,752	6.63	8	-1.37
Ramstein	FGZ	151	2,125	14.07	9	5.07
	FHZ	799	10,374	12.98	9	3.98
Dover	FGZ	755	6,096	8.07	6	2.07
	FHZ	1,529	12,426	8.13	5	3.13
Kadena	FGZ	410	4,797	11.70	12	-0.3
	FHZ	2,445	25,221	10.32	10	.32333
Totals		**8,490**	**76,770**	**9.04**	**8**	**1.04**

Table 3. Computed O&ST with Receipt Data with AI Receipts and Air Force Policy Truncation Percentages

NSN	SRAN	RID_FROM	OST
5120012427772	FB5621	DDQ	099
5826002557085	FB6540	DAN	099
5306013578361	FB6142	DQV	098
5895000894403	FB6011	DMJ	096
5826001345971	FB6011	DMJ	096
5826001345973	FB6011	DMJ	096
5841001345975	FB6011	DMJ	096
5826001345976	FB6011	DMJ	096
5826001345979	FB6011	DMJ	096

Table 4. Examples of Reported Excessive O&ST Values

(when fewer than 100 receipts were available). The SBSS does not compute a new O&ST if a base source-of-supply, priority-group combination has fewer than 100 receipts. There were cases where some base or source-of-supply combinations had apparently never experienced 100 receipts in a year. Thus, fields used to compute O&ST were apparently never properly initialized or prepped by the SBSS. These apparently uninitialized O&ST fields caused excessive O&ST values such as those shown in Table 4.

Including AI receipts in the O&ST computation and correcting use of the truncation percentages would help alleviate this problem. The erroneously high values caused an overstatement of O&ST. The uninitialized values were more apparent in the January RBL run because the SBSS used only 90 days of receipt data (the first quarter of FY02), highlighting more bases with routing identifiers with fewer than 100 receipts.

Including airlift investment in O&ST for reparables and correcting the truncation percentages would significantly increase the number of receipts used to compute O&ST, causing the SBSS to recompute O&ST averages each quarter. Therefore, to improve base-reported O&ST, the Air Force should include receipts for AI items in reparable calculations, and correct truncation percentages should be used to exclude receipts with depot delay.

Including airlift investment in O&ST for reparables and correcting the truncation percentages would significantly increase the number of receipts used to compute O&ST, causing the SBSS to recompute O&ST averages each quarter.

Median Analysis

There was some concern that SBSS-computed median logic is not accurate and sometimes causes reporting of excessive O&ST values to RBL. As a result, O&ST average and median values on base routing identifier records were examined. The median O&ST is used instead of the computed average whenever it is greater than the calculated average O&ST and a base routing identifier has at least 100 receipts. Table 5 shows the results of the comparison with current SBSS routing identifier record data.

For routing identifiers with at least 100 receipts, the median was the same or greater than the O&ST in 90 percent of the cases. For cases where the base routing identifier did not experience at least 100 receipts, the median would have been used 58 percent of the time, if computed accurately. Frequent use of the median is due, in part, to the truncation

A review of sample O&ST data for DLA-managed items showed truncation points for DLA-managed items were overstated, causing O&ST days to be too high.

percentage problem discussed earlier. The average O&ST was too low since it truncated 67 percent of the O&ST values instead of 33 percent and thereby understated base O&ST. Table 6 compares the median computed by the current method to the median computed accurately using AI items and the current truncation percentage.

The sample base median, when computed accurately, was always greater than the accurate O&STs—on average 1.5 days. Therefore, it seemed that using the median artificially inflated O&ST.

O&ST for DLA-Managed Items

A review of sample O&ST data for DLA-managed items showed truncation points for DLA-managed items were overstated, causing O&ST days to be too high. Tables 7 and 8 show examples of DLA average O&ST and truncation points (for CONUS bases) compared to O&ST averages and truncation points computed.

The truncation points were probably inconsistent for DLA-managed items because the current program used the previous year's data to set a truncation point. The Q05 program determined the 84th percentile observation value and used that number as the truncation point for the next year's data. Thus, the 84th percentile value with the previous year's data may not be the 84th percentile with the current

For F RID w/ 100 receipts or more (97 cases)**			
	Cases	Percent	Average Days Difference
OST > MED	10	10	-2.6
MED > OST	35	36	3.3
MED = OST	52	54	0
For F RID w/o 100 receipts (236 cases)**			
OST > MED	52	22	-5.4
MED > OST	138	58	4.7
MED = OST	46	19	0

Table 5. Median Analysis—Current Method

year's data. The proposal, which will correct base O&ST for Air Force-managed items, will also correct O&ST for DLA-managed items.

Summary

Base-reported O&ST was inaccurate. The base-reported O&ST for Air Force-managed items increased almost 2 days from October 2001 to January 2002 (from 9.2 days to 10.9 days) because of initialization problems of O&ST fields needed to compute O&ST. Many of these O&ST values were much greater than truncation points.

The SBSS excluded too much receipt data from O&ST computation. Excluding receipts from airlift investment items also affected base O&ST; that is, an accurate O&ST could not be computed at times because a sufficient number of receipts had not accumulated.

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Proposed Solutions

To correct base-reported O&ST, the SBSS should be modified to include receipts for AI items and correct the use of truncation percentages and the initialization problem. The first two changes will help resolve the initialization problem, and the items will retain their AI identification. The only change is that the AI items will be included in O&ST computation. There could still be sources of supply with fewer than 100 receipts in a quarter, even after implementing the first two changes. However, SSG resources are not available to correct the SBSS code.

Base	RID	Accurate OST	Accurate Median	Days Median > OST	Accurate Median Used	Current Median	Difference in Median
Langley	FGZ	6.07	8	1.93	✓	8	none
	FHZ	6.63	8	1.67	✓	8	none
Ramstein	FGZ	14.07	16	1.93	✓	21	+ 5 days
	FHZ	12.98	14	1.02	✓	15	+ 1 day
Dover	FGZ	8.07	9	.93	✓	8	- 1 day
	FHZ	8.13	10	1.87	✓	9	- 1 day
Kadena	FGZ	11.7	13	1.3	✓	9	- 3 days
	FHZ	10.32	12	1.68	✓	10	- 2 days

Table 6. Median Analysis—Proposed Method

Order and Ship Time—Accuracy of Base-Reported Values

In the short-term, the Supply User Report Generator (SURGE) program should be used to compute base O&ST. It will scan base transaction history records each quarter and collect a year's receipt data for both Air Force-managed and DLA-managed items. It also will apply the correct truncation percentage and generate a file of FCL3 images. The FCL transactions would then update the base O&ST data on the routing identifier record with accurate O&ST data.

The FCL transaction would only update the O&ST average; it cannot update the median value (it only updates three positions of the five-position field that contains both the O&ST and the median value). The median field would contain all zeros. Therefore, the SBSS would no longer use the median if it exceeds the average O&ST.

The SURGE program offers some advantages over the current method of computing O&ST, even if the current method could be corrected. It always uses a year's worth of receipt data. The current (Q05) program uses 90, 180, 270, and 365 days of data for December, March, June, and September runs, respectively. The SURGE program will help ensure sufficient receipts to compute a new O&ST

BASE	RID	AFLMA OST PG 1 &2 (FAST)	SBSS OST PG 1&2 (FAST)	Diff SBSS OST FAST to AFLMA OST FAST	AFLMA OST PG 3 (SLOW)	SBSS OST PG 3 (SLOW)	Diff SBSS OST SLOW to AFLMA OST SLOW
4469	S9I	5.96	7	1.04	7.67	9	1.33
4661	S9I	6.40	6	-0.40	9.24	9	-0.24
4661	S9C	5.11	7	1.89	8.89	10	1.11
4661	S9G	6.50	7	0.50	9.56	9	-0.56
4804	S9C	6.09	10	3.91	6.89	83	76.11
4809	S9I	5.60	5	-0.60	10.61	11	0.39
4852	S9C	6.23	7	0.77	8.43	9	0.57
4852	S9E	5.33	7	1.67	7.77	9	1.23
4852	S9I	5.90	7	1.10	8.63	10	1.37
4852	S9G	6.77	7	0.23	8.67	9	0.33
4872	S9I	7.22	14	6.78	6.68	83	76.32
4872	S9C	6.48	15	8.52	6.70	83	76.30
4897	S9I	6.93	7	0.07	9.50	9	-0.50
4897	S9G	6.75	7	0.25	9.25	9	-0.25
Average Difference				**1.84**			**16.68**

Table 7. Examples of DLA O&ST Comparison

average. In addition, the SURGE program will always truncate the right number of receipts since it uses the same data to truncate as it does to compute the average. The Q05 uses the previous year's data to set the truncation point and then uses that truncation point for the current year. Thus, if O&ST values are decreasing (or increasing), the current program will truncate too many (or too few) receipts. Figure 2 shows the proposed O&ST computation process.

Order and Ship Time—Accuracy of Base-Reported Values

Computation of a reasonable approximation of O&ST, using the logic of the proposed SURGE program, measured the impact of the proposed surge on reported O&ST values. The currently reported O&ST for Air Force-managed (XD) items is 10.5 days; an approximation using the SURGE program computes an O&ST of 7.1 days.

One concern regarding the proposed SURGE program is its run time. The time it would take to scan a year's worth of transaction records may be prohibitive.

To ensure a new O&ST value is computed and reported, a minimum of 25 receipts should be established instead of

BASE	RID	AFLMA TRUN-CATION POINT (FAST)	SBSS TRUN-CATION POINT (FAST)	Diff SBSS TP I to AFLMA TP I	AFLMA TRUN-CATION POINT (SLOW)	SBSS TRUN-CATION POINT (SLOW)	Diff SBSS TP II to AFLMA TP II
4469	S9I	11.61	11	-0.61	11.86	32	20.14
4661	S9I	12.38	15	2.62	13.44	32	18.56
4661	S9C	8.10	11	2.90	12.66	43	30.34
4661	S9G	11.68	32	20.32	13.13	30	16.87
4804	S9C	9.40	30	20.60	11.27	60	48.73
4809	S9I	13.32	20	6.68	14.88	49	34.12
4852	S9C	10.57	11	0.43	12.71	17	4.29
4852	S9E	9.01	10	0.99	11.94	14	2.06
4852	S9I	11.62	14	2.38	13.28	34	20.72
4852	S9G	11.90	15	3.10	13.67	40	26.33
4872	S9I	10.52	0	-10.52	10.09	0	-10.09
4872	S9C	9.83	0	-9.83	10.10	0	-10.10
4897	S9I	11.94	16	4.06	13.16	32	18.84
4897	S9G	12.25	21	8.75	13.32	44	30.68
Average Difference				**3.70**			**17.96**

Table 8. Examples of DLA Truncation Comparison

At an average base, there are only about 200 Air Force-managed, consumable-item NSNs loaded, and fewer than 50 of those have any demand (and receipt activity). Air Force-managed consumables are the only Air Force-managed items that can use routine transportation.

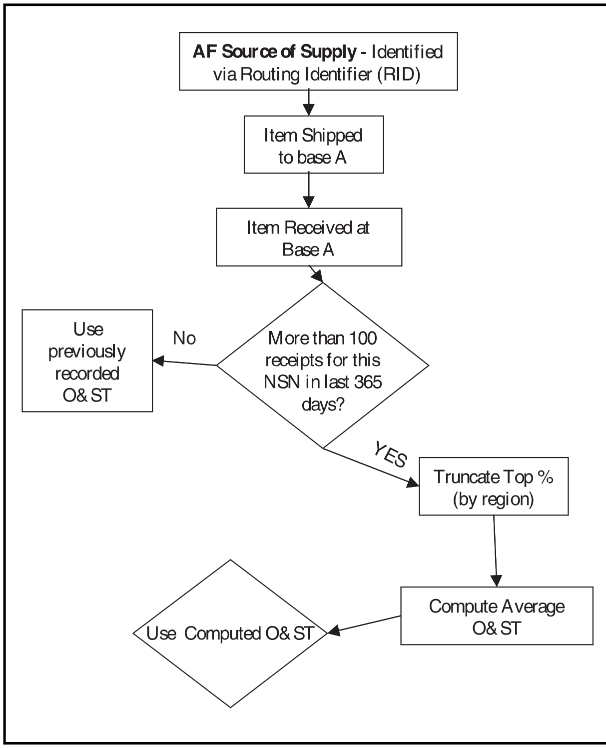


Figure 2. Proposed O&ST Computation Process

100 receipts. The SURGE program then will compute an average O&ST for Air Force-managed consumable items using at least 25 receipts for those items coded as using routine transportation (for transportation denial code other than F) and a Uniform Materiel Movement and Issue Priority System priority of 08 or greater for CONUS bases and 06 or greater for outside the CONUS (OCONUS) bases. OCONUS bases use priority 06 for routine replenishment of stock levels. There still may be a problem recording enough receipts to compute a new O&ST for Air Force-managed consumable items. At an average base, there are only about 200 Air Force-managed, consumable-item NSNs loaded, and fewer than 50 of those have any demand (and receipt activity). Air Force-managed consumables are the only Air Force-managed items that can use routine transportation. So priority group 03 (routine) O&ST only

use receipts for Air Force-managed consumable items, and there may not be 100 receipts in a year.

Conclusions and Recommendations

Conclusions

Base-reported O&ST values are incorrect for three reasons:

- SBSS incorrectly calculated truncation points.
- Some fields in base routing identifier records were not initialized.
- Too few receipts were used throughout the computation process, thereby biasing the calculation of averages. Two days of inaccurately reported O&ST could generate a requirement for $43M in additional pipeline inventory.

Recommendations

The long-term recommendation is to modify the SBSS to include receipts for AI items in O&ST computation, correct the use of truncation percentages, eliminate the median value check, and use 25 or more receipts to compute a new average.

The long-term recommendation is to modify the SBSS to include receipts for AI items in O&ST computation, correct the use of truncation percentages, eliminate the median value check, and use 25 or more receipts to compute a new average.

The short-term recommendation is to approve the use of a SURGE program to scan base transaction history records each quarter to compute a more accurate O&ST. The SURGE should use accurate truncation percentages and include AI receipts in O&ST computation and compute O&ST averages when there are at least 25 receipts.

The Air Force Stockage Policy Working Group and the Air Force Supply Executive Board approved all recommendations for implementation.

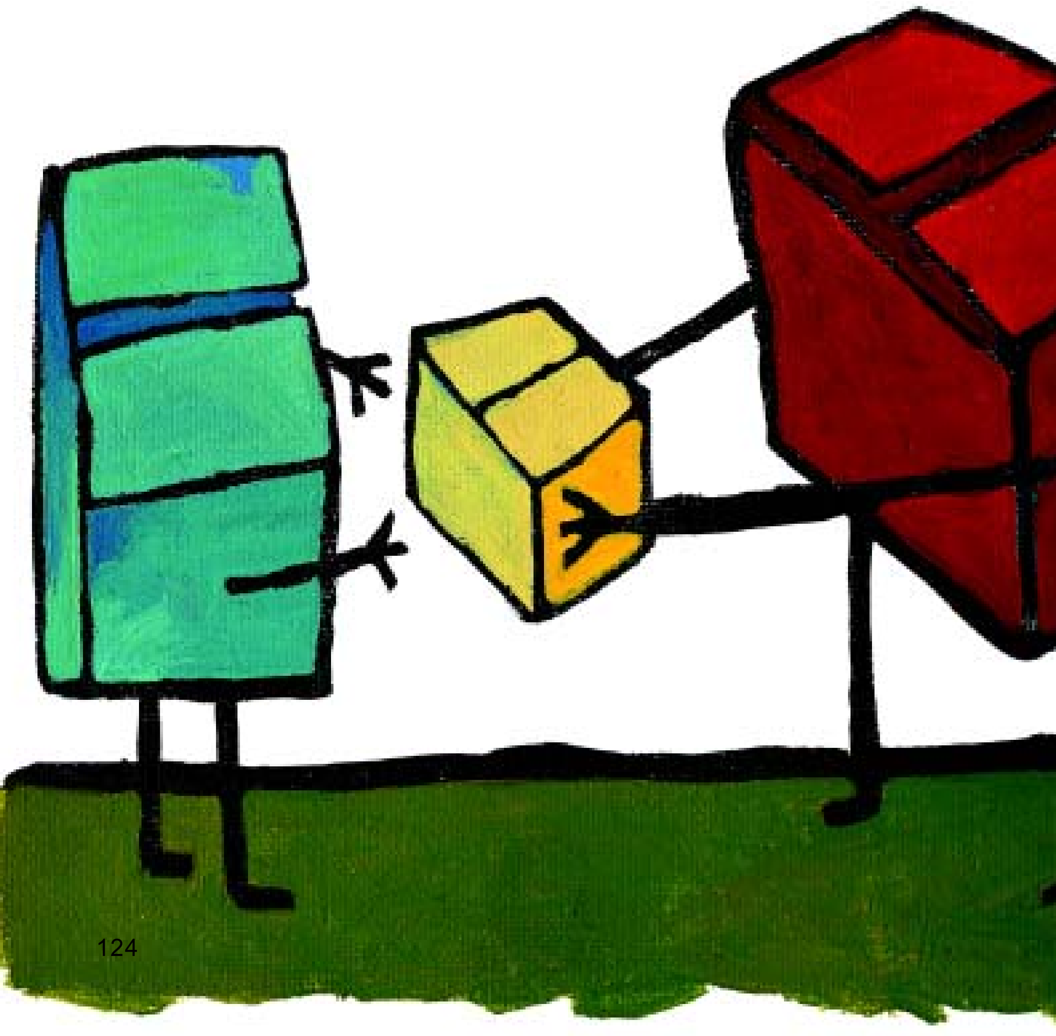
Benefits

Accurate O&ST allows for accurate computation of Air Force buy and repair requirements. Correcting the O&ST error allows the Air Force to avoid the additional $43M in requirements created by just 2 days' increase in O&ST.

Notes

1. Lean Logistics is providing the right parts to the right place, as soon as possible, with as few system resources as possible by focusing on meeting customer mission requirements, applying modern business practices, and making system-wide changes or process reengineering.

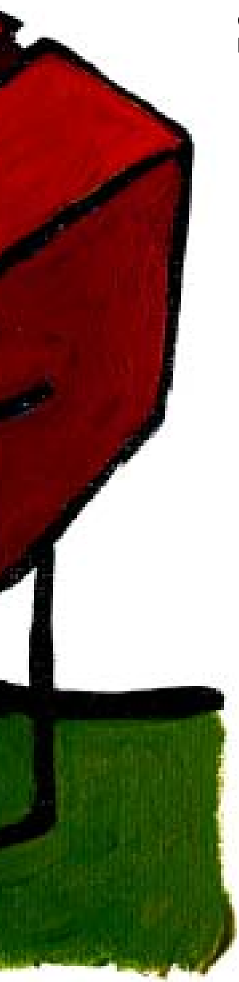
Improving



Increasing the safety level multiplier from 1 to 2 theoretically increases the replenishment-time fill rate from 84 to 97 percent. However, actual practice does not always follow theory.

Supply Support

selectively applying safety-level multipliers



Readiness-based leveling is used to set base demand levels for Air Force-managed reparable items. It allocates the worldwide requirement to all using bases to minimize expected back orders.

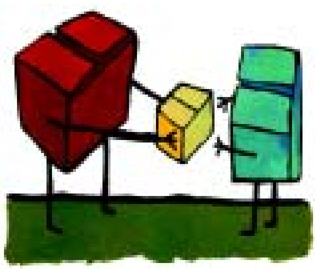
Captain Christopher A. Boone

Introduction

Currently, the Air Force provides higher levels of supply support for bases outside the continental United States (OCONUS). These bases achieve higher levels of support because they use higher safety levels. OCONUS bases are authorized a only safety-level multiplier of 2 for weapon-system items. Conversely, CONUS bases are authorized a multiplier of 1. The Standard Base Supply System (SBSS) calls the safety-level multiplier the *C factor*.

Assuming a normal distribution for demand during replenishment lead time, a C factor of 1 provides a fill-rate probability of 84 percent. For a normal distribution, the mean (X), plus one standard deviation (X+1S), covers 84 percent of the probability. A C factor of 2, meaning the mean plus 2 standard deviations of demand during the replenishment lead time, yields a fill rate of 97 percent. Worth noting is the concept of diminishing returns. Increasing the C factor from 0 to 1 achieved a 34-percent (50 percent to 84 percent) increase in fill rate (reduction in the probability of a back order). Increasing the C factor from 1 to 2 achieved a 13-percent (84 to 97 percent) fill-rate increase. Increasing the C factor from 2 to 3 achieves less than a 3-percent (97 to 99.7 percent) fill-rate increase. However, if the item is expensive, increasing the safety levels could cost more than the expected back-order reduction is worth or the Air Force is willing to spend.

Increasing the safety-level multiplier from 1 to 2 theoretically increases the replenishment-time fill rate from 84 to 97 percent. However, actual practice does not always follow theory. Demand is not necessarily normally distributed. In addition, estimates of demand and lead time are not always perfect. Nonetheless, higher safety levels will yield higher supply support in the long run, as shown by the current OCONUS and CONUS stockage effectiveness rates.



Background

The Air Force uses readiness-based leveling to set base demand levels for Air Force-managed reparable (XD) items.

In the late 1980s, an Air Force Logistics Management Agency (AFLMA) study (LS831107, *Alternative Approaches to the Standard Base Supply System Economic Order Quantity Depth Model*) compared levels resulting from a back-order optimization model to the current Air Force economic order quantity (EOQ) cost-minimization, fixed-safety-level approach. The back-order optimization model significantly reduced back orders and increased stockage effectiveness. Although the model was considered too complex for SBSS use, AFLMA compared the levels it generated to SBSS EOQ demand and reorder levels. Compared to the EOQ model, the back-order optimization approach had significantly larger safety levels for selected high-demand, low-cost items. The AFLMA study recommended and the Air Force approved increased safety levels for selected high back-order items. However, the AFLMA-recommended policy was not implemented because of a lack of funds.

The study and analysis described below built on the previous effort and emulated the back-order optimization levels for high-demand, low-cost items. It also included mission-impact thresholds. By selecting items with a mission-impact code (MIC) of 1 or 2, the analysis targeted previous mission-capable (MICAP [MIC 1]) and high-priority back-ordered items (MIC 2).

The overall objective was to determine the impact of changing safety levels to reparable (XD) and consumbable (SB and XF) items on:

- Inventory cost
- Level of support—annual expected back-ordered (AEBO) units, expected stockage effectiveness, and mission capability (aircraft availability and cannibalization)

Research and Analysis

Reparable Item Methodology

The Air Force uses readiness-based leveling (RBL) to set base demand levels for Air Force-managed reparable (XD) items. RBL allocates the worldwide requirement to all using bases to minimize expected back orders (EBO). RBL allocates each successive unit of the worldwide requirement to the base with the highest decrease in EBOs. For example, if Base A achieves a .05 decrease in EBO with a level increase of 1 while Base B achieves a .055 decrease in EBO with the same increase, RBL will allocate the next unit to Base B. RBL differentiates between CONUS and OCONUS bases by their C factor. For OCONUS bases (authorized a C factor of 2), RBL multiplies the EBO decrease by 1.15 (97 percent divided by 84 percent—the expected fill-rate percentage for two standard deviations divided by the expected fill-rate percentage for one standard deviation). Using the example, assume Base A is an OCONUS base and has a C factor of 2. RBL would multiply Base A's expected EBO reduction of .05 by 1.15. Base A's new EBO reduction would be .057—RBL would allocate the next level to Base A instead of Base B. The C factor does have an impact but only when two competing bases have very similar EBO reductions. In essence, the C factor becomes a tiebreaker.

A major goal of the study was to measure the impact of excluding all C factors of 2 on RBL levels and EBOs. The July 2001 RBL run had 404,768 stock number (national

Equalizing C factors (making all bases use a C factor of 1) had little impact on XD levels and EBOs. Therefore, no change to XD item stockage policy is recommended.

stock number [NSN]-Stock Record Account Number [SRAN]) base-level allocations. There were 49,280 NSN-SRANs with a C factor of 2, and 19,023 of them had a positive daily demand rate and, therefore, had an EBO reduction. Thus, less than 4 percent (19,023/404,768) of the RBL NSN-SRAN cases could be affected by C factor changes.

Reparable Item Research and Analysis

The July 2001 RBL input data were run through RBL, and all C factors were set to 1. Using a C factor of 1, there were 954 level changes and a decrease of 4.68 Air Force-wide EBOs. Table 1 provides the results.

At OCONUS bases, 483 levels changed; 12 went from one OCONUS base to another. A total of 471 levels moved from OCONUS to CONUS bases. These level changes increased OCONUS EBOs by 39.42 and decreased CONUS EBOs by 44. Air Force-wide, RBL estimated approximately 10,000 EBOs for items with RBL-pushed levels, so the decrease of 4.68 EBOs was a net EBO reduction of .04 percent. Equalizing C factors (making all bases use a C factor of 1) had little impact on XD levels and EBOs. Therefore, no change to XD item stockage policy is recommended.

Consumable Item Methodology

Several alternatives were evaluated for increasing safety levels for consumable items (XB and XF). For an eight-base sample (three Air Combat Command [ACC], three Air

NSN-SRANs	LEVEL CHANGES	EBO CHANGE
OCONUS Bases		
Increases	12	-0.1
Decreases	471	39.42
CONUS Bases		
Increases	471	-44
Decreases	0	
Total	954	-4.68

Table 1. XD Level and EBO Changes

National Guard [ANG], and two OCONUS bases), the cost and back-order impact of changing safety levels for all and for selected groups of items was compared. To compute the impact, SBSS depth formulas found in Air Force Manual (AFMAN) 23-110, *USAF Supply Manual*, were used.

Consumable Item Research and Analysis

Various groupings of items were evaluated based on the AFLMA study that emulated back-order optimization levels. From this, the cost and annualized AEBO difference for each alternative at sample bases were determined. These results were then used to estimate the impact for their respective major commands (MAJCOM), then all CONUS MAJCOMs, and finally, all MAJCOMs. Table 2 provides the various XB policy alternatives evaluated.

Since the goal was to maximize AEBO reduction while minimizing cost, the analysis began by using all items and then selected fewer and fewer items based on cost, mission impact, and demand criteria. Ultimately, the purpose of the analysis was to determine the grouping that reduced AEBOs most efficiently. Table 3 provides the results for all XB items (budget code 8 and 9) at Langley AFB, Virginia, that have a demand level.

Changing the C factor to 2 for all XB items (Alternative 1) increased the demand-level cost (DL $) by $675K and resulted in a reduction of 12,559 units back ordered annually at Langley AFB (from the baseline case of all items having a C factor of 1). Establishing a price threshold decreased the number of items that would receive an increase in safety level (Alternative 2) and reduced the total cost increase, but it reduced the decrease in AEBO units from Alternative 1. Selecting only MIC 1 and 2 items further reduced the number of items (Alternative 3) that would receive increased safety levels but further reduced the decrease in AEBO units. Adding more expensive, high-demand MIC 1 items increased the number of items with increased safety levels and, thus, cost but also slightly increased the number of AEBO units reduced. Selecting very low-cost, high-demand items for even larger safety levels (C factor of 3) added some cost but significantly increased the reduction in units back ordered (Alternative 5). From Table 3, one should also note that increasing safety levels for all items was not efficient. A greater AEBO

Since the goal was to maximize AEBO reduction while minimizing cost, the analysis began by using all items and then selected fewer and fewer items based on cost, mission impact, and demand criteria. Ultimately, the purpose of the analysis was to determine the grouping that reduced AEBOs most efficiently.

XB Alternative #	Abbreviated Logic	Complete Logic
1	All C 2	All items receive a C factor of 2.
2	<$300 Alternative	All items with a unit price less than $300 receive a C factor of 2.
3	<$300 MIC 1,2	All items with a unit price less than $300 and a MIC code 1 or 2 receive a C Factor of 2.
4	<$300 MIC 1,2 and MIC 1 > $300 with DDR > .3	All items with a unit price less than $300 and a MIC code 1 or 2 and all MIC 1 items with a DDR >.3 receive a C factor of 2.
5	<$300 MIC 1,2 and MIC 1 > $300 with DDR > .3 and C3 for MIC 1,2 <$25 & DDR >.1	All items with a unit price less than $300 and a MIC code 1 or 2 and all MIC 1 items with a DDR >.3 receive a C factor of 2. All MIC 1 and 2 items with a unit price <$25 and a DDR >.1 receive a C factor of 3.
6	<$100 MIC 1,2 and MIC 1 > $100 with DDR > .3 and C3 for MIC 1&2 <$25 & DDR >.1	All items with a unit price less than $100 and a MIC code 1 or 2 and all MIC 1 items with a DDR >.3 receive a C factor of 2. All MIC 1 & 2 items with a unit price <$25 and a DDR >.1 receive a C factor of 3.

Table 2. XB Policy Alternatives

reduction was achieved at a lower cost by using Alternative 5 vice using a C factor of 2 for all items. Fewer items were targeted with Alternative 6 as part of the efforts to identify a cost-neutral policy alternative. By applying Alternative 6 to both CONUS and OCONUS bases, the Air Force can reduce AEBOS at nearly no cost.

Figure 1 demonstrates the cost characteristic of the XB items. The majority of XB items are inexpensive. Nearly 65 percent of these items cost $25 or less, while 80 percent of all XB items cost less than $100. Therefore, with the proposed policy alternatives, various subsets of 80-90 percent of the XB items are targeted.

Next, XF items were examined. Table 4 provides the various XF alternative policies evaluated.

Table 5 provides the results of applying these alternatives for XF items at Langley AFB.

For the C=2 case (which is similar to the overseas policy), there is a relatively large increase in demand-level cost for the small decrease in AEBOs (compared to results for XB items). However, reducing the number of items with C=2, by setting price and mission-impact thresholds, reduces the cost increase significantly. Comparing the AEBO reduction to XB items, it was more efficient to increase safety levels for XB items than XF items. At the very least, an approach that reduces the number of XF items using a C factor of 2 would seem to be promising.

XB Alternative	Logic	Increased DL $	Decreased AEBO units	% of Items with Increased Levels
1	All (C=2)	$675	12,559	100
2	<$300	$185K	12,196	90
3	<300 MIC 1,2	$178K	11,651	84
4	#3 & MIC 1 > $300 with DDR >.3	$193K	11,724	84
5	# 4 & C3 for MIC 1 & 2 <$25 & DDR> .1	$211K	14,361	84
6	<100MIC 1,2 & # 4 & #5	$131K	14,002	75

Table 3. Langley XB Analysis

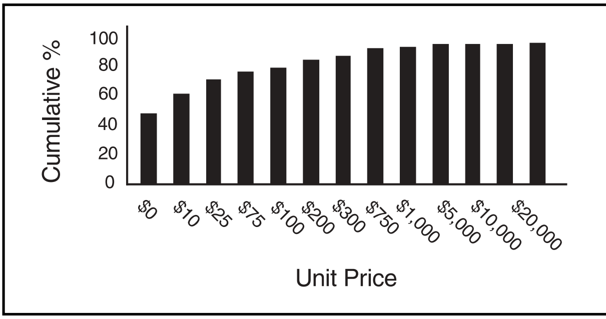


Figure 1. Cost Characteristics of XB Items

XF Alternative #	Abbreviated Logic	Complete Logic
1	All C 2	All items receive a C factor of 2.
2	<$750	All items with a unit price under $750 receive a C factor of 2.
3	<$750 MIC 1,2	All MIC 1 and 2 items with a unit price under $750 receive a C factor of 2.
4	<$1,000 MIC 1,2	All MIC 1 and 2 items with a unit price under $1K receive a C factor of 2.
5	<$2,000 MIC 1,2	All MIC 1 and 2 items with a unit price under $2K receive a C factor of 2.
6	All C 1	C factor of 1 for all items (CONUS Baseline).

Table 4. XF Policy Alternatives

XB Alternative	Logic	Increase DL$	Decrease AEBO units	% of Items with Increased Levels
1	All C2	$245K	265	100
2	<$750	$35K	120	45
3	<750 MIC 1,2	$34K	120	45
4	<$1000 MIC 1,2	$43K	148	55
5	<2000 MIC 1,2	$76K	215	81

Table 5. Langley XF Analysis

CONUS Cost Estimate. Next, the results were generalized Air Force-wide, starting with the CONUS cost estimates. For the alternative with the most AEBO reduction (alternative 5 for XB and alternative 3 for XF), the percentage of change to total demand-level cost was estimated to estimate MAJCOM-wide cost changes. Table 6 and 7 show the percent of cost increases for the six sample bases.

The weighted average-percentage increase across the three ACC bases was 6.98 for XB Alternative 5 and XF Alternative 3. For the smaller ANG bases, the percent increase for the same alternatives was 9.03. Next, these percentages were applied to each MAJCOM demand-level cost totals. Applying the results from ANG to Air Force

	Delta DL ($000)	Total Stock ($000)	% Increase
Shaw	228	3,019	7.55
XB	197	2,538	7.76
XF	31	481	6.44
Langley	245	3,505	6.99
XB	211	3,021	6.98
XF	34	484	7.02
Seymour Johnson	347	5,225	6.64
XB	292	3,946	7.40
XF	55	1,279	4.30
Totals	**820**	**11,749**	**6.98**

Table 6. CONUS (Active Bases) Percentage Demand-Level Cost Change Computation

When evaluating OCONUS bases, the initial assumption was that the C factor of 2 was applied to all weapon-system items (Air Force policy). However, during the analysis, it became clear that not all items had a C factor of 2.

	Delta DL ($000)	Total Stock ($000)	% Increase
Fresno	50	507	9.86
XB	36	404	8.91
XF	14	103	13.59
Portland	149	1649	9.04
XB	123	1266	9.72
XF	26	383	6.79
Otis	55	658	8.36
XB	44	550	8.00
XF	11	108	10.19
Totals	**254**	**2814**	**9.03**

Table 7. CONUS (ANG Bases) Percentage Demand-Level Cost Change

Reserve Command (AFRC) data assumes that supply demand levels for these two commands are similar.

Table 8 applies the ANG percentage to the AFRC total demand-level cost and ACC's percentage to the other CONUS MAJCOM demand-level costs, using the results from six sample bases for XB Alternative 5 and XF Alternative 3. This assumes that supply demand and item characteristics experienced by ACC are similar across MAJCOMs. XB item characteristics and policy impact for a base from each of these commands were reviewed to validate this assumption.

Table 8 includes the total increase in budget code 9 demand levels for Alternatives 5 for XB and 3 for XF. CONUS-wide the total cost is $20M, with a reduction of 952,000 AEBOs.

OCONUS Cost Estimate. When evaluating OCONUS bases, the initial assumption was that the C factor of 2 was applied to all weapon-system items (Air Force policy). However, during the analysis, it became clear that not all items had a C factor of 2. The final recommendations are based on a comparison of the proposed policies and the current C factor application (baseline). With this in mind, the cost of each alternative was structured so that comparisons could be made to both the C factor of 2 for all items and to the baseline, which represents the C factor policy as it is implemented today.

Air Force policy calls for OCONUS bases to apply a C factor of 2 to all weapon-system items. However, the CONUS analysis demonstrated that applying a C factor of 2 to all items is not efficient and proposed a more efficient policy for all CONUS bases. The recommended policy does not directly target weapon-system items. Rather, targeting

MAJCOM	Total DL$	% Increase	$ Increase
ACC	$72,779,824	6.98	$5,080,032
ANG	$12,186,563	9.03	$1,100,447
AFRC	$19,730,033	9.03	$1,781,622
SPACECOM	$8,652,762	6.98	$603,963
AMC	$63,381,825	6.98	$4,424,051
AETC	$41,020,936	6.98	$2,863,261
AFSOC	$6,533,953	6.98	$456,070
AFMC	$53,094,650	6.98	$3,706,007
Totals	**$277,380,546**		**$20,015,452**

Table 8. Estimated CONUS Demand-Level Increase Alternative 5 (XB) and 3 (XF)

Alternative	Logic	Demand Level $$ (C2)	AEBO Units	% of Items
	Baseline	$9,408,128	24,240	-
	All (C=1)	$7,790,291	65,057	100.0
1	All (C=2)	$10,275,555	13,501	100.0
2	<$300	$8,571,793	14,271	91.0
3	<300 MIC 1,2	$8,476,593	19,383	76.4
4	#3 & MIC 1 with DDR >.3	$8,501,271	19,308	76.5
5	# 4 & C3 for MIC 1 & 2 <$25 & DDR> .1	$8,577,033	9,585	76.5
6	<100MIC 1,2 & DDR >.3 and C3 for MIC 1,2 with DDR >.1	$8,273,689	10,635	76.5

Tablee 9. Kadena XB Demand-Level Cost and AEBO Totals

Alternative	Logic	Demand-Level Costs	AEBO Units	% of Items
	Baseline	$2,874,101	645	-
1	All C=2	$3,067,522	561	100
2	<$750	$2,028,731	982	49
3	<750 MIC 1,2	$2,021,854	1001	46
4	<$1000 MIC 1,2	$2,059,870	943	51
5	<2000 MIC 1,1	$2,211,991	753	70
6	All C=1	$1,897,005	1295	100

Table 10. Kadena XF Demand-Level Costs and AEBO Totals

MIC items allows focus on those items with a significant mission impact such as previous MICAPs and high-demand back orders. This proposed policy was evaluated for applicability in the OCONUS environment. Tables 9 and 10 provide the XB and XF results for Kadena AB, Japan.

Note from Table 9, by *decreasing* the C factor from 2 to 1 for high-cost, low-demand items and *increasing* C factors from 2 to 3 for low-cost, high-demand items (Alternatives 5 and 6 for XB), the Air Force can actually reduce AEBOs at Kadena (from 13,501 to 9,585 or 10,635) with a demand-level reduction (from $10.2M to $8.5M or $8.3M). Alternatives 5 and 6 retain or increase the C factor for 76.5 percent of the items, reduce the demand-level cost by nearly $2M, and decrease AEBOs by about 3,000 compared to the current Air Force policy (C=2).

Table 10 indicates that the all C=2 policy for XF items is inefficient. The C factor of 2 policy increased demand levels by $1.2M ($3.1M-$1.9M) over a C factor of 1 policy and reduced only 734 (1,295-561) AEBOs. Applying increased C factors to selected items reduced the inefficiency, but it is still inefficient.

The impact on the OCONUS demand level was estimated the same as for the CONUS. Table 11 illustrates the impact of implementing the proposed policy at the two OCONUS sample bases.

Next, the 19.6-percent decrease was applied to the demand-level cost for budget code 9 items at all United States Air Forces in Europe (USAFE) and Pacific Air Forces (PACAF) bases. Table 12 shows how the AFLMA-proposed policy alternatives (5 for XB and 3 for XF) reduced the OCONUS demand-level cost by $13.9M, while reducing 15,000 AEBOs (compared to the all C=2 policy).

Proposal. Up to this point in the analysis, the results for the policy alternatives that resulted in the most AEBO reductions (Alternative 5 for XB and Alternative 3 for XF) have been highlighted. This policy would increase CONUS demand levels for budget code 9 items by $20M and decrease OCONUS levels by $13.9M, while decreasing 967,000 (952,000 CONUS plus 15,000 OCONUS) AEBOs annually.

The next step was to provide a cost-neutral option. Table 13 compares the costs and impact on AEBOs for the

	Delta DL($000)	Total Stock ($000)	% Reduction
Kadena	**2,743**	**13,342**	**20.56**
XB	**1,698**	**10,275**	**16.53**
XF	**1,045**	**3,067**	**34.07**
Aviano	**817**	**4,824**	**16.94**
XB	**598**	**4,062**	**14.72**
XF	**219**	**762**	**28.74**
Totals	**3,560**	**18,166**	**19.60**

Table 11. OCONUS Demand-Level Cost Reduction (Alternative 5 for XB and Alternative 3 for XF)

	Total DL$	***% Decrease***	***$ Decrease***
USAFE	$28,512,413	19.60	$5,588,433
PACAF	$42,818,000	19.60	$8,392,328
Totals	**$71,330,413**		**$13,980,761**

Table 12. OCONUS Costs

XB Alt	XF Alt	Proposal	CONUS Cost Increase (Millions)	OCONUS Cost Decrease (Millions)	Total AF Cost	AEBO Reduction
5	3	Initial Proposal	$20.0	**($13.9)**	6.1	.967M
5	6	Exclude XF	$16.9	**($14.6)**	2.3	.898M
6	6	Cost-Neutral	$10.1	**($16.4)**	-6.3	.835M

Table 13. Policy Alternatives, Assuming C=2 for all OCONUS Demand Levels

three most promising alternatives, including cost-neutral policy alternatives.

The initial proposal (XB Alternative 5 and XF Alternative 3) would cost $6.1M Air Force-wide ($20M CONUS increase and $13.9M OCONUS decrease) and reduce 967,000 AEBOs. Excluding all XF items (Alternative 5 for XB and 6 for XF) from getting increased safety levels reduced the CONUS cost increase by $3M and increased the OCONUS cost decrease by $700K. Higher C factors were not efficient for XF items, so there was minimal dropoff in the AEBO reduction. The cost-neutral policy (Alternative 6 for XB and 6 for XF) reduced the number of XB items that receive increased safety levels by reducing the cost threshold from $300 to $100.

As mentioned earlier, all items at OCONUS bases received a C factor of 2. Therefore, it appeared that applying XB Alternative 6 and XF Alternative 6 would reduce Air Force demand levels by $6.3M. However, a C factor of 2 was applied to approximately 69 percent of the items at OCONUS bases (based on a sample of nine USAFE and PACAF bases). As a result, to assess the true impact of the proposed policy, actual demand-level costs were computed using current C factors. This revealed that the true decrease in OCONUS demand levels would be $12.2M, not $16.4M as originally thought. Table 14 illustrates this difference.

Considering current, actual demand-level costs, the cost-neutral policy (Alternative 6 for XB and Alternative 6 for XF) would provide increased safety levels for 70-80 percent of the XB items, reduce 904,000 AEBOs, and actually *reduce* Air Force-wide, demand-level costs by $2.1M. This indicates the cost-neutral alternative (Alternative 6 for XB and XF) should be implemented Air Force-wide. The cost-neutral policy will result in an approximate 2 to 3 percent increase in stockage effectiveness at CONUS bases and a slight increase in stockage effectiveness at OCONUS bases.

XB Alt	XF Alt	Proposal	CONUS Cost Increase (Millions)	OCONUS Cost Decrease (Millions)	Total AF Cost	AEBO Reduction
6	6	Cost-Neutral (All C2)	$10.1	**($16.4)**	-6.3	.835M
6	6	Cost-Neutral (Actual)	$10.1	**($12.2)**	-2.1	.904M

Table 14. Cost-Neutral Policy Alternatives with Current OCONUS C Factor

Improving Supply Support—Selectively Applying Safety-Level Multipliers

AFLMA recommends no increased C factors for XF items and still stands by its originally proposed alternative that reduces worldwide inventory by $2.1M and reduces 904,000 AEBOs.

As part of the study, ACC requested that policies be identified to improve supply support for homeland defense. Applying the proposed policy to homeland defense bases will cost only $3.9M and reduce 328,000 AEBOs. This cost was defined by using the cost increase for all CONUS ACC, ANG, and AFRC bases. Homeland defense included support to F-15, F-16, KC-135, C-130, and E-3 weapon systems. Homeland defense, then, was more than just ACC, ANG, and AFRC bases, and not all ACC, ANG, and AFRC bases support homeland defense. However, there was no good way to apply the proposed policies to selected weapon systems, since there is currently no accurate method to identify items by weapon system. In spite of the difficulties, Alternative 6 for XB and 6 for XF are the best choice for implementation Air Force-wide. The proposed policy provides benefits to all weapon-system items, decreases MICAPS, and increases stockage effectiveness 2 to 3 points at no cost. Applying these changes to *all* CONUS bases (and not changing any OCONUS policies) will cost $10.1M and reduce 829,000 AEBOs.

At the March 2002 Air Force Stockage Policy Working Group (AFSPWG), AFLMA recommended reducing the C factor to 1 for all XF items at all bases, as described previously. However, OCONUS base representation wanted to retain a C factor of 2 for at least some of the XF items. To satisfy the concerns of the OCONUS MAJCOMs, additional alternatives were evaluated. Table 15 presents the results of the additional analysis.

Air Force Supply Executive Board (AFSEB) Additional Option 1. If the Air Force implemented the XB policy Air Force-wide (all MAJCOMs agreed with the proposed XB policy) but did not change the OCONUS bases' C factors for XF items (remain as they are today), it would increase inventory by $2.9M and reduce 907,000 AEBOs. That would be $5M ($12.2M-$7.5M) for 3,000 (90,000-904,000) AEBOs compared to the AFLMA proposal.

AFSEB Additional Option 2. If the Air Force implemented the XB proposal but OCONUS bases retained the C factor of 2 for XF items with a unit cost of $750 or less, the Air Force-wide inventory reduction would be

$1.3M, and there would be a reduction of 905,000 AEBOs. Increasing inventory by $800,000 would reduce 1,000 AEBOs compared to the AFLMA proposal. That alternative seemed acceptable to the OCONUS bases representative at the AFSPWG. This option is still cost-neutral.

AFSEB Additional Option 3. The final alternative is the AFLMA proposal for XB, which applies a C factor of 2 for all bases (not just OCONUS) and a C factor of 2 for XF items under $750. That would *increase* worldwide inventory by $1.8M and reduce 943,000 AEBOs. Compared to the AFLMA-proposed policy, it would increase inventory by nearly $4M and decrease AEBOs by 39,000.

AFLMA recommends no increased C factors for XF items and still stands by its originally proposed alternative that reduces worldwide inventory by $2.1M and reduces

OCOUNS XF Alt	Proposal	CONUS Cost Increase (Millions)	OCONUS Cost Decrease (Millions)	Total AF Cost	AEBO Reduction
6	AFLMA Cost Neutral Proposal (Original)	$10.1	($12.2)	($2.1)	.904M
Current C factor	AFLMA Proposal ($100) for XB and - No Change to current XF C factors for OCONUS	$10.1	($7.2)	$2.9	.907M
3	AFLMA Proposal ($100) for XB and - C factor of 2 for OCONUS MIC 1,2 XF < 750	$10.1	($11.4)	($1.3)	.905M
3	AFLMA Proposal ($100) for XB and - C factor of 2 for CONUS & OCONUS MIC 1,2 XF < 750	$13.2	($11.4)	$1.8	.943M

Table 15. Additional Alternatives Requested by the AFSPWG

Using this range of numbers in the aircraft availability prediction model, an increase of 129 to 258 aircraft annually and a reduction of 2,729 to 5,458 cannibalizations annually was estimated.

904,000 AEBOs. However, the third alternative on the chart (Alternative 6 for XB, 6 for XF in CONUS, and 3 for XF OCONUS) also reduces inventory and retains some C factors of 2 at OCONUS accounts. This policy may be more acceptable to OCONUS commands while still meeting the intent of increasing support without increasing overall inventory costs.

An AFLMA-developed model was used to relate back-order reduction to aircraft availability, and the results indicated there would be an increase in 129 mission-capable aircraft annually if the AFLMA cost-neutral alternative were implemented. However, of the 904,000 units back ordered do not translate directly to MICAP reductions. First, the units back ordered must be converted into customer back orders. The units back ordered per NSN were divided by the average lot size (the number of units ordered per customer order) to obtain the number of customer back orders. Only about half the NSNs with increased safety levels were MIC 1 items (caused a MICAP or AWP [awaiting part] back order). Then the number of customer back orders was divided in half to get the MIC 1 customer orders back ordered. Of those MIC 1 items, it could be estimated that only one-half of those orders were for MICAP-causing items (the remaining were AWP orders). Finally, the back orders were units out of stock in supply when the item was requested. That does not necessarily mean a hole in an aircraft; it may mean a shortage in bench-stock items. About one-half to three-fourths of these customer back orders were actually bench-stock replenishments. Thus, 1,006 (assuming one-half were bench-stock back orders) to 2,012 (assuming three-fourths were bench-stock back orders) customer back orders were MICAP preventions. Using this range of numbers in the aircraft availability prediction model, an increase of 129 to 258 aircraft annually and a reduction of 2,729 to 5,458 cannibalizations annually was estimated.

Implementation Issues

Air Force-Managed Items. To implement the policy for Air Force-managed items, one must address the Requirements Management System (D200A). D200A determines the requirement for Air Force-managed items.

Changing base levels will not generate a commensurate increase in the Air Force gross requirement or the amount the Air Force buys. Increasing the levels will generate retail requisitions sooner but will not result in a commensurate increase in the D200A requirement. D200A may see a slight increase in the retail demand rates, but it will not generate increased safety-level support. The D200A safety-level (and buy) requirement is determined by the variable safety level (VSL) target D200A uses.

To increase support for Air Force-managed consumable items, the Air Force must increase the VSL target and implement the proposed C factor rules. There is no guarantee changing the VSL target will buy the same items the retail policy proposes. There is an inconsistency between the retail and wholesale policy for Air Force-managed consumable items. For the short term, the Air Force must change both the VSL target and retail policy to achieve the benefits of the retail policy change for Air Force-managed consumable items.

The cost increase of the proposed policy for Air Force-managed items was estimated to be $3.1M, resulting in a reduction of 155,000 AEBOs. These changes should result in a stockage effectiveness increase of 2 to 3 percent for budget code 8 consumable items. The Logistics Management Institute (LMI) estimated the cost to increase the VSL from its current 92-percent goal to 95 percent and from 92 to 98 percent . Table 16 provides these results.

Retail Implementation. Implementing a cost-neutral policy will not require any SBSS programming changes. The SBSS item record already has a data element for the C factor—the standard deviation field. Once the base loads a C factor of 2 (or 3), the SBSS will use that factor as a multiplier of the standard deviation to determine the safety level.

Goal	Cost Increase
92%	Current
95%	$2M
98%	$11M

Table 16. LMI Buy Cost Estimate for Varying VSL Goals

Improving Supply Support—Selectively Applying Safety-Level Multipliers

To increase support for Air Force-managed consumable items, the Air Force must increase the VSL target and implement the proposed C factor rules.

At the request of AMC, the impact of the proposed alternative on FSLs was evaluated. The analysis indicates there is little benefit to applying the proposed alternative to the FSLs. In fact, only 962 XB and 91 XF items are stocked by the FSLs.

In the near term, the MAJCOMs or the Standard Systems Group (SSG) can develop a surge program to load a C factor of 2 (or 3) on the item record of those items that qualify for the increased factor. The surge program should be run regularly (recommend quarterly) to update the C factor field.

Long-term Model. The current C factor field in the SBSS is a singe-digit field, so the only C factors allowed are 1, 2, or 3. The analysis used whole numbers for the C factor. However, it is likely there is an even more efficient policy using fractional C factors. In fact, the best way to efficiently reduce back orders is an optimization model that minimizes back orders, given some level of funding. AFMC uses a back-order minimization model, the Customer Oriented Leveling Technique, to set levels for depot retail accounts. The Air Force should explore these types of models for potential use within the Integrated Logistics System—Supply.

Variance Error. During the analysis, it was discovered that the SBSS made some erroneous variance calculations. In fact, there were variance calculations in excess of 100,000. There is a cap on the safety level, so the impact of the incorrect, extremely large variance was reduced. However, if the proposal to use C factors of 2 and 3 is adopted, large variances will have a greater impact. The SBSS software error has been identified to SSG, and they have documented it as a deficiency report. It is important that SSG fix the variance before the Air Force increases safety levels.

AMC Forward Supply Locations. At the request of AMC, the impact of the proposed alternative on FSLs was evaluated. The analysis indicates there is little benefit to applying the proposed alternative to the FSLs. In fact, only 962 XB and 91 XF items are stocked by the FSLs. The analysis also showed these items were more expensive and had less demand than a typical base. For example, only 43 percent of the FSL XB items had a unit price of $100 or less. Nearly 80 percent of the XB items at the other bases analyzed had a unit price of $100 or less. As a result, FSLs will not realize the same benefit from applying the policy that other bases would receive. Application of the proposed alternative for XF items would result in an increase of 94

AEBOs and a decrease of $577K in demand-level cost; applying it to XB items would decrease 85 AEBOs and increase demand-level costs by $531K. The results are nearly a wash: an increase of nine AEBOs with a cost decrease of $46K. Therefore, no change should be made to the safety levels for the FSLs.

AFMAN 23-110, *USAF Supply Manual*, Documentation. AFMAN 23-110 documentation is inaccurate, fragmented, and incomplete. Attachment 19A-2 is titled Formulas and Examples (Repair Cycle Demand Level) yet contains formulas for consumable safety levels. Some of the formulas are incorrect due mainly to inaccurate mathematical notation.

Implementation Timing. The cost-neutral proposal is cost-neutral Air Force-wide; it is not cost-neutral at individual bases. At CONUS bases, the levels will increase, while the levels will decrease at OCONUS bases. To avoid a large disruption in stock fund obligations, the Air Force should implement the new levels at the beginning of the fiscal year. That would provide time for OCONUS bases to *sell off* their inventory and compensate for the CONUS increases. It should take a year to *rebalance* the average inventory and stock fund obligations. The inventory level in units will increase at all bases, but Air Force-wide, the inventory dollar value will remain the same. There will be a redistribution of the inventory value, OCONUS bases will stock fewer expensive items, and all bases will stock more inexpensive items

The cost-neutral proposal is cost-neutral Air Force-wide; it is not cost-neutral at individual bases. At CONUS bases, the levels will increase, while the levels will decrease at OCONUS bases.

Conclusions and Recommendations

Conclusions

Today's policy to increase safety levels for *all* weapon-system items at OCONUS bases is inefficient. The proposed policy to selectively increase CONUS safety levels will increase supply support to homeland defense and CONUS bases and will improve support Air Force-wide. Applying the proposed policy (XB Alternative 6 [$100 threshold] and XF Alternative 6 [no XF items]) to homeland defense bases only will cost $3.9M and reduce 328,000 AEBOs.

Applying the proposed policy to all CONUS bases will cost $10.1M and reduce 829,000 AEBOs, while applying the proposed policy Air Force-wide will actually *reduce* the Air Force demand-level cost by $2.1M and reduce 904,000 AEBOs.

The proposed cost-neutral policy will increase Air Force stockage effectiveness for XB items by 2 to 3 percent and increase available aircraft by at least 129 annually. The additional alternative requested by the AFSPWG, to use the AFLMA proposal for XB items and retain increased safety levels for XF items with a unit cost of $750 or less at OCONUS bases only, is also cost-neutral and would mitigate some of the concerns of the OCONUS bases. To achieve the benefits for Air Force-managed consumable items (budget code 8 XB and XF items), the variable safety-level target in the Requirements Management System must be increased. There is an error in the SBSS calculation of variance of demand that could result in inaccurate and excessive safety levels, especially if safety levels are increased by using higher C factors. The SBSS documentation for base demand levels is incomplete and inaccurate

Recommendations

The following policy should be implemented Air Force-wide:

- Use a C factor of 2 for all MIC 1 and 2 XB items costing less than $100 and all MIC 1 items with a daily demand rate greater than .3. Use a C factor of 3 for all MIC 1 and 2 XB items costing less than $25 and a daily demand rate greater than .1. Use a C factor of 1 for all XF and the remaining XB items. Should it be necessary to retain higher safety levels at OCONUS bases for XF items, apply a C factor of 2 for XF items with a unit cost of $750 or less.
- SSG should develop a program to load the C factor of 2 (or 3) to the appropriate items, correct the SBSS code that computes the variance demand, and update and correct the *AFMAN 23-110, USAF Supply Manual,* stockage policy documentation. The Air Force should increase the D200A variable safety-level target for Air Force-managed consumable items.

Benefits

Benefits to implementing the proposals include:

- **Supply Support.** The proposed policy will decrease unit back orders by 10 percent and increase stockage effectiveness by 2 percent .
- **Mission Support.** It is estimated that the proposed C factor policy will reduce nearly 1 million expected back-ordered units and provide for an annual increase of at least 129 mission-capable aircraft.
- **Efficiency.** The current policy is inefficient. The proposed policy provides for supply and mission improvements at no additional cost to the Air Force.


7401151

Air Force-Managed Consumable Assets

utility of using readiness-based leveling

Captain Steven L. Martinez

Introduction

In the early 1990s, the Office of the Secretary of Defense directed the Air Force to transfer management of most of its consumable items to the Defense Logistics Agency (DLA). What remained under Air Force control was a small percentage of items either unique to Air Force systems or still in development. As a result, the Air Force eliminated the system used to manage consumable items at the wholesale level—the D062. The consumable items that remained under Air Force management (approximately 35,000 items, with fewer than 6,000 of these being active) were put into the D200A—the system the Air Force uses to manage reparable items—allowing cost savings by reducing the number of data systems being managed and maintained. The supposition was that the Air Force reparable-item system could adequately handle consumable items. The first step was to compute consumable-item requirements with the D200A system. The next logical step would be to use readiness-based leveling (RBL) to set base levels for these items.

Background

Function of RBL

RBL was implemented in April 1997 to allocate the worldwide recoverable item (D200A) requirement to bases and depot accounts while minimizing worldwide expected back orders (EBO). It is an optimization model that uses marginal analysis to allocate the next level to a base or depot, resulting in the largest EBO decrease. It allocates the D200A-computed requirement for all reparable items (XD1 and XD2) among Air Force bases, supporting repair activities, and depot retail activities (such as programmed depot maintenance and engine overhaul).

Two key assumptions made in the RBL model are that items are repaired at the depot and items are leveled under a use-one, order-

one (S, S-1) policy. The pipeline quantity calculation used by RBL includes a value for depot repair cycle time, since RBL was designed as a system to level reparable items. Along those lines, RBL is a methodology based on the Multiechelon Technique for Recoverable Item Control, which assumes that items are managed with an S, S-1 policy. This concept dictates that, given a stock level of S, an order for a quantity to restore the level back to S (order-up-to level), is placed whenever one of that item is used (reorder point of S-1).

Function of the D200A, Secondary Item Requirements System

The purpose of the D200A Secondary Item Requirements System is to compute the worldwide spares requirement for secondary items. This system replaced the D041 Recoverable Consumption Item Requirements System for this function. There are approximately 175,000 items (national stock numbers) managed in the D200A.

A secondary item is a part that loses its unique identity when installed on a higher-level asset (next higher assembly). Among the secondary items managed in D200A are both recoverable and consumable items. Recoverables are assets economical to repair at the depot level. These are the items that used to be managed in the D041 system. Consumables are parts that are not economical to repair and are expended upon use. They are sometimes called economic order quantity (EOQ) items and were previously managed in the D062 system. An important difference between the computation logic in D200A and D062 is the latter calculated an EOQ, normally greater than one, whenever a buy action was recommended (when the reorder point was breached). Like RBL, the D200A system assumes that items are managed with an S, S-1 policy and repairs are being done on the items.

A secondary item is a part that loses its unique identity when installed on a higher-level asset (next higher assembly).

Reparable and Consumable Policy Inconsistencies

The Air Force manages consumable items differently than reparable items. The Air Force Materiel Command (AFMC) uses reparable-item systems to compute requirements for consumable items, and this produces inconsistencies in retail and wholesale policies. Bases use an EOQ, quantity-and-reorder-point (Q, R) leveling system. Whenever on-hand stock reaches the reorder point, the base orders up to a year's worth of demand. The order size is set to minimize both the cost to hold and cost to order stock. It costs (money and manpower) to requisition and receive property, so the Air Force orders relatively inexpensive items less frequently. The base level is independent of the wholesale level. The previous AFMC system, the D062, computed only the wholesale requirement and used a Q, R policy to set wholesale levels.

The D200A system, however, computes a worldwide (both base and wholesale) requirement, assuming the base orders an item whenever it uses one. That is, D200A and RBL assume an S, S-1 policy. Bases still operate under the Q, R policy, but the sum of the base-computed levels does not necessarily equal what D200A computes as the requirement. This study analyzes the differences between the base and depot levels to determine if it is beneficial to use RBL to allocate base levels for Air Force-managed consumable assets.

Why is this important?

Issues surrounding consumable-item management are often secondary concerns, since there has typically been an emphasis on reparable item or aircraft spares management. This may have been due to the notion that the more expensive parts causing an aircraft to be less than mission capable (MICAP) are more important and deserve more attention. From a cost perspective, Air Force-managed consumable assets comprise only 5 percent of the total Air Force-wide base inventory cost. However, they account for 49 percent of AFMC's MICAP units back ordered.

Analysis

Methodology

- Some key questions were formulated that, when answered, would give the insight to fulfill the goals.
- Do Air Force-managed consumable assets display reparable-item characteristics?
- Will RBL provide reasonable base levels for Air Force-managed consumable assets?
- Is the D200A requirement effective?
- Are there other alternative approaches?

Eighty percent of the consumable items cost less than $2,750, and 50 percent cost less than $438. In fact, the least expensive consumable was a mere 5 cents.

Research and Analysis

Characteristics of Air Force-Managed Consumable Items

To answer the first key question, the characteristics of Air Force-managed consumables and reparables were compared. First, a list of 4,341 items from D200A that had RBL base records were developed. The analysis focused on two characteristics: unit price and daily demand rate (DDR). When the data for consumables were matched against the reparables, it became clear that the average cost of the consumable items was much lower and the average daily demand rate was much higher than for the reparable items (Table 1).

Further, 80 percent of the consumable items cost less than $2,750, and 50 percent cost less than $438. In fact, the least expensive consumable was a mere 5 cents. Low cost and high demand are the textbook definition of consumable items.

Classical ABC inventory theory dictates that low-cost, high-demand items be categorized as *C* items. In general, *C* items comprise a large percentage of the units in the inventory while accounting for only a small percentage of the inventory cost. For the Air Force, consumable items (including DLA-managed items) make up 80 percent of the inventory and only 5 percent of the inventory cost. Typically, organizations will stock a large number of these inexpensive items to prevent stockouts rather than invest in costly management systems and numerous orders.

Will RBL Provide Reasonable Levels?

To answer the second key question, the following activities were accomplished:

	Avg Cost (Unit Price)	Avg DDR	Avg DDR for items w/ DDR > 0
Consumables	$3,226	.05	.152
Reparables	$16,500	.00	.03

Table 1. Comparison of Consumable and Reparable-Item Characteristics

4,341 "active" items	Levels	RBL Comparisons	
Total Requirement	86,007	RBL ≥ Pipeline	99%
Allocated	43,274	RBL < Base Demand Level	89%
Capped	27,940	Avg # of Units Short	13

Table 2. Summary of Consumable-Item RBL Run

- Ran RBL with the current Air Force-managed consumable item data (as of June 2001) and obtained the levels that RBL would allocate for them.
- Calculated the Standard Base Supply System (SBSS) EOQ levels for the same items.
- Compared the RBL levels and the SBSS EOQ levels, considering:
  - Worldwide EBOs,
  - The value (in dollars) of the computed requirements and the resultant inventory costs, and
  - Performance measures such as mission-capable (MC) rates

RBL allocates base, depot retail, and depot wholesale levels. The depot retail levels support depot repair of reparable items that fail at the bases and in programmed depot maintenance. However, for the analysis, depot retail levels were excluded since the D035K accounts (in which depot retail items are managed) are not reporting demand usage for Air Force-managed consumables. RBL was run using the base-only portion of the D200A worldwide requirement (excluding programmed depot maintenance, engine overhaul, and depot variable safety-level requirements).

The RBL run showed 4,341 active consumable items with a total requirement of 86,007 units. The requirement was insufficient for 271 items (14,793 units); these stock numbers were *N* and *Z* problem items (RBL will not push levels for these items).

Table 2 shows that, for 99 percent of the items, the quantity that RBL allocated based on the requirement fed to it was enough to cover the pipeline quantity, the number

RBL allocates base, depot retail, and depot wholesale levels. The depot retail levels support depot repair of reparable items that fail at the bases and in programmed depot maintenance.

Air Force-Managed Consumable Assets—Utility of Using Readiness-Based Leveling

Using RBL with the current requirements computation logic would significantly reduce the base levels and not be sufficient for Air Force-managed consumable assets.

NSN	D200A Reqmt	Sum of Base PL	Sum of Base Dmd Lvls
1730000656708 GG	85	28.92	300
1630001037025	479	179.87	950
2835001106852 RP	8	2.58	13
5330001131802 NY	11	2.26	300

Table 3. Examples of D200A Requirements Less Than Current Base Levels

of items flowing from the source of supply to a base at any point in time. However, in 89 percent of the cases, the RBL level was less than the base demand level for that item. In fact, the average deficit was 13 items. Table 3 lists some examples of the inadequate levels that would be produced by using the D200A requirement and RBL in their current formats.

For the first item, the D200A requirement of 85 was more than enough to satisfy the pipeline quantity but was far short of the sum of the base demand levels. Again, this occurred in 89 percent of the cases. Therefore, using RBL with the current requirements computation logic would significantly reduce the base levels and not be sufficient for Air Force-managed consumable assets.

Is the D200A Requirement Effective?

For the 4,341 active consumable items, RBL allocated a positive level in 4,647 cases (national item identification number/stock record account number [NIIN/SRAN] combinations), which yielded 1,528 EBOs. So the consumable items averaged 0.323 EBOs per positive base level. In the January 2001 Central Level Summary, there were 100,010 non-zero NIIN/SRAN cases for reparable items, and 9,628 EBOs resulted. This equates to an average of 0.096 EBOs per base level for reparable items. The performance of the requirement computed for Air Force-managed consumables was not as good as that for reparable items.

From a cost perspective, Air Force-managed consumable assets comprise only 5 percent of the total Air Force-wide base inventory cost. However, they account for 49 percent of AFMC MICAP units back ordered. They are inexpensive, so they should have fewer back orders than more costly reparable items. The fact that they cause so many back orders today indicates a failure in the system.

A more detailed analysis of the D200A requirement showed the RBL capping policy had a small part in the diminished performance of the consumable requirement in this study. Currently, the allocation process continues for a particular national stock number until the marginal reduction in EBO is less than 0.0005 allocations to a base or 0.00001 allocations to a depot. In the RBL computation, 1,017 items (23.4 percent) were capped. For 98 percent of these capped-item cases, the requirement was sufficient to satisfy the base demand level. However, 71 items had cases where the RBL level was less than the base demand level—too much was capped. For the uncapped items, the D200A requirement was less than the base demand level for 1,040 items (31 percent). For both capped and uncapped items, it seems the requirement was inadequate.

A more detailed analysis of the D200A requirement showed the RBL capping policy had a small part in the diminished performance of the consumable requirement in this study.

There are three primary reasons the D200A requirement passed to RBL was not adequate and was much smaller than the current base levels. The S, S-1 policy assumption means the D200A level is essentially a reorder point. Bases compute an order quantity (up to a year's demand) in addition to the reorder point. The requirement D200A passes to RBL is, in essence, the gross requirement D200 uses to compute the next quarter's repair requirement. The D200A requirement assumes depot repair, and, for consumables, there is no depot repair. For items with high-condemnation rates (consumables have a 100-percent condemnation rate), D200A should include some portion of the depot's procurement lead-time (PLT) pipeline. So, the requirement D200A passes to RBL is not accurate—it assumes an S, S-1 philosophy, it assumes depot repair, and it does not include a portion of the depot procurement lead time.

Alternative Approaches

As a result of the analysis, three alternative approaches were used for computing requirements and leveling Air Force-managed consumable assets.

Before selecting an alternative, each option was examined in the context of the problems to be resolved.

Option 1. The first alternative was to change RBL so that it computes a quantity and reorder point that could be fed into the D200A as the consumable requirement. This alternative would also require a change to the SBSS to accept the quantity and reorder point that would be computed by RBL.

Option 2. This alternative involved computing consumable-item requirements using the Aircraft Availability Model. This computation would level consumable items based on aircraft availability and require that each consumable item be linked to a specific weapon system. This option could either rely on the Aircraft Availability Model's continued use of an S, S-1 concept or adjust the model to accept a quantity and reorder point.

Option 3. This option would change the D200A logic to compute EOQ-type levels for consumables and also link wholesale and retail levels by adding a depot delay time to the base O&ST values. This would include the D062 consumable-item wholesale computation into the D200A.

Changing the retail (base) leveling policy to align with the wholesale S, S-1 approach was considered. This would resolve the disparity in leveling policies between the retail and wholesale echelons of support. Of the 6,773 cases for which bases had an EOQ level greater than zero, 69 percent (4,695 cases) were levels greater than 1. If a strict case in which every level required a separate order to be placed were assumed, the change would result in an increased workload of approximately 86,000 requisitions per year. More requisitions may not seem like a significant change since items are ordered electronically, for the most part; however, for every item ordered for stock, there is a manual workload for handling property for receipts and stocking. In addition to the effort that would be required to make a system change to the SBSS, a modification of retail leveling policy to use one, order one would drive a workload increase.

Option Analysis

Before selecting an alternative, each option was examined in the context of the problems to be resolved. First, the D200A requirement for Air Force-managed consumables was neither adequate nor correct. As shown previously, the

All the options considered address both the requirement and policies.

levels allocated by RBL for consumables resulted in a much higher EBO per level than the reparable items. Second, the current RBL logic does not apply to consumable items. For example, a value for the depot repair-cycle time is used in the RBL computation. However, there is no repair for consumable (XB and XF) items, so the computation is missing a part of the consumable pipeline—the condemnation portion. In addition, RBL does not make use of the procurement lead time since it was designed to level reparable items. The option chosen to tackle this issue must address both of these problems.

The requirement needs to be fixed, Q, R levels must meet mission needs, and the requirement and levels must be consistent at both the retail and wholesale levels.

All the options considered address both the requirement and policies. Option 1 provides Q, R levels to the bases but does not correct the computation in the D200A; it merely adds the base requirement to the currently computed D200A requirement. Although the RBL and D200A are linked and consistent, D200A would still be using the theoretically incorrect logic to compute worldwide requirement. Option 1 was feasible but was theoretically inferior to the other alternatives; therefore, it was not suitable for leveling Air Force-managed consumable items.

With Option 1 eliminated, the focus shifted to Option 3 since the AFMC Management Sciences Division was tasked to look into Option 2. The AFMC Supply Management Division plans to consider the results of the Management Science Division's investigation of Option 2, along with this analysis, prior to selecting a course of action. Option 3 allows for a multiechelon (both retail and wholesale) computation of the requirement, while the depots and bases continue to order independently. The retail requirement was linked to the wholesale requirement, but the two can be computed separately. The wholesale computation includes only wholesale levels. It also uses a continuous review, since the D200A requirement would include a reorder point that, once breached, would trigger an order for the reorder quantity. The D200 computes a forecast of condemnations that has had large errors in the past, which could lead to premature procurement orders or delays in ordering. Option 3 corresponds with the current operating procedures—it is a Q, R system.

A test run of the Option 3 *linked comp,* using actual data, was provided (the 732 consumable items that had 12 or more demands). The linked comp included base-computed Q, R levels (requisition objective with depot delay time) and wholesale EOQ (D062-like logic) computation. A base requisition objective, including the depot delay time to establish a link between the wholesale and retail levels (Table 4), was then calculated. Because of this relationship, as levels and fill rate increase at the wholesale echelon and the depot delay time decreases, fewer items are leveled at the retail accounts (this relationship is highlighted by the increasing and decreasing wedges).

Table 4 shows the modified wholesale requisition objective, base-computed (base requisition objective) levels, wholesale and base reorder point (ROP) quantity (to show the level of inventory required to be on hand) and the total requirement.

The current D200A requirement was compared to the linked model that was a computation replicating the logic previously used in the D062 system with only a slight modification. The wholesale requirement was similar to D062 since it computed only the wholesale requirement. The modification was a change to the base levels to account for the depot delay time. Table 5 provides the results and compares the D062-like totals to the current D200A requirement. The current D200A requirement passed to RBL (without the procurement lead time) served as the baseline for comparison. Then the procurement lead

Whole-sale Fill Rate	Modified Whole-sale RO $M	Modified Whole-sale ROP $M	Base RO $M	Base ROP $M	Total RO $M	Total ROP $M
.87	74.77	67.56	14.72	7.48	89.5	75.04
.89	74.86	67.65	14.71	7.47	89.5	75.12
.92	75.30	68.09	14.62	7.38	89.9	75.47
.94	76.21	69.00	14.42	7.17	90.6	76.17
.97	78.15	70.94	14.00	6.75	92.1	77.69

Table 4. Linked Wholesale and Retail Levels

D200A Requirement		D062 Reorder Point Requirement (@ 87% Wholesale Fill Rate)		
Reqt Fed to RBL	RBL + PLT	Whole-sale	Base	Total
$13.7M	$81.2M	$67.6M	$7.5M	$75.1M

Table 5. Option 3 Computation and Policy Comparison

time was added as a correct pipeline factor instead of using the depot repair cycle time. The procurement lead time is the time from when the depot orders items from its supplier until it receives those items. Only reorder points were compared since the D200A does not compute EOQs.

The D200A requirement passed to RBL ($13.7M) was too small since it did not come close to the total D062-like ROP requirement; some portion of the procurement lead time should be included. The procurement lead time is the number of demands (condemnations) over the procurement lead time and, therefore, will need to be replenished. Some of those condemnations should be included in the base levels.

Additional stock the base has was not included as EOQ levels in the comparison. The base includes an EOQ that was not incorporated in the comparison shown in Table 5. For the sample of items, there were about $7M of base levels above the reorder point; that is, the EOQ. In addition, the linked computation includes an operating level (EOQ) in its wholesale level as well. The wholesale operating level was about $7M above the reorder point ($67.6M as identified in Table 5). There may be a one-time cost to raise existing inventory levels to satisfy this depot EOQ requirement, although it is suspected some of these assets are already available. The base levels have always included the EOQ, so these were not included in the estimate of the cost increase.

Next, the performance of the linked comp was compared to the baseline computation. As shown in Table 6, the linked comp significantly outperformed the baseline. It resulted in a 99-percent decrease ([1,247 – 13]/1,247) in worldwide EBO and no *N* or *Z* problem items (items for which there is a significant disparity in the pipeline quantity and the requirement). The model should compute relatively few EBOs for these relatively inexpensive items.

Note from Table 6 that RBL only allocated 134,913 of the 702,133-unit requirement, which was from the linked computation and included an operating level (EOQ) at the wholesale level, plus a procurement lead time (a year or two) of condemnations. Again, RBL assumed an S, S-1 policy and provided stock to fill the (repair) pipeline. Therefore, the current RBL logic would cap the requirement and not allocate beyond a certain point. It is not that the requirement is too large. It is more that RBL is assuming a different (wrong) model of operation. The Air Force could change RBL to better emulate how the bases operate. However, with the linked model, there is no need to use RBL to allocate requirements, since Option 3 would compute a wholesale level independent of the retail levels. RBL would merely be computing a level for the base that the base already computes (except the depot delay time is added). RBL ensures the base levels match the worldwide requirement, but since the linked model only computes the wholesale requirement, there is no need to use RBL for Option 3.

To review, the D200A logic was changed to compute EOQ-type levels for Air Force-managed consumable items in Option 3. The wholesale levels were then linked with the retail levels by adding the depot delay time to the base order-and-ship-time value. Analysis showed that Option 3 computes a more effective requirement and can be applied

	WW Asset Reqmt	WW EBO (Pushed Items)	Allocated Reqmt	N & Z Problem Items
D200A Comp (OIM & DLM only)	84,480	1,246.68	45,640	225
Linked Comp	702,133	13.15	134,913	0

Table 6. Linked Requirement Performance Comparison

to all consumable items (Option 2 can only be applied to items linked to an aircraft). AFMC could develop a subroutine within D200A that uses the old D062 computation (or Logistics Management Institute [LMI] code that matches D062 logic) applied to only consumable items. In fact, the LMI code was used to compute the requirements. However, the relative ease of modifying this change cannot be determined. The computation itself may be relatively straightforward, but its interface with systems (for example, ABCS, stratification of inventory) may be more extensive. This option has little impact on the retail system, SBSS. However, Option 3 with its required changes to D200A is not a near-term alternative.

For this option, there really is no need to include consumable items in RBL. Option 3 is meant to operate and compute wholesale and retail levels independently. The link is used to include the depot delay in the base levels, and the depot delay depends on the wholesale level. The Air Force could develop some method to pass depot delay to the bases—a depot delay time for each stock number. So Option 3 has the advantage that it will not require any changes to RBL and only minor changes to the SBSS.

An Interim Solution

The inventory value (in dollars) was previously calculated for the current D200A requirement for Air Force-managed consumable items passed to RBL. As indicated in Table 5, the procurement lead time was added as a way to more accurately portray the condemnation requirement (reflected in Table 5 as RBL + PLT). Adding procurement lead time to the current D200A requirement passed to RBL creates yet another alternative.

At this point in the analysis, it was necessary to determine how to apply the PLT addition to the current D200A requirement. One approach was using the entire procurement lead time for each item, a year's worth of demands (365 days times the daily demand rate) for each item, and the minimum of either the entire procurement lead time or a year's demands. RBL was run with the combination of each of these values and the current D200A requirement as the total requirement. The results were then

	WW Asset Reqmt	WW EBO (Pushed Items)	Allocated Reqmt	N & Z Problem Items
D200A Comp (OIM & DLM Only)	84,480	1,246.68	45,640	225
D200A + OIM + DLM + PLT	475,200	26.53	132,986	0
D200A + OIM + DLM + 365*DDR	456,189	13.24	134,659	0
D200A + OIM + DLM + Min (PLT, 365*DDR)	405,032	26.01	132,946	0
Linked Comp	702,133	13.15	134,913	0

Table 7. Comparison of Interim Computations with Original and Modified Computations.

compared to the current D200A computation and the modified, linked computation.

As Table 7 illustrates, these methods allocated almost as much requirement as did the modified computation (Option 3). These options are big improvements over using the current RBL process; however, two of the three produced twice as many EBOs. The addition of 365 days' worth of demand resulted in almost as few EBOs as did the linked computation. Although this process produced computations that did not perform as well as Option 3, they are feasible alternatives to the current computation and would require less work to implement than Option 3. However, they would require a way for the SBSS to accept an RBL (reorder quantity), as well as a way to compute a percentage of the level (reorder point). Currently, such a change would require workarounds and adjustments to the SBSS and RBL code.

It was also important to measure the performance of these options in terms of whether the change allows RBL to allocate levels in greater quantities than would the SBSS. For each of the interim options, the levels produced by RBL were compared to the base demand levels for all the items. The results are summarized in Table 8.

As Table 8 indicates, each of the methods used for the interim computations produces RBLs equal to or greater than the SBSS demand levels for roughly three-fourths of the items.

The RBL model includes a capping rule that limits the allocation of levels for an item once the marginal reduction of EBOs drops below an established threshold (0.0005 for bases, 0.00001 for depots). This limitation should not apply when leveling consumable items in a Q, R system, however. It is designed to affect the allocations of items under an S, S-1 process. For the three interim computations, RBL capped 83 percent or more of the items in each run, which prompted an examination of the effects of relaxing the capping role.

For the three interim computations, RBL capped 83 percent or more of the items in each run, which prompted an examination of the effects of relaxing the capping role.

It was expected that much more of the requirement would be allocated so that much more of the RBLs would at least equal the base DLs calculated by the SBSS.

As shown in Table 9, the expectation was correct. For a large percentage of the capped items, the amount of requirement not allocated was greater than or equal to the resultant difference between the base DL and the RBL. Therefore, once the capping rule was relaxed, RBL allocated more requirement and eliminate most of the cases when RBL was less than the current base DL.

	Base DL > RBL	Base DL = RBL	Base DL < RBL
D200A + OIM + DLM + PLT	27.9%	39.9%	32.1%
D200A + OIM + DLM + (365*DDR)	25.7%	39.3%	35.0%
D200A + OIM + DLM + Min (PLT, 365*DDR)	27.9%	39.9%	32.2%

Table 8. Comparison of RBLs Produced by Interim Computations to Base Demand Levels

There is a feasible interim solution to using RBL for setting base levels consistent with the worldwide requirement. But the requirement computation is inconsistent with the level allocation, since the procurement lead time in a depot pipeline and RBL would allocate it to the bases.

	Base DL > RBL	Base DL = RBL	Base DL < RBL
D200A + OIM + DLM + PLT	7.2%	60.6%	32.1%
D200A + OIM + DLM + (365*DDR)	3.6%	61.4%	35.0%
D200A + OIM + DLM + Min (PLT, 365*DDR)	8.9%	58.9%	32.2%

Table 9. Comparison of RBLs and Base DLs with Relaxed Capping Rule

There is a feasible interim solution to using RBL for setting base levels consistent with the worldwide requirement. But the requirement computation is inconsistent with the level allocation, since the procurement lead time in a depot pipeline and RBL would allocate it to the bases. While it is true that D200A computes up to a year's requirement in addition to the procurement lead time, there is no guarantee those assets are available to fill a base requisition. In addition, RBL's calculation allocates based on an S, S-1 policy but will push a quantity and reorder point. The interim approach is like fitting a square peg into a round hole—it works, but not quite right. And it really results in requirements and levels much like those that exist with today's system.

	Increase in MC Aircraft		**Decrease in Cann Actions**	
	Month	**Year**	**Month**	**Year**
25% B/O = MICAP	3.30	39.64	69.72	836.67
75% B/O = MICAP	9.91	118.92	209.17	2,510.03

Table 10. Impact of Option 3 on Mission Support

To determine the impact of Option 3 on aircraft mission capability, compared to using the current RBL process, the decrease in worldwide EBOs (1,233) that resulted from using the modified comp was input into an AFLMA model that equates changes in EBO to changes in the MC rate. It was assumed that between 25 and 75 percent of back orders cause a MICAP incident. Of that amount, approximately 54 percent cause aircraft MICAPs (54 percent is the Air Force average MICAPs that affect an aircraft).

As shown in Table 10, the reduction in worldwide EBOs equated to between approximately 3 (assuming 25 percent of the back orders caused an inoperable system or MICAP) to 10 (assuming 75 percent of the back orders caused a MICAP) additional MC aircraft per month. On an annual basis, there would be an additional 40 to 119 mission-ready aircraft. Also, the model indicated there could be a reduction of approximately 70 to 209 cannibalization actions per month or 837 to 2,510 cannibalizations per year (assuming either 25 or 75 percent of back orders, respectively, were for items that caused a MICAP and were eligible for cannibalization).

Using the same approach, the third interim option (D200A + OIM + DLM + Min [PLT, 365*DDR]) yields almost the same results in relation to increased MC aircraft and decreased cannibalization actions (Table 11).

Conclusions and Recommendations

Conclusions

- The RBL process is not appropriate for leveling Air Force-managed consumable assets.

	Increase in MC Aircraft		Decrease in Cann Actions	
	Month	Year	Month	Year
25% B/O = MICAP	3.27	39.23	69.00	827.95
75% B/O = MICAP	9.81	117.68	206.99	2,483.85

Table 11. Impact of Interim Computation on Mission Support

Air Force-Managed Consumable Assets—Utility of Using Readiness-Based Leveling

Do not use RBL with the current D200A to level Air Force-managed consumable assets.

- The D200A computation process with its periodic review and S, S-1 logic is not the appropriate method for computing consumable asset requirements.
- The process used for leveling Air Force-managed consumable assets is disconnected. The retail system sets its own level while the wholesale system sets worldwide levels that do not match the base levels.
- The condemnation forecast error is large, and since D200A relies on accurate forecasts of condemnations to predict when buys will be needed, this error has a significant negative impact on leveling consumable items.
- A linked (D062-like) requirement policy for Air Force-managed consumable assets would provide a more consistent requirement, result in much better performance, and be feasible to implement.

Recommendations

- Do not use RBL with the current D200A to level Air Force-managed consumable assets.
- Increase variable safety-level targets in the D200A.
- Upon completion of the AFMC Management Sciences Division's analysis, select either the Aircraft Availability Model or linked requirements for implementation.

Shaping Logistics—Supply Spares Campaign

The Spares Campaign initiatives are the result of 4 months of intensive review and analysis by five teams representing expertise from every level of the major commands (MAJCOM), Air Staff, air logistics centers, Defense Logistics Agency, and commercial technical experts and consultants, including RAND and KPMG Consulting. Focus was on increasing weapon system availability and mission capable (MC) sorties and ensuring spares support in the expeditionary aerospace force (EAF) operating environment. The teams analyzed the strategic processes to identify disconnects, deficiencies, and areas for improvement:

- Forty-seven process disconnects were identified and then organized into 12 major categories
- One hundred and ninety implementation options were developed and considered to fix these disconnects; ultimately, 86 were deemed viable and considered for implementation.
- These implementation options were aggregated into 20 initiatives. A *red team* made up of eight senior Air Force logisticians reviewed the work done by the five teams.
- These 20 initiatives were then presented to the MAJCOM logistics commanders, who provided comments and ranked the initiatives.

Given the MAJCOM logistics commanders' priorities, the impact of the initiatives, and the time needed to implement them, eight were selected for immediate action:

- Restructure defense logistics requirements by setting stable prices and allocating costs to the responsible commands.
- Improve spares budgeting by establishing a single consolidated budgeting process for spares and consumable items, thereby meeting all spares requirements.
- Improve financial management by tracking execution of weapon-system support against approved requirements and budget. Simply put, determine whether the Air Force is getting an MC rate equivalent to the amount it is spending.
- Improve item demand and repair workload forecasting. This initiative calls for improved methods for calculating the type and timeframe of maintenance needs for the future; that is, commercial technologies like advanced planning and scheduling systems.
- Establish a virtual single inventory control point to centrally prioritize spares and funds allocation, passing the execution phase down to the air logistics centers.
- Align supply chain management to focus more on weapon systems and MC rate goals.
- Standardize and expand the role of regional supply squadrons to support expeditionary operations.
- Adopt improved purchasing and supply management practices, thereby reducing purchasing costs and improving product quality and delivery.

Any one of these initiatives taken by itself will not make a tremendous impact. But together, these initiatives will overhaul the entire spares process by getting spares into the hands of the maintainers and enabling the Air Force to improve weapon-system support to meet current and future expeditionary requirements.

The implementation of these eight initiatives is the cornerstone in reshaping Air Force supply in the context of the EAF.

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