United States General Accounting Office

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Report to the Ranking Minority Member, Subcommittee on Oversight of Government Management and the District of Columbia, Committee on Governmental Affairs, U.S. Senate

February 1996

BEST MANAGEMENT PRACTICES

Reengineering the Air Force's Logistics System Can Yield Substantial Savings

GAO/NSIAD-96-5

GAO

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National Security and
International Affairs Division

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February 21, 1996

The Honorable Carl Levin
Ranking Minority Member
Subcommittee on Oversight of
Government Management and the
District of Columbia
Committee on Governmental Affairs
United States Senate

Dear Senator Levin:

This report was prepared in response to your request that we continue to compare commercial logistics practices with similar Department of Defense (DOD) operations. We compared the Air Force's management of its $33 billion reparable parts inventory with the operations of leading-edge private sector firms to identify opportunities where costs could be reduced and service improved. This report focuses on (1) best management practices used in the commercial airline industry to streamline logistics operations and improve customer service, (2) Air Force reengineering efforts to improve the responsiveness of its logistics system and reduce costs, and (3) barriers that may stop the Air Force from achieving the full benefits of its reengineering efforts.

We are sending copies of this report to appropriate congressional committees; the Secretaries of Defense and the Air Force; the Director, Office of Management and Budget; and other interested parties. We will also make copies available to others on request.

If you or your staff have any questions concerning this report, please call me on (202) 512-8412. Major contributors to this report are listed in appendix III.

Sincerely yours,

David R. Warren,
Director
Defense Management Issues

Executive Summary

Purpose

As part of GAO's continuing effort to review the Department of Defense's (DOD) inventory management practices, GAO compared the Air Force's management of its $33 billion reparable parts inventory with the operations of leading-edge private sector firms to identify opportunities where costs could be reduced and service improved. The review was done at the request of the Ranking Minority Member, Subcommittee on Oversight of Government Management and the District of Columbia, Senate Committee on Governmental Affairs. This report focuses on (1) best management practices used in the commercial airline industry to streamline logistics operations and improve customer service, (2) Air Force reengineering efforts to improve the responsiveness of its logistics system and reduce costs, and (3) barriers that may stop the Air Force from achieving the full benefits of its reengineering efforts.

Background

The private sector, driven by today's globally competitive business environment, is faced with the challenge of maintaining and improving quality service at lower costs. At the same time, new technology and management concepts are being introduced that facilitate achieving those goals. As a result, many firms have radically changed, or reengineered, their ways of doing business to meet customer needs and retain profitability. Since DOD is facing a similar challenge of providing better service at a lower cost, DOD and the services must begin to reexamine their business practices. With the end of the Cold War, DOD's logistics system must now support a smaller, highly mobile, high-technology force. Also, due to the pressures of budgetary limits, DOD must seek ways to make logistics processes as efficient as possible.

To provide reparable parts for its approximately 6,800 aircraft, the Air Force uses an extensive logistics system that was based on management processes, procedures, and concepts that have evolved over time but are largely outdated. Reparable parts are expensive items that can be fixed and used again, such as hydraulic pumps, navigational computers, wing sections, and landing gear. The Air Force's logistics system, often referred to as a logistics pipeline, consists of a number of activities that play a role in providing aircraft parts where and when they are needed. These activities include the purchase, storage, distribution, and repair of parts, which together require billions of dollars of investments in personnel, equipment, facilities, and inventory.

Although not as large as the Air Force, commercial airlines' operations are similar to the Air Force's. They operate fleets of aircraft that also use

reparable parts and operate reparable parts pipelines that consist of the same activities as the Air Force. For both the Air Force and commercial airlines, time plays a crucial role in the responsiveness of logistics operations and the amount of inventory needed. Condensing pipeline times, therefore, simultaneously improves responsiveness and drives down costs. Pipeline complexity also adds to logistics costs by increasing overhead and contributing to lengthy pipeline times.

Results in Brief

The commercial airline industry, including certain manufacturers, suppliers, and airlines, are using leading-edge practices to improve logistics operations and reduce costs. Some manufacturers are providing aircraft parts to their customers on a just-in-time basis, and suppliers are assuming inventory management responsibilities for airlines and manufacturers. One airline GAO reviewed reengineered its entire logistics system in an integrated fashion by examining all aspects of its logistics operations to pinpoint and remove inefficient processes and functions.

In recognition of increasing budgetary pressures, the changing global threat, and the need for radical improvements in its logistics system, the Air Force has begun a reengineering program aimed at redesigning its logistics operations. GAO has urged these changes and supports them, and has identified additional private sector practices that may result in even greater savings. However, there are several major barriers to bringing about change that must be addressed and resolved if the Air Force is to reengineer its logistics system and save billions of dollars.

The Air Force reengineering effort addresses inherent problems with its logistics system, but additional steps can be taken to maximize potential improvements. Under this effort, the Air Force is beginning to test certain management practices found in the private sector, such as removing unnecessary inventory layers, repairing parts as they break, and rapidly transporting parts between the end user and the repair facility. Additional steps GAO identified that could enhance this program include establishing a top-level DOD champion of change to support the Air Force initiatives, greater use of third-party logistics services, closer partnerships with suppliers, encouraging suppliers to use local distribution centers, centralizing repair functions, and modifying repair facilities to accommodate these new practices.

The success of the Air Force in achieving a “quantum leap” in system improvements hinges on its ability to address and overcome certain

barriers, such as inherent organizational resistance to change. Top-level DOD officials must be supportive of and engaged in Air Force reengineering efforts to remove these barriers and drive success. Also, information systems do not always provide Air Force managers and employees with accurate, real-time data on the cost, amount, location, condition, and usage of inventory—elements that are required to successfully plan, control, and measure inventory management operations. Without the support of top-level DOD management and accurate, real-time inventory information, the expansion of the Air Force's reengineering efforts could be seriously impaired.

Principal Findings

Private Sector Initiatives Are Streamlining Logistics Systems

The airline industry is developing leading-edge practices that are primarily focused on reducing the time and complexity associated with logistics pipelines. For example, British Airways, a leader in the airline industry, has an efficient logistics system that has helped it achieve profitable operations every year from 1983 to 1995. Starting in 1981, British Airways began making radical changes to streamline its logistics system. It changed the corporate focus, placing customer service as its number one priority; obtained new information systems; reorganized its repair processes; and streamlined the storage and distribution of spare parts. It approached this system reengineering in an integrated fashion by setting a clear corporate strategy, and then simultaneously examining and improving all aspects of its operations.

The most dramatic and effective changes GAO observed were in British Airways' new repair facilities, which incorporated new management philosophies, material management systems, repair processes, and information systems with a mostly new workforce of flexible, team-oriented employees. These facilities, built to embody the new corporate vision, have actually magnified the success of British Airways' reengineering efforts.

Through these efforts, British Airways has improved inventory data accuracy to 95 percent; achieved 97 and 86 percent supply availability rates for expendable and reparable parts, respectively; and maintained low inventory levels. Moreover, these efforts have recently contributed to millions of dollars in companywide savings during 1993 and 1994.

GAO also noted that other airlines have pursued initiatives similar to those taken by British Airways and have likewise seen dramatic improvements. In addition, GAO observed other practices that have enabled airlines to minimize the inventory investments they must make and reduce the inefficiencies in their logistics pipeline. For example, one airline achieved substantial savings in reduced inventory investment by developing systems to automatically redistribute inventory to different operating locations when shortages arise. Another airline reduced shop repair times from 90 days to 3 days in its wheel shop by rearranging its work stations to allow for a more orderly flow of parts and by transferring other functions to the flight line.

Needed Air Force Improvements Face Major Barriers

The Air Force currently operates an inefficient and costly logistics system. Although it is difficult to precisely determine actual logistics costs, for fiscal year 1996, the Air Force estimates it will cost about $4.6 billion for maintenance of equipment and aircraft at the depot level. Also, as of September 1994, the Air Force had invested about $37 billion in aircraft parts. Of this amount, $20 billion, or 56 percent, was needed to support daily operations and war reserves, and the remaining $16 billion was divided among safety stock, other reserves, and excess inventory.

Under the current process, the Air Force can spend several months or even years to contract for an item and have it delivered or it may take several months to repair the parts and then distribute them to the end user. The complexity of the repair and distribution process creates as many as 12 different stopping points and several layers of inventory as parts move through the process. Parts can accumulate at each step in the process, which increases the total number of parts in the pipeline. One part GAO examined had an estimated repair cycle time of 117 days; it took British Airways only 12 days to repair a similar part.

Recognizing the need for radical improvements to its logistics system, the Air Force has started a reengineering effort, called “Lean Logistics,” that reflects many of the concepts GAO observed in the private sector, such as testing a consolidated inventory concept, providing rapid transportation services, and repairing individual component parts soon after they break. All of these actions address ways of reducing pipeline time, cost, and complexity. There are, however, several initiatives not currently included in the Air Force plan that have worked successfully in the private sector and, if applied where feasible, could aid in reducing cost and improving service. Some of these initiatives include (1) the benefits of transferring

inventory management responsibilities to third parties, (2) the use of supplier distribution centers that enable suppliers to respond to customer needs within a few hours, (3) the application of repair process improvements that reduce the time to conduct repairs, and (4) the upgrade of facilities that magnify the success of reengineered processes.

There are certain barriers to successful reengineering that stand in the Air Force's way of accomplishing major process improvements in its logistics system. For example, (1) the "corporate culture" within DOD and the Air Force has been traditionally resistant to change and must become receptive to radical new concepts of operations; (2) the traditional role of DLA as a supplier of expendable parts and as a storage and distribution service will be significantly altered and, until DLA decides what new approaches to implement, the Air Force's ability to improve repair processes may be limited; and (3) improvements to outdated and unreliable inventory data systems require management actions and funding decisions that must be made outside the responsibility of both Lean Logistics managers and the entire Air Force. Issues like these must be resolved before the Air Force achieves a fully reengineered logistics system that substantially reduces cost and improves service.

Recommendations

To build on existing Air Force reengineering efforts and achieve major logistics system improvements, GAO recommends that the Secretary of Defense commit and engage top-level DOD managers to support and lead Air Force reengineering efforts to ensure its success. In addition, GAO recommends that the Secretary of Defense direct the Secretary of the Air Force to incorporate additional leading-edge logistics concepts into the existing Lean Logistics program, where feasible, and prepare a report to the Secretary of Defense detailing its strategy to adopt these leading practices.

GAO further recommends that the Secretary of Defense use the Air Force report to set forth the actions and milestones to alleviate any barriers or obstacles, provide the appropriate resources, and ensure the collaboration between the Air Force and other DOD components that would enable the Air Force to achieve an integrated approach to reengineering its processes. Once these steps are taken, GAO recommends that the Secretary of Defense direct the Secretary of the Air Force to institutionalize its reengineering effort.

Agency Comments

In commenting on a draft of this report, DOD generally agreed with the findings, conclusions, and recommendations, and stated that the Air Force's Lean Logistics program should receive top-level DOD support in achieving its goals. DOD also stated that the Air Force should consider incorporating additional leading-edge practices into its reengineering effort. According to DOD, the Air Force will be asked to provide a report to the Secretary of Defense by July 1996 that will discuss the feasibility of including such additional practices in the Lean Logistics initiative and to address other concerns raised in this report. By October 1996, the Office of the Secretary of Defense will address how it plans to alleviate any barriers and obstacles identified in the Air Force's report. DOD indicated that the Air Force plans to take steps to institutionalize its reengineering efforts by December 1996.

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Figures

Abbreviations

AFB	Air Force Base
AFMC	Air Force Materiel Command
ALC	Air Logistics Center
DLA	Defense Logistics Agency
DOD	Department of Defense
FLS	FedEx Logistics Service
GAO	General Accounting Office
JLSC	Joint Logistics Systems Center
TIME	Total Inventory Management for Engineering

Introduction

The private sector, driven by today's globally competitive business environment, is faced with the challenge of maintaining and improving quality service at lower costs. As a result, many firms have radically changed, or reengineered, their ways of doing business to meet customer needs. Since the Department of Defense's (DOD) environment is also changing, it needs to do the same. With the end of the Cold War, DOD's logistics system must now support a smaller, highly mobile, high-technology force. Also, due to the pressures of budgetary limits, DOD must seek ways to make logistics processes as efficient as possible.

The Air Force's Logistics System

To provide reparable parts for its aircraft, the Air Force uses an extensive logistics system that was based on management processes, procedures, and concepts largely developed decades ago. As of September 1994, the Air Force had invested $33 billion in reparable parts for its fleet of more than 6,800 aircraft.[1] Reparable parts are items that can be fixed and used again, such as hydraulic pumps, navigational computers, landing gear, and wing sections. The Air Force's logistics system, often referred to as a logistics pipeline, consists of a number of activities, including the purchase, storage, distribution, and repair of parts.

The Air Force's reparable parts pipeline primarily exists to ensure that aircraft stationed around the world at Air Force installations can get the parts they need to keep them operational. It also exists to support aircraft overhaul activities, when aircraft are periodically taken out of service for structural repairs and parts replacements.

The Air Force Materiel Command (AFMC) is the organization that has primary responsibility for carrying out pipeline operations. Its tasks include determining how much inventory the Air Force needs to support its fleet, purchasing parts when necessary, and operating the facilities where major parts and aircraft repair are done. To carry out many of these tasks, AFMC has five air logistics centers (ALC) that are located in different regions throughout the United States.[2] Each center is responsible for managing a portion of the reparable parts inventory, repairing certain parts, and overhauling specific types of aircraft. For fiscal year 1996, the Air Force estimates it will cost about $4.6 billion for maintenance of equipment and aircraft at the depot level.

[1]The Air Force has also invested an additional $3.7 billion in expendable parts.

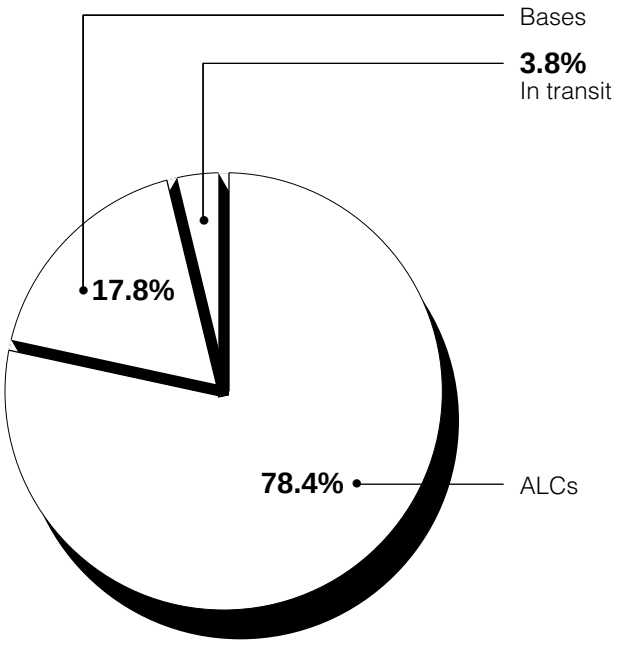
[2]In June 1995, the Defense Base Realignment and Closure Commission recommended that two of the five ALCs—McClellan and Kelly Air Force Bases (AFB)—be closed.

Other organizations also play a role in pipeline operations, including Air Force bases around the world, where Air Force aircraft are stationed. Although base maintenance personnel handle minor repairs, they send parts and aircraft to the ALCs for the heavier, more involved repairs. The bases, in turn, order replacement parts through the ALCs, where the bulk of Air Force inventory is stored.

Another of these organizations is the Defense Logistics Agency (DLA), which handles the warehousing and distribution operations at each of the five ALCs. In general, new and repaired parts are stored at each center in DLA warehouses until they are needed. When an order is placed for a part, DLA retrieves the part from warehouse shelves and ships it accordingly. DLA also receives the broken items being shipped from the bases and stores them until the ALC repair shops are ready to fix them.

Figure 1.1 shows how the Air Force's inventory was distributed among Air Force bases and the ALCs (including DLA warehouses) as of September 1994. It also shows the amount of inventory in transit between the various locations.

Figure 1.1: Location of Air Force Reparable Parts



DLA plays another important role in pipeline operations; it provides expendable parts needed by the various Air Force repair activities. Expendable parts—also known as consumables—include items such as nuts, bolts, and rivets that are used extensively to fix reparable parts and aircraft. If these items are not readily available, repair operations can stall and lead to large quantities of unrepaired inventory. We have issued a series of reports on private sector practices that could be applied to DOD's expendable inventories.[3] Each report recommended new techniques that would minimize DLA's role in storing and distributing expendable inventory.

[3]Inventory Management: DOD Can Build on Progress in Using Best Practices to Achieve Substantial Savings (GAO/NSIAD-95-142, Aug. 4, 1995); Commercial Practices: DOD Could Reduce Electronics Inventories by Using Private Sector Techniques (GAO/NSIAD-94-110, June 29, 1994); and Commercial Practices: DOD Could Save Millions by Reducing Maintenance and Repair Inventories (GAO/NSIAD-93-155, June 7, 1993).

Similarities Between Air Force and Commercial Airline Logistics Operations

Although not as large as the Air Force, commercial airlines' operations resemble the Air Force's in several ways. First, airlines operate out of a number of different airports, and they must provide the aircraft at these locations with the parts they need. Second, airlines must periodically overhaul their aircraft and ensure that repair activities get the necessary parts. Third, the reparable parts pipeline that exists to fulfill these needs involves the purchase, storage, distribution, and repair of parts.

In addition, for both the Air Force and commercial airlines, time plays a crucial role in the reparable parts pipeline. The amount of time involved in the various pipeline activities directly affects the responsiveness of logistics operations. For example, the longer it takes to deliver parts to a mechanic, the longer it will be before the aircraft can be repaired and ready for takeoff. Time also has a significant impact on cost. For example, the longer it takes to repair a part, the more inventory an organization must carry to ensure coverage while that part is out of service. Condensing pipeline times, therefore, simultaneously improves responsiveness and drives down costs.

Complexity also plays an important role; it adds to costly overhead and pipeline time. For example, if an organization holds multiple layers of inventory at different locations, it must provide the space, equipment, and personnel to accommodate this inventory at each location, all of which contribute to overhead costs. Moreover, if a part must filter through each of these levels before finally reaching the end user, such as a mechanic, each stop along the way adds to pipeline time.

Objectives, Scope, and Methodology

As part of our continuing effort to help improve DOD's inventory management practices, the Ranking Minority Member, Subcommittee on Oversight of Government Management and the District of Columbia, Senate Committee on Governmental Affairs, requested that we compare the Air Force's management of its $33 billion reparable parts inventory with the operations of leading-edge private sector firms. This report focuses on (1) best management practices used in the commercial airline industry to streamline logistics operations and improve customer service, (2) Air Force reengineering efforts to improve the responsiveness of its logistics system and reduce costs, and (3) barriers that may stop the Air Force from achieving the full benefits of its reengineering efforts.

To obtain DOD's overall perspective on the Air Force's logistics system and the potential application of private sector practices to its operations, we

interviewed officials at the Office of the Under Secretary of Defense for Logistics and Air Force Headquarters, Washington, D.C., and DLA Headquarters, Alexandria, Virginia. We also discussed specific Air Force logistics policies and operations and reviewed inventory records at AFMC, Dayton, Ohio.

To examine Air Force repair facilities, other logistics operations, and the new logistics practices being tested in the Air Force, we visited the Sacramento ALC, McClellan AFB, California; San Antonio ALC, Kelly AFB, Texas; Oklahoma City ALC, Tinker AFB, Oklahoma; and Dyess AFB, Texas. At these locations, we discussed maintenance and repair activities and processes, inventory management practices, "Lean Logistics" and reengineering program initiatives, and the potential application of additional private sector practices. We also contacted officials at the Warner Robins and Ogden ALCs to discuss and document the new business practices being tested and planned at those locations.

Except where noted, our analysis reflects inventory valued at the last acquisition cost, as of September 1994. As highlighted in this report, the accuracy of Air Force inventory information is questionable. We did not test or otherwise validate the Air Force inventory data.

During this review, we selected and physically examined a sample of items from the Air Force inventory that we believe highlighted the effect of the current and past DOD inventory management practices. This judgmental sample was drawn from E-3 and C-135 unique parts. Because we selected these items based on high dollar value, high levels of inventory on hand, and/or low demand rates, the results of our sample analysis cannot be projected to the total Air Force inventory.

To identify best management practices being used by the private sector, we reviewed over 200 articles from various management and distribution publications, identified companies that were highlighted as developing innovative management practices, and visited the following organizations in the airline industry:

- American Airlines Maintenance Center, Tulsa, Oklahoma;
- British Airways Engineering, Heathrow Airport, United Kingdom;
- British Airways Avionics Engineering, Llantrissant, South Wales, United Kingdom;
- British Airways Maintenance Cardiff, South Wales, United Kingdom;
- United Airlines, San Francisco, California;

- United Airlines Maintenance Center, Indianapolis, Indiana;
- Boeing Commercial Airplane Group, Seattle, Washington;
- Federal Express, Memphis, Tennessee; and
- Tri-Star Aerospace Corporation, Deerfield Beach, Florida.

At each company, we discussed and examined documentation related to the company's reengineering efforts associated with management, employees, information technology, maintenance and repair processes, and facilities. We also contacted Southwest Airlines to obtain information on its maintenance and material management operations and visited the Northrop-Grumman Corporation aircraft production facility in Stuart, Florida, to examine its integrated supplier operations.

To obtain additional information on supplier partnerships and implementation strategies, we participated in an International Quality and Productivity Center symposium on supplier partnerships in Nashville, Tennessee. Representatives from John Deere Waterloo Works; Bethlehem Steel; Federal Express; BP Exploration (Alaska), Inc.; E.I. DuPont; Salem Tools; Volvo GM-Heavy Trucks; Berry Bearing Company; The Torrington Company; Procard, Inc.; Lone Star Gas Company; Coors Brewing Company; Texas Instruments, Inc.; Allied Signal; Oryx Energy Company; Timken; Sun Microsystem, Inc.; Dixie Industrial Supply; Darter, Inc.; Mighty Mill Supply, Inc.; Alloy Sling Chain Industries; Columbia Pipe and Supply Company; Strong Tool Company, Inc.; Id One, Inc.; and Magid Glove and Safety Manufacturing Company, discussed their supplier partnership concepts, implementation strategies, and results.

To gain a better understanding of how companies are applying integrated approaches to their logistics operations, we attended an integrated supply chain round table, hosted by Procter and Gamble. Attending this round table were representatives from Chrysler Corporation, Digital Equipment Corporation, E.I. Dupont Corporation, Levi Strauss, Massachusetts Institute of Technology, Siemens Corporation, 3M Corporation, and Xerox Corporation. To determine the ongoing problems of the current Air Force logistics system, we reviewed related reports issued since 1990 by us, the Air Force Audit Agency, and Air Force Logistics Management Agency.

We conducted our review from August 1993 to August 1995 in accordance with generally accepted government auditing standards.

Private Sector Practices Increase Efficiencies and Reduce Costs

Commercial airlines have cut costs and improved customer service by streamlining their logistics operations. The most successful improvements include using highly accurate information systems to track and control inventory, employing various methods to speed the flow of parts through the pipeline, shifting certain inventory management tasks to suppliers, and letting third parties handle parts repair and other functions.

British Airways Illustrates the Benefits of Reengineering

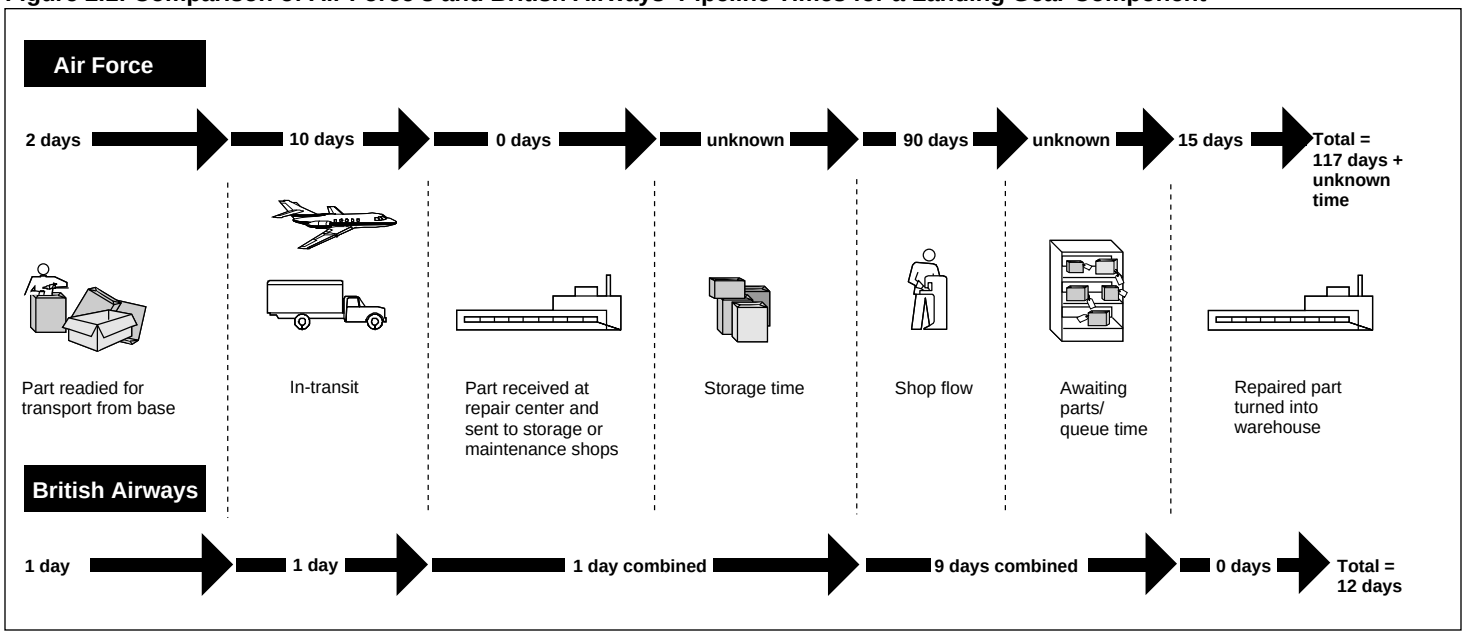
One of the airlines we studied, British Airways, has substantially reengineered its logistics operations over the last 14 years. These improvements have helped transform British Airways from a financially troubled, state-owned airline into a successful private sector enterprise. British Airways today is considered among the most profitable airlines in the world and has posted profits every year since 1983.

British Airways has approached the process of change as a long-term effort that requires a steady vision and a focus on continual improvement. Although the airline has reaped significant gains from improvements to date, it continues to reexamine operations and is making continuous improvements to its logistics system.

British Airways has used an integrated approach to reengineer its logistics system. It laid out a clear corporate strategy, determined how logistics operations fit within that strategy, and tied organizationwide improvements directly to those overarching goals. With this approach, the various activities encompassed by the logistics pipeline were viewed as a series of interrelated processes rather than isolated functional areas. For example, when British Airways began changing the way parts were purchased from suppliers, it considered how those changes would affect mechanics in repair workshops.

British Airways takes a significantly shorter time than the Air Force to move parts through the logistics pipeline. Figure 2.1 compares British Airways' condensed pipeline times with the Air Force's current process by showing how long it takes a landing gear component to move through each organization's system.

Figure 2.1: Comparison of Air Force's and British Airways' Pipeline Times for a Landing Gear Component



British Airways officials described how an integrated approach could lead to a continuous cycle of improvement. For example, culture changes, improved data accuracy, and more efficient processes all lead to a reduction in inventories and complexity of operations. These reductions, in turn, improve an organization's ability to maintain accurate data, and they stimulate continued change in culture and processes, both of which fuel further reductions in inventory and complexity.

Despite this integrated approach, British Airways' transformation did not follow a precise plan or occur in a rigid sequence of events. Rather, according to one manager, airline officials took the position that doing nothing was the worst option. After setting overall goals, airline officials gave managers and employees the flexibility to continually test new ideas to meet those goals.

The five general areas in which British Airways has reengineered its practices are corporate focus and culture, information technologies, material management, repair processes, and facilities. These efforts are summarized in table 2.1 and are discussed briefly after the table and in more detail in appendix I.

Table 2.1: Key Characteristics of British Airways' Reengineering Efforts

Corporate focus and culture
Top management champions of change with full authority to make changes
Integrated pipeline management
Performance measures aligned with corporate goals
Successful continuous improvement
Use of third parties to reduce complexity and cost of pipeline
Information technology
Accurate information on amount, location, condition, and usage of inventory
Real-time inventory data
Extensive use of data systems to track and manage flow of parts
Timely development of new systems
Material management
Supplier partnerships, reduced supplier base
Supplier-operated local distribution centers to delay purchase of inventory until needed
Fast, reliable deliveries
Reduction in layers of inventory
High fill rates
Reduction of just-in-case inventory
Repair process
Cellular process, fast turnaround times
Repair of individual parts as they break
Availability of parts when required for repairs
Facilities
Facilities reflect new business practices
Gree-field sites reflect most aggressive changes

Corporate Focus and Culture

British Airways officials said changing the corporate mind-set was the single most important aspect of change, as well as the most difficult. Before reforms got underway in 1981, British Airways was an inefficient, over-staffed government organization on the brink of bankruptcy. By 1987, when privatization occurred, British Airways had substantially changed the culture that gave rise to these problems. Converting this culture has entailed

- appointing new top management from private industry to bring a better business focus to the organization and serve as champions of change;

- undertaking an initial round of drastic cost cuts, which included a 35-percent reduction in the workforce to eliminate redundant and unnecessary positions;
- adopting a new corporate focus and strategy in which improving customer service became the driving force behind all improvements;
- setting new performance measures that reflected customer service goals and corporate financial targets;
- instituting ongoing training and education programs to familiarize managers and employees with the new corporate philosophy;
- adopting total quality management principles to promote continual improvement;
- replacing managers who were unwilling or unable to adapt to the new focus; and
- negotiating agreements with employee unions to allow for a more flexible workforce.

Information Technologies

British Airways officials said the airline could not have successfully reengineered its practices without having the right technological tools to plan, control, and measure operations. As a result, the airline developed three key systems, the most important of which was an inventory tracking system that provides real-time, highly accurate visibility of parts and processes. The three systems have enabled managers and workers to know what parts are on hand, where they are, what condition they are in, when they will be needed, and how well operations are meeting corporate goals.

Material Management

The airline did not delay initiatives to streamline specific processes until changes in corporate culture and upgrades in data systems had been made; it began reexamining its processes concurrently. Two of the areas targeted were the way parts flow in from suppliers as well as how they are stored and distributed internally. Initiatives to streamline these areas have included

- shifting from in-house personnel to a third-party logistics company the task of arranging, tracking, and ensuring delivery of parts from its primarily North American suppliers and to third-party repair vendors;
- reducing the number of suppliers from 6,000 to 1,800 and working toward more cooperative relationships with the remaining suppliers;

- working with key expendable parts suppliers to establish more than 30 local distribution centers near British Airways' main repair depot, such as the one shown in figure 2.2, to provide 24-hour delivery of such parts;
- establishing an integrated supplier program in which a key expendable parts vendor has taken on responsibility for monitoring parts usage and determining when to replenish inventory levels;
- consolidating internal stocking points into strategic locations to reduce inventory layers and improve responsiveness to end users; and
- installing automated storage, retrieval, and delivery systems to help ensure quick delivery of parts to end users.

Figure 2.2: Boeing's Local Distribution Center at Heathrow Airport

Repair Processes

British Airways also targeted its component repair and aircraft overhaul operations for change because it wanted to speed up the repair process. It has converted a number of workshops to a "cellular" arrangement, which involves bringing the resources needed to repair an item or range of items into one location, or "cell" (see fig. 2.3). These resources include not only the mechanics and the equipment directly involved in the repairs, but also support personnel and inventory. In the past, all of these resources may have been scattered among several different sites. The cellular approach

has reduced repair times by simplifying the flow of parts through repair workshops and ensuring that mechanics have the support they need to complete work quickly.

Figure 2.3: A British Airways' Repair Center Cell

Facilities

While reengineering its processes, British Airways decided to renovate existing structures or build entirely new facilities to accommodate the new practices. Converting to cellular operations, for example, required moving widely scattered workshops under one roof and providing additional space for inventory and support staff. The renovations occurred primarily at British Airways' main repair depot at London's Heathrow Airport. Two new facilities were constructed in South Wales to house avionics component repair and Boeing 747 aircraft overhaul activities.

British Airways was able to implement the most aggressive changes through the new facilities, called "green field sites" (see fig. 2.4). British Airways, which undertook this new construction after determining that it needed additional capacity, used the new facilities as an opportunity to start with a clean slate. It was able to fully implement state-of-the-art practices in workforce management philosophies, information systems,

material management, and repair processes without being hindered by preexisting conditions. For example, one of the most valuable aspects of the green field sites has been British Airways' ability to establish an entirely new corporate culture. Most employees are new hires, and all had to pass through a rigorous screening process to ensure that they possessed the skills and personal characteristics conducive to the flexible, team-oriented environment envisioned.

Figure 2.4: British Airways Green Field Site for Avionics Repair

Source: British Airways.

Improvements Achieved by British Airways

British Airways' initiatives have helped improve the responsiveness of logistics operations and reduced associated costs. Table 2.2 shows key performance measures that illustrate the result of British Airways' efforts.

Table 2.2: British Airways' Key Performance Measures

Inventory data accuracy (percent)	95
Supply availability (fill) rate (percent)[a]	
Reparable parts	86
Expendable parts	97
Inventory levels (months on hand)[b]	
Reparable parts	5.12
Expendable parts	8.06

[a]This rate is a measure of how often the supply system immediately fills the requests of a mechanic. It is calculated by dividing the total number of parts issued by the total number of requests for that part.

[b]Inventory levels are expressed in months on hand, which is the total inventory divided by the amount requested per month (expendable parts) or amount repaired per month (reparable parts).

Other Airlines' Initiatives Also Illustrate Reengineering Benefits

Other airlines have pursued improvements similar to the steps taken by British Airways and have likewise seen dramatic results. For example, United Airlines adopted cellular repair in its engine blade overhaul workshop. As a result, United Airlines has reduced repair time by 50 to 60 percent and decreased work-in-process inventory by 60 percent. Table 2.3 highlights examples of some of the approaches other companies have used.

Table 2.3: Summary of Other Airlines' Initiatives

Area addressed	Company	Detail	Results
Information technologies	American Airlines	Developed systems to determine how to allocate inventory across American's different operating locations, identify potential shortages that could arise, and automatically redistribute inventory to cover these shortages.	Achieved substantial savings by minimizing inventory investment while maintaining parts availability, reducing the number of flight delays, and averting costly flight cancellations.
Material management	United Airlines	Developing program in which Boeing provides kits of expendable parts needed for aircraft overhaul; mechanics would use the parts they needed then return the kit to Boeing, which would bill United only for the parts used.	Expected to reduce amount of expendable inventory carried at overhaul docks.
Component repair	United Airlines	In wheel shop, rearranged the work stations to make for a more logical flow of parts and transferred certain functions to the flight line.	Reduced shop repair times from 90 days to 3 days.
		In constant speed drive shop, pinpointed the bottleneck that was slowing repairs and contracted that function to an outside vendor; also, assigned mechanics to handle specialized, rather than a range of tasks, after determining that mechanic expertise speeded up repairs.	Reduced shop repair time from between 45 and 50 days to 17 days; saved $38 million, which includes reductions in inventory, over the 8 years this approach has been in place.
Component and aircraft overhaul	Southwest Airlines	Contracts out almost all maintenance, thus avoiding costly investments in facilities, personnel, and inventory.	Recognized as one of the most consistently profitable airlines in the United States and has often served as a benchmark for other carriers.
Facilities	United Airlines	Established green field site for aircraft overhaul and is using the cellular workshop approach in overhaul bays; 90 percent of items removed from the aircraft, such as seats and doors, remain in the bay for repair.	Facility is in start-up phases; final results are not available.

Southwest Airlines differs from other airlines; it contracts out almost all component repair and aircraft overhaul. In selecting repair vendors, Southwest emphasizes the quality of repairs because fewer breakdowns enable it to carry less inventory and keep repair costs down. Southwest also emphasizes the speed of repairs. It stipulates specific repair turnaround times, and it applies penalties whenever these times are exceeded.

Manufacturers, Suppliers, and Third Parties Can Help Streamline Operations

Manufacturers, suppliers, and third-party logistics providers are also playing a role in streamlining operations and improving the effectiveness of logistics activities. In many cases, these vendors enter partnership-type arrangements with customers that involve longer term relationships and more open sharing of information. The following are examples of vendors that are helping companies better meet logistics needs.

Boeing Commercial Airplane Group

Boeing, one of the world's leading aircraft manufacturers, has adopted a policy in which it promises next-day shipment for all standard part orders unless the customer specifies otherwise. Through its main distribution center in Seattle, Washington, and a network of smaller distribution centers worldwide, Boeing is providing quick order-to-delivery times and making it possible for customers to move from just-in-case toward just-in-time stocking policies.

Tri-Star Aerospace

Tri-Star, a distributor of aerospace hardware and fittings, offers an integrated supplier program in which it works closely with customers to manage expendable parts inventories. Its services, which can be tailored to customer requirements, include placing a Tri-Star representative in customer facilities to monitor inventory bins at end-user locations, place orders, manage receipts, and restock bins. Tri-Star also maintains data on usage, determines what to order and when, and provides replenishment on a just-in-time basis. The integrated supplier programs entail other services as well, such as 24-hour order-to-delivery times, quality inspection, parts kits, establishment of electronic data interchange links and inventory bar coding, and vendor selection management.

Tri-Star operates integrated supplier programs with nine aerospace companies, including British Airways, the first airline to enter such an arrangement with Tri-Star, and United Airlines, a recent addition. Table 2.4 shows the types of services, reductions, and improvements achieved by Tri-Star for some of its customers (designated as A through E) under the integrated supplier program.

Table 2.4: Tri-Star Integrated Supplier Program Key Characteristics (data as of February 1995)

Company	A	B	C	D	E
Date	10/16/93	1/17/92	1/7/94	7/29/92	7/9/93
Length of contract (years)	5	5	3	3	3
Number of line items	8,858	8,000	4,500	1,888	1,900
Numbers of stocking points/bins	29,505	3,404	13,153	not available	4,311
Number of customer facilities	45	7	3	1	1
Amount of inventory reduction	$7,350,000	$2,000,000	$1,800,000	$300,000	$200,000
Percent reduction	84	50	60	30	29
Fill rate (percent)	98.0	88.7	96.7	99.0	94.3
Order ship time (hours)	24	48	48	24	24
Frequency of deliveries	Daily	Daily	Daily	Daily	Daily
Number of orders filled daily	300	200	150	15	75

Source: Tri-Star Aerospace.

FedEx Logistics Services

FedEx Logistics Services (FLS), a division of express delivery pioneer Federal Express, enables companies to shed certain logistics functions while boosting their capabilities to respond to operational or customer needs. Among its services is PartsBank, in which FLS stores a company's spare parts at FLS warehouses; takes orders; and retrieves, packs, and ships needed parts. Once a replacement part is received, the customer can place the broken item in the package, and Federal Express will pick up the item and deliver it to the source of repair within 48 hours. FLS provides coverage 24 hours a day, 365 days a year. It also maintains the data associated with these activities and can provide real-time visibility of assets in the warehouse or in transit. In addition to PartsBank, FLS will develop customized services, which involves examining a client's distribution practices and finding ways to eliminate wasteful steps.

Air Force Reengineering Efforts Can Be Expanded, but Obstacles Must Be Overcome

In recognition of increasing budgetary pressures, the changing global threat, and the need for radical improvements to its logistics system, the Air Force has begun a reengineering program aimed at redesigning its logistics operations. This program, called Lean Logistics, is testing many of the same leading-edge concepts found in private sector that have worked successfully in reducing cost and improving service. The Air Force, however, could expand and improve Lean Logistics, where feasible, by including closer "partnerships" with suppliers and third-party logistics services, testing the cellular concept in the repair process, and modifying its facilities. Incorporating some of these practices will require the collaboration of DLA and other DOD components. Also, to adopt these concepts Air Force-wide, the Air Force must improve its information system capabilities.

Certain issues must be resolved before the Air Force achieves a fully reengineered logistics system that substantially reduces cost and improves service. For example, (1) the basic DOD culture must become receptive to radical new concepts of operations, (2) the traditional role of DLA as a supplier of expendable parts and as a storage and distribution service will be significantly altered, and (3) improvements to outdated and unreliable inventory data systems require management actions and funding decisions that must be made outside the responsibility of both Lean Logistics managers and the entire Air Force.

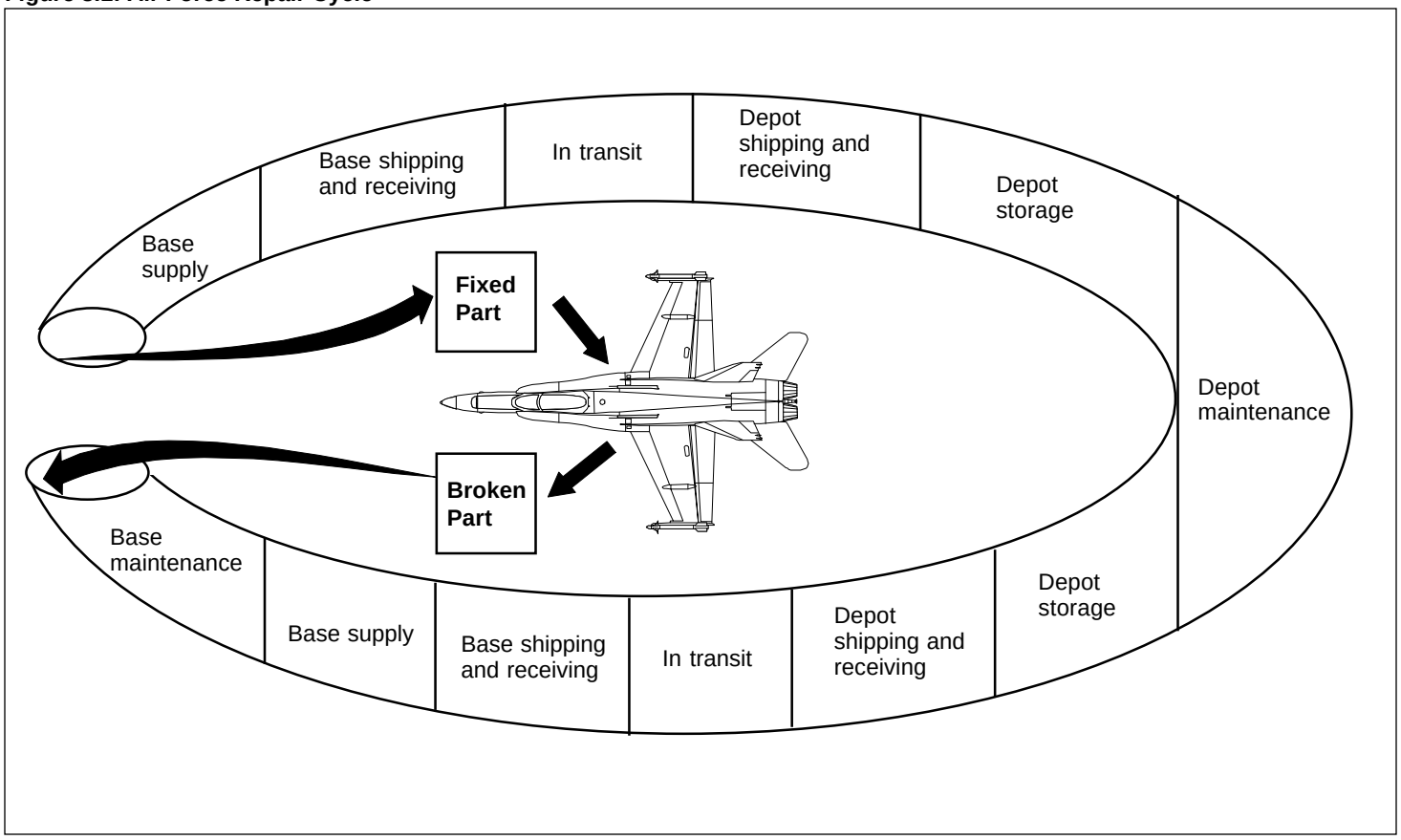
The Air Force Operates an Outdated Logistics System

The current Air Force logistics system is slow and cumbersome. Under the current process, the Air Force can spend several months or even years to contract for an item or piece parts and have it delivered or it may take several months to repair the parts and then distribute them to the end user. The complexity of the repair and distribution process creates many different stopping points and layers of inventory as parts move through the system. Parts can accumulate at each step in the process, which increases the total number of parts in the pipeline.

The Air Force has developed both a three-level and a two-level maintenance concept to repair component parts. Under the three-level concept (organizational, intermediate, and depot), a broken part must pass through a number of base-level and depot-level steps in the pipeline (see fig. 3.1). After a broken part is removed from the aircraft by a mechanic, it is routed through the base repair process. If the part cannot be repaired at the base, it is sent to an ALC and enters the depot repair system. After it is repaired, the part is either sent back to the base or returned to the DLA

warehouse, where it is stored as serviceable inventory. When DLA receives a request for a part, it ships the part to the base, where it is stored until needed for installation on an aircraft.

Figure 3.1: Air Force Repair Cycle



Currently, the Air Force estimates that this repair cycle takes an average of 63 days to complete. This estimate, however, is largely based on engineering estimates that do not provide an accurate measure of repair cycle time. The actual repair time may be significantly longer because the Air Force does not include in its estimate the time a part sits in the repair shop or in storage awaiting repair.

Under the two-level maintenance concept (organizational and depot), items that were previously repaired at the intermediate base maintenance

level will be repaired at the depot level, thus significantly reducing the logistics pipeline, inventory levels, and maintenance personnel and equipment at the base level.

Billions Have Been Invested in Parts That Might Be Unnecessary

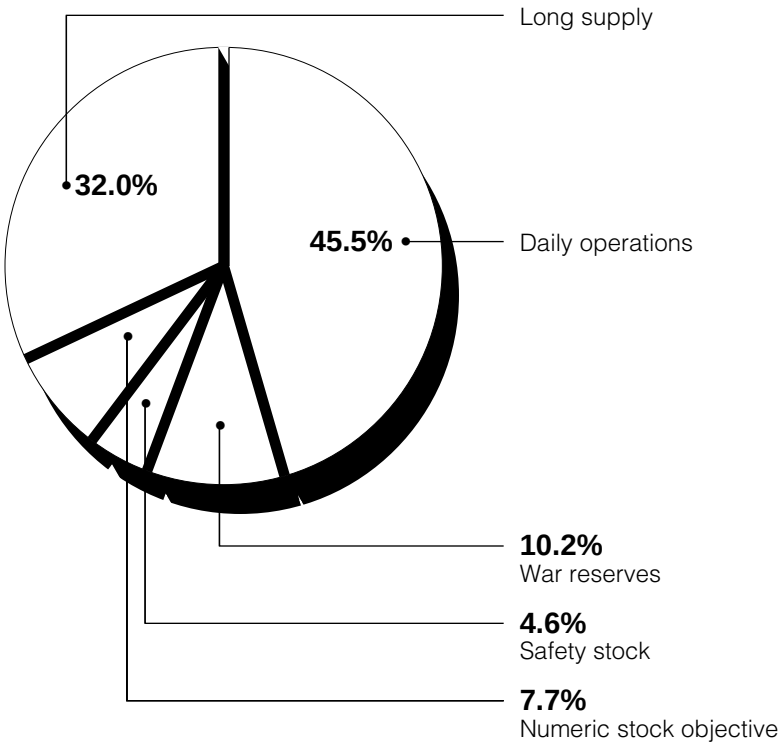
In part because of the length of its pipeline, the Air Force has invested $33 billion in reparable aircraft parts and $3.7 billion in expendable parts, totaling $36.7 billion as of September 1994.[1] The Air Force estimates that $20.4 billion of its total inventory is needed to support daily operations and war reserves. The Air Force allocates the remaining 44 percent to other types of reserves to ensure that it will not run out of parts if they are needed. The reserve inventory, valued at $16.3 billion, consists of the following categories:

- $1.7 billion for safety stocks, which are stocks purchased to ensure the Air Force will not run out of routinely needed parts;
- $2.8 billion for numeric stockage objective items, which are parts that are not routinely needed but are considered critical to keep an aircraft in operational status, so they are purchased and stored just in case an item fails; and
- $11.8 billion for items considered in "long supply," which is a term denoting that more stock is on hand than what is needed to meet current demands, safety, and numeric stockage objective levels, but this stock is not currently being considered for disposal.

Figure 3.2 details the Air Force's allocation of its inventory to daily operations, war reserves, and other categories of stock.

[1]DOD's Supply System Inventory Report lists the Air Force as having $27.5 billion in reparable parts and $3.5 billion in consumable parts. The difference between these values and the inventory values presented in this report is caused by DOD's use of its standard valuation methodology. For example, DOD reports excess inventory at salvage value (2 percent of last acquisition cost). Also, DOD reduces the value of reparable parts requiring repair by the estimated cost of repair.

Figure 3.2: Allocation of Air Force Inventory as of September 1994



The Air Force Recognizes the Need for Change

Air Force officials have said the Air Force can no longer continue its current logistics practices if it is to effectively carry out its mission in today's environment. Budgetary constraints in recent years have led to substantial reductions in personnel, leaving the remaining workforce to deal with a logistics operation that has traditionally relied on large numbers of personnel to make it work. At AFMC, the organization primarily responsible for supporting the Air Force fleet, the workforce was reduced by 18.5 percent between 1990 and 1994. Moreover, in June 1995, the Defense Base Realignment and Closure Commission recommended that two of AFMC's five ALCs be closed. As these ALCs are eventually closed, AFMC will have to find ways to accommodate their workload with the resources that remain.

In addition, the end of the Cold War has led to an evolution of the military services' roles and missions. DOD's emphasis today is on sustaining a military force that can respond quickly to regional conflicts, humanitarian efforts, and other nontraditional missions. These changing roles and missions, combined with ongoing fiscal constraints, has resulted in DOD's call for a smaller, highly mobile, high-technology force and a leaner, more responsive logistics system.

To address logistics needs, in 1994 DOD issued a strategic plan for logistics that sets forth a series of improvements. This plan, which reflects many of the philosophies found in the private sector, outlines improvements in three areas. First, it calls for reducing logistics response times—the time necessary to move personnel, inventory, and other assets—to better meet customer needs. Second, it calls for a more "seamless" logistics system. The different activities comprising logistics operations are to be viewed and managed as a series of interdependent activities rather than isolated functional areas. Third, the plan seeks a streamlined infrastructure to help reduce overhead costs associated with facilities, personnel, and inventory.

Significant Changes Envisioned Through Air Force Initiatives

The Air Force has described its initiatives to improve its logistics system as the cornerstone of all future improvements. These efforts, spearheaded by AFMC, are aimed at dramatically improving service to the end user while simultaneously reducing pipeline time, excess inventory, and other logistics costs. The initiatives, called Lean Logistics, are still in the early stages and therefore still evolving. Nonetheless, AFMC began testing certain practices through small-scale demonstration projects in October 1994, with promising results to date. In addition, AFMC plans to begin testing additional, broader-based process improvements in fiscal year 1996.

The demonstration projects underway as of March 1995 involved less than 1 percent of Air Force inventory items and tested the following primary concepts: (1) consolidated serviceable inventories, in which minimum levels of required inventory were stored in centralized distribution points in ALCs; (2) rapid transportation of parts between bases and ALCs; (3) repair of broken parts at ALCs as they arrive from bases or as centralized inventory levels drop;[2] and (4) improved tracking of parts through the repair process. Each ALC tested some combination of these concepts and was identifying the information system improvements needed to adopt these practices on a wider scale.

[2]ALC repair shops traditionally "batch" items for repair based on schedules developed almost 1 year in advance. This approach causes items to sit idle awaiting repair, sometimes for extended periods, until enough items accumulate to make a batch.

The tests scheduled to begin in fiscal year 1996 are aimed at broadening these efforts. Teams involving personnel from AFMC headquarters and each ALC have been redesigning five underlying business processes to overhaul the way parts are bought, distributed, and repaired. The teams are now determining how the redesigned processes must fit together so that reforms can be carried out in an integrated manner. Table 3.1 shows the business areas being addressed and briefly describes how each process will be changed.

Table 3.1: Air Force Lean Logistics Projects—March 1995

Business area	Current process	Future process
Requirements determination	Purchase or repair of items based on forecasts produced by three different requirement computation systems and manual intervention.	Automated process to buy or repair items based on actual demands created when items are taken from the consolidated serviceable inventory.
Stock control and distribution	Complex distribution process characterized by multiple layers of inventory, lack of asset visibility, and manual intervention.	Automated process to ship items where and when needed.
Workload management	Complex process to match requirements with internal Air Force sources of repair and available funding.	Streamlined process to channel Air Force repair requirements to any source of repair (Air Force, contractor, and other services).
Production	Lengthy aircraft overhaul and component repair processes.	Increased throughput, reduced operating expenses, and reduced inventories.
Depot maintenance business area operations	Management information and measures focused on output efficiency.	Management information and measures focused on repair cost.

Results

The test projects currently underway have demonstrated that the Air Force could sustain operations with significantly fewer parts. For example, at the Sacramento ALC, where all four concepts are being tested, 62 percent ($52.3 million) of the items involved in the project were identified as potential excess. Similarly, at the Warner Robins ALC, 52 percent ($56.3 million) of the items in its test program were identified as potential excess.

The Air Force Can Test Additional Leading-Edge Practices

AFMC has recently developed a preliminary plan for implementing its Lean Logistics concepts commandwide. Although these concepts could substantially improve operations, Air Force efforts to date are not as extensive as they could be. A number of leading-edge practices that have worked successfully in the private sector in reducing cost and improving service are not currently incorporated into the Lean Logistics program. These include the following:

- Use of third parties: The current Lean Logistics program does not include the use of third-party logistics services to store and distribute reparable parts between the bases and depot repair centers. As discussed in chapter 2, these services not only provide delivery of parts within 48 hours, they also alleviate information technology shortfalls by independently tracking parts through the storage and distribution process.
- Fast information system capability improvements: The Air Force expects the information technology improvements needed to expand Lean Logistics initiatives to come from two sources—commercial software for interim solutions to its current needs and DOD-wide system improvements being managed by the Joint Logistics Systems Center (JLSC) for long-term solutions. These long-term solutions may not be available for 5 to 10 years. In contrast, British Airways fully implemented information system improvements within 3 years.
- Supplier partnerships and reduced supplier base: The Air Force has not incorporated the concept of an integrated supplier into the Lean Logistics program. As discussed in chapter 2, British Airways and some aircraft manufacturers have significantly improved their logistics systems using this concept. Improved availability of expendable parts is critical to reducing the amount of time it takes to repair component parts.
- Supplier distribution centers: Similar to the integrated supplier program, the supplier distribution center is a technique used by British Airways to minimize the amount of time it takes to receive parts from a suppler. Currently, the Lean Logistics program is not testing this concept.
- Cellular concept for repair processes: To minimize the amount of time it takes to repair parts, British Airways adopted the cellular concept that centralizes the functions and resources needed to repair a part (e.g., testing, cleaning, machining, tooling, and supplies) in one location. British Airways also applied this concept to the aircraft overhaul facilities. The Lean Logistics program has not planned to test this concept.
- Modernize existing or build new facilities to reflect new business practices: To adopt the cellular concept and improve the storage and distribution of parts, British Airways modernized existing facilities. To maximize the impact of their entire reengineered process and corporate

culture, British Airways built green field site facilities and staffed them with employees selected for their technical competence as well as their flexibility for new processes and team orientation. Although new construction and modernization of logistics facilities is a very difficult aspect of reengineering for the Air Force because of base closures and funding limitations, this aspect of reengineering could be a consideration when future logistics decisions are made for supporting new weapon systems.

A number of these additional initiatives would require new relationships between the Air Force and commercial suppliers, distributors, and other third parties. To develop these relationships, the Air Force and DLA must work together because, under the current system, DLA is the primary supplier to the Air Force for expendable items and provides a storage and distribution service for Air Force reparable parts.

Obstacles May Prevent the Air Force From Making Necessary Changes

Several major obstacles stand in the way of the Air Force's efforts to institutionalize its reengineered logistics system. These obstacles include the following:

- The "corporate culture" within DOD and the Air Force has been traditionally resistant to change. Organizations often find changes in operations threatening and are unwilling to change current behavior until proposed ideas have been proven. This kind of resistance must be overcome if the Air Force is to expand its radical new concepts of operations.
- One of the largest obstacles to speeding up repair times is the lack of expendable parts needed to complete repairs. With a new approach to better serve its military customers, the role of DLA as the traditional supplier of consumable items and as a storage and distribution service is changing. However, at this point, DLA is still considering alternative approaches to manage expendable parts and is discussing these new concepts with contractors and the services. Until these new approaches are implemented, the Air Force's ability to improve the repair process may be limited.
- Some of the biggest gains available to the Air Force, such as improvements to outdated and unreliable inventory data systems, require management actions and funding decisions that must be made outside the responsibility of both Lean Logistics managers and the entire Air Force. In addition, some of these systems will not be fully deployed throughout the Air Force for 5 to 10 years.

Changes in corporate culture must accompany efforts to transform operations if progress is to continue within the Air Force reengineering program. According to a Lean Logistics official, the current mindset may hinder Lean Logistics for several reasons. First, people find radical changes in operations threatening and, as is common in many organizations, resist efforts to change. Second, Lean Logistics is still a relatively new concept, and personnel lack a thorough understanding of what it is and how it will improve operations. As a result, they are unwilling to change current behaviors until Lean Logistics concepts are proven. Third, Lean Logistics does not yet have support from all of the necessary functional groups within AFMC, the Air Force, and DOD. This support will be needed if the full range of changes is to be carried out.

In June 1994, we convened a symposium on reengineering that brought together executives from five Fortune 500 companies that have been successful in reengineering activities.[3] The following principles for effective reengineering, reflecting panel members' views, emerged from the symposium:

- Top management must be supportive of and engaged in reengineering efforts to remove barriers and drive success.
- An organization's culture must be receptive to reengineering goals and principles.
- Major improvements and savings are realized by focusing on the business from a process rather than functional perspective.
- Processes should be selected for reengineering based on a clear notion of customer needs, anticipated benefits, and potential for success.
- Process owners should manage reengineering projects with teams that are cross-functional, maintain a proper scope, focus on customer metrics, and enforce implementation timelines.

Panel members at the symposium expressed the view that committed and engaged top managers must support and lead reengineering efforts to ensure success because top management has the authority to encourage employees to accept reengineered roles. Also, top management has the responsibility to set the corporate agenda and define the organization's culture and the ability to remove barriers that block changes to the corporate mindset. For example, the Vice President of Reengineering at Aetna Life and Casualty Insurance Company said, "Top management must drive reengineering into the organization. Middle management won't do it."

[3]Reengineering Organizations: Results of a GAO Symposium (GAO/NSIAD-95-34, Dec. 13, 1994).

The panelists agreed that a lack of top management commitment and engagement is the cause of most reengineering failures.

According to the Corporate Headquarters Program Manager of Process Management at IBM, "To be successful, reengineering [needs to be] embedded in the fiber of our people until it becomes a way of life." To develop a corporate culture that is receptive to reengineering, the panelists emphasized the importance of communicating reengineering goals consistently on all levels of the organization, training in skills such as negotiation and conflict resolution, and tailoring incentives and rewards to encourage and reinforce desired behaviors.

One of the largest obstacles to speeding up repair times is the lack of expendable parts needed to complete repairs. Supplier-operated local distribution centers could help ensure quick availability of such parts. Similarly, integrated supplier programs, in which certain inventory management responsibilities are shifted to the supplier, are also aimed at improving expendable item support. We have strongly urged DLA to endorse the use of aggressive just-in-time concepts whose principal objectives are to transfer inventory management responsibilities to key distributors.

Existing information systems are also an obstacle because they do not always provide the accurate, real-time information needed to expand current efforts beyond their limited scope. According to AFMC's deputy chief of staff for logistics, AFMC is working with systems that have not been significantly improved in 15 years. As a result, much of the data used to run the Lean Logistics demonstration projects have been collected manually, a task that project leaders said would be impossible under an Air Force-wide program.

Improvements to material management and depot maintenance information systems—key to success of the Lean Logistics initiatives—are under the control of JLSC. JLSC is staffed with personnel from the military services and DLA, and is trying to standardize data systems across DOD. These systems, however, will not be fully deployed throughout the Air Force for 5 to 10 years. Currently, AFMC officials are working with JLSC officials to define Air Force requirements. They are also working to develop short-term solutions to enable the Lean Logistics program to move forward using commercial software. According to one Lean Logistics official, however, AFMC may have trouble pursuing and later

adopting many of these short-term solutions because funding for systems outside of JLSC's umbrella is severely limited.

Conclusions

The current Air Force logistics system is inefficient and costly compared with leading-edge business practices. AFMC has recognized the need for radical change and is beginning to pursue some of these practices. Because some of the results to date have been promising, these efforts should be supported and expanded. The Air Force, however, could build on its reengineering effort by including additional practices pursued and successfully adopted by the private sector.

In addition, current and future AFMC initiatives will be seriously hindered unless top-level DOD commitment and engagement is received, and all affected Air Force organizations and other DOD components—specifically DLA and JLSC—fully support AFMC's efforts. DLA's support will be critical for developing local distribution centers and integrated supplier programs to meet the Air Force requirements for expendable parts. JLSC officials may have to find ways that will allow the Air Force the flexibility to use existing commercial software to resolve existing information technology weaknesses and expand its reengineering initiatives.

Without these logistics system improvements, the Air Force will continue to operate a logistics system that results in billions of dollars of wasted resources. Given the budget reductions it has already absorbed, the Air Force might not be able to provide effective logistics support to future DOD operations.

Recommendations

To build on the existing Air Force reengineering efforts and achieve major logistics system improvements, we recommend that the Secretary of Defense commit and engage top-level DOD managers to support and lead Air Force reengineering efforts to ensure its success. We also recommend that the Secretary of Defense direct the Secretary of the Air Force to incorporate additional leading-edge logistics concepts into the existing Lean Logistics program, where feasible. Specific concepts that have been proven to be successful and should be considered, but have not been incorporated in the current Air Force program include

- installing information systems that are commercially available to track inventory amounts, location, condition, and requirements;

- counting existing inventory once new systems are in place to ensure accuracy of the data;
- establishing closer relationships with suppliers;
- encouraging suppliers to establish local distribution centers near major repair depots for quick shipment of parts;
- using integrated supplier programs to shift to suppliers the responsibility for managing certain types of inventory;
- using third-party logistics services to manage the storage and distribution of reparable parts and minimize DOD information technology requirements;
- reorganizing workshops, using the cellular concept where appropriate, to reduce the time it takes to repair parts; and
- integrating successful reengineered processes and flexible, team-oriented employees in new facilities (like the green field sites) to maximize productivity improvements, as new facilities are warranted to meet changes in the types and quantities of aircraft.

In addition, we recommend that the Secretary of the Air Force (1) prepare a report to the Secretary of Defense that defines its strategy to adopt these leading practices and expand the reengineering program Air Force-wide and (2) establish milestones for the report's preparation and issuance and identify at a minimum

- the barriers or obstacles that would hinder the Air Force from adopting these concepts;
- the investments (people, skills, and funding) required to begin testing these new concepts and the projected total costs to implement them Air Force-wide;
- the potential savings that could be realized; and
- the Air Force and other DOD components whose support will be needed to fully test these new concepts.

We further recommend that the Secretary of Defense use the Air Force's report to set forth the actions and milestones to alleviate any barriers or obstacles (such as overcoming resistance to organizational change and improving outdated inventory information systems), provide the appropriate resources, and ensure the collaboration between the Air Force and other DOD components that would enable the Air Force to achieve an integrated approach to reengineering its processes. Once these steps are taken, we recommend that the Secretary of Defense direct the Secretary of the Air Force to institutionalize a reengineering effort that is consistent with successful private sector reengineering efforts. These efforts include

- communicating reengineering goals and explaining them to all levels of the organization,
- training in skills to enable employees to work across functions and modifying this training as necessary to support the reengineering process, and
- tailoring rewards and incentives to encourage and reinforce desired behaviors.

Agency Comments

In commenting on a draft of this report, DOD generally agreed with the findings, conclusions, and recommendations, and stated that the Air Force's Lean Logistics program should receive top-level DOD support in achieving its goals. DOD also stated that the Air Force should consider incorporating additional leading-edge practices into its reengineering effort. According to DOD, the Air Force will be asked to provide a report to the Secretary of Defense by July 1996 that will discuss the feasibility of including such additional practices in the Lean Logistics initiative and to address other concerns raised in this report. By October 1996, the Office of the Secretary of Defense will address how it plans to alleviate any barriers and obstacles identified in the Air Force's report. DOD indicated that the Air Force plans to take steps to institutionalize its reengineering efforts by December 1996.

Details on British Airways' Reengineering Initiatives

This appendix details how British Airways reengineered its logistics practices in five general categories—corporate focus and culture, information technology, material management, repair processes, and facilities—to reduce the time and complexity associated with operations.

Corporate Focus and Culture

British Airways could not have made such significant changes in operations without transforming the corporate mind-set, airline officials said. British Airways' corporate focus emphasizes serving customer needs while continually finding ways to keep costs down. The customer is defined not only as the passenger on the aircraft but also as the person on the receiving end of any activity. This focus has been the driving force behind all operational improvements, and bringing managers and employees around to this way of thinking has involved a number of different efforts over time.

The changes began with new top management. In 1981, the British government appointed a new chairman, who in turn brought in other executives, after deciding to convert the state-owned airline into a private sector enterprise.[1] These executives were recruited from private industry to bring a better business focus to the organization, and their mission was to make the airline fit for privatization. Accomplishing this mission entailed first saving British Airways from bankruptcy and then setting the airline on a course to ensure long-term success.

The organization that the new management inherited suffered from several problems. An industrywide recession had pushed the airline to the brink of bankruptcy after years of increasing debt and meager profits. Moreover, according to one top official, British Airways was grossly overstaffed, managers' time was spent addressing one crisis after another, and employee morale had collapsed. Forty different industrial disputes were going on at one time. As a result, "horror stories" about customer service abounded, said the chief executive officer in a 1987 speech. The official said a high proportion of British Airways' customers chose the airline because they had to, not because they wanted to.

Changing the culture that allowed these problems to arise was one of the most important but difficult aspects of British Airways' turnaround, said one manager. To begin the transformation, the new management took two key steps. First, it launched a series of cost-cutting measures aimed at

[1]Privatization occurred in 1987, when the British government sold British Airways shares in a public offering.

averting bankruptcy. These measures included reducing the workforce from 55,000 to 36,000 between 1981 and 1983 to eliminate redundant positions and other positions that added no value to the operation. Second, it set forth a long-term strategy for success. This strategy placed top priority on serving the customer better, and it emphasized the importance of continually finding ways to reduce costs.

To carry out this strategy, management took a number of steps to reorient the workforce to the new corporate philosophy. One of the first steps was to institute ongoing training and education programs. The first course, entitled "Putting People First," was offered in 1983 and introduced the workforce to the customer service concepts British Airways wanted to promote. Subsequent courses have included training in total quality management principles, trends in the airline industry, and the ways different areas within British Airways contribute to the overall operation.

In addition, British Airways targeted managers for intensive training. Over time, managers have been schooled in measuring customer service performance, implementing new production methods, and benchmarking against other companies, among other things. In addition, British Airways Engineering, the division responsible for logistics operations, has helped its top managers attain master's degrees in business.

Another key step in the reorientation of the workforce was the development of new performance measures. Early on, management began setting stringent financial and customer service targets, a departure from past practices in which the few measures that did exist carried little meaning for employees. In addition, management changed the type of measures used to better reflect corporate goals. For example, maintenance shops previously focused on their own isolated goals, such as the number of hours worked or the number of parts produced each week. Under current measures, the shops are assessed on how well repair operations are supporting the British Airways fleet, such as through reduced repair turnaround time. British Airways also bolstered these measures by adopting "rallying cries" for improvements. For example, the expression "Times Two" called for halving costs or doubling productivity in a number of important areas, and it became the standard under which all improvements were to be measured.

Finally, British Airways sought to create an environment that promoted change. Toward that end, it instituted total quality management principles to enable employees at all levels to identify and carry out improvements. It

also negotiated agreements with employee unions to allow managers to assign workers to different jobs whenever necessary. It has also tried to alleviate employee fears that efficiencies gained through improvements would lead to job losses. In the late 1980s, British Airways made the strategic decision to aggressively market its repair services to other airlines. As a result, additional capacity resulting from improvements could be used for this additional work.

Despite the long-term success of these efforts, one manager said the process of change has sometimes been painful. For example, managers who were unwilling or unable to adapt to the new philosophy were let go. Even British Airways' chief executive officer, who had been brought in as part of the new management team, replaced two-thirds of his staff because they hindered reforms.

Information Technologies

British Airways' success in reengineering logistics practices has hinged on giving managers adequate technological tools to plan, control, and measure operations. British Airways has developed a number of systems to aid improvements, but three key systems have been credited with being the most valuable. The first is an inventory tracking and control system that provides accurate, real-time data on the amount of inventory on hand and its location, condition, and usage. The second is a material requirements planning system that determines what parts British Airways will need to support operations. The third is a decision support system that quickly gives managers the data needed to assess performance.

The most crucial of the three systems has been the inventory tracking and control system, called Total Inventory Management for Engineering (TIME). One manager said that British Airways developed TIME because it believed that without accurate inventory data, any improvements would be "built on sand." TIME maintains data accuracy of more than 95 percent and enables British Airways to track inventory and associated processes. Bar-coded tags are attached to each item or package of items, and employees use laser scanners to update TIME on the items' status each time the items change hands. Employees also scan in their bar-coded identification cards to establish clear ownership of the items. Moreover, TIME works with other systems to direct the flow of parts. For example, when a part is scanned in, TIME shows whether the part is to go to storage, a particular repair shop, or a customer. It also enables British Airways to place orders electronically with suppliers.

British Airways began developing TIME in 1984 after internal audits showed that data accuracy in some areas was as low as 55 percent. British Airways used a systematic approach to determine what data was needed to manage operations, and then it designed in capabilities, such as the bar-coding features, to ensure the system maintained its accuracy. Moreover, when bringing the system on line in 1987, British Airways counted all inventory to establish an accurate baseline. This exercise resulted in savings substantial enough to pay for the system's implementation because it revealed items that previously had not been recorded in inventory. According to one manager, the switch to TIME was so dramatic, but so important, that British Airways was willing to risk a disruption in service or even a total grounding of aircraft to bring the system on line.

Soon after TIME was on line, British Airways developed the material requirements planning system to gain even greater control over inventory. This system taps into TIME and other systems to forecast what reparable parts will be needed to support operations. On the basis of those forecasts, it determines which items need to be repaired when, how many reparable and expendable components are needed to accomplish those repairs, and whether purchases are necessary. This capability has helped British Airways avoid critical shortages, identify excess inventory, avoid unnecessary expense, and ensure that parts do not stall in workshops for lack of the components needed to complete repairs.

British Airways used a flexible, pilot program approach to bring the material requirements planning system on line. After selecting commercially available software, British Airways installed the software in one shop and then went through several iterations of identifying and removing bugs from the system and updating employees on the upgrades. Through this approach, British Airways was able to have the software ready for widespread application within 1 year despite substantial modification. Implementation was nearly complete 1 year later. According to British Airways, typical implementation times for material requirements planning systems in the industry is 4 years. Therefore, using the pilot program approach shortened the implementation time by 2 years.

The third system, called FOCUS, is a decision support system that can extract data from numerous systems and provide customized reports for managers. It has enabled British Airways to base decisions on actual data rather than estimates by providing almost instant access to information such as inventory levels, fill rates, and inventory turnover. Because of the system's speed and flexibility, managers can assess numerous aspects of

operations. For example, FOCUS can provide information on an individual part; a functional group, such as avionics; or overall inventory. FOCUS was developed from commercially available software in 1983. Although FOCUS was developed before TIME and the material requirements planning system, its use grew significantly as the quality of data improved.

Material Management

With culture change and information system improvements underway, British Airways began targeting specific processes in the reparable parts pipeline. Among these processes were the methods used to order, store, and distribute inventory. The goal has been to improve the availability of parts without substantially increasing inventory and other costs. To accomplish this goal, British Airways has concentrated on relationships with outside vendors as well as on the way inventory is handled internally.

British Airways has changed the way parts are transported to and from suppliers and third-party repair vendors, who are primarily in North America. It contracts with a freight forwarder to gather the items to be shipped, arrange transportation, track the items while they are in transit, ensure that the items get through customs, and deliver the items to British Airways' or the vendors' receiving areas.

This setup has enabled British Airways to improve the reliability of deliveries. It receives most items within 5 days, including customs delays, and is able to deliver most items to third-party repair vendors within 3 days. In the past, deliveries ranged anywhere from 3 days to 3 weeks. In addition, British Airways has reduced its administrative burden and associated costs. The freight forwarder has also helped British Airways identify where items are stalling and the cost of those delays.

British Airways has also changed the nature of its relationships with suppliers. First, it has decreased the number of suppliers from 6,000 to 1,800, with further reductions planned as part of an overall move toward more cooperative relationships with fewer suppliers. Second, it has worked with key expendable parts suppliers to establish local distribution centers. These centers, located near British Airways' main repair depot, receive orders electronically and then deliver items within 24 hours. Twenty-five suppliers have opened these centers, and seven more are planned.

The local distribution centers have contributed to reductions in reparable parts repair times because they help ensure the availability of the

expendable items needed to complete repairs. The centers' quick response times have also enabled British Airways to carry less expendable inventory. British Airways hopes to eventually purchase 80 percent of all of its parts, which includes reparable items, through the centers. Currently, about 20 percent of purchases are through the centers.

British Airways is also moving toward giving suppliers a more active role in managing its inventory of expendable parts. In a pilot program, one local distribution center supplier, Tri-Star Aerospace, is responsible for monitoring parts usage and determining how much inventory is needed to maintain a 60-day supply in inventory bins. Tri-Star also inspects the items to ensure that they meet quality standards and maintains data so that any item can be traced back to individual manufacturing lots.

Moreover, before the items are shipped from the center, Tri-Star records on British Airways' inventory system that the items have been received, which enables Tri-Star items to circumvent British Airways receiving docks and go directly to storage areas. Under this program, British Airways can receive up to eight deliveries a day, with British Airways staff handling transport from the center to storage areas.

British Airways has also used several methods to streamline the way inventory is handled internally. It has consolidated inventory storage locations into four main stores at its major repair facilities, and these stores are supplemented by a pattern of substores throughout repair workshops. This setup replaces the 60 to 70 storage locations previously used. Although British Airways considered consolidating inventories further, it determined that it needed a certain number of substores to provide adequate support to repair operations.

In addition, British Airways has installed automated storage and retrieval systems and uses pneumatic tubes, similar to those found at bank drive-in windows, to deliver parts within minutes to mechanics. When possible, it also provides mechanics with preestablished kits of parts needed to accomplish specific repairs. When repairs are complete, the kit is returned to the stores and replenished.

Repair Processes

British Airways targeted its repair processes for improvement because it wanted to speed up repair time. It has converted to cellular workshops, which involves bringing the resources needed to repair an item or a range of items into one location, or one "cell." These resources include not only

the mechanics and the equipment directly involved in the repairs, but also support personnel and inventory. This approach, which British Airways has applied to component and aircraft overhaul operations, has helped eliminate obstacles that slow repairs or stop them altogether. British Airways adopted the cellular concept after determining that items could be repaired as much as 10 times faster if these obstacles were removed.

The cellular approach simplifies the repair process in a number of ways. First, it eliminates the need to route items to several different locations to complete repairs, thereby eliminating travel time and the time required to pack and unpack items whenever they change locations. In the past, functions such as testing, inspection, painting, and machining could each have been handled at different sites. Second, the approach places the inventory needed to complete repairs near the workshops so that mechanics can get quick access to parts. In fact, British Airways began converting to consolidated inventory points and pattern of substores with the cellular approach in mind. Moreover, broken parts awaiting repair are also stored near workshops so that employees can easily track any backlog and have parts readily at hand when it comes time for repair. Third, each cell has its own planners, schedulers, and other support staff to ensure that operations run smoothly.

The process of redesigning repair operations gave both managers and employees the opportunity to rethink British Airways' approaches to repair. When searching for new approaches, managers benchmarked British Airways' operations against those of other companies to see what has worked well in other industries, and used links with education resources such as Warwick University. After settling on the cellular concept, managers sought employees' suggestions on how to design the new workshops. Moreover, close examination of existing operations led British Airways to determine that outside vendors could handle certain tasks more economically. For example, British Airways sold its engine repair facility to General Electric, and the airline now contracts with General Electric for engine repair. British Airways was also able to make informed decisions on processes that did not lend themselves to cells. For example, some high capital cost activities, such as metal plating, remain centralized.

The cellular approach has helped reduce repair time and provided other benefits. British Airways has found that repair cells can now handle the same or increased volume with fewer staff. It has also facilitated the use of performance measures. For example, because repairs are concentrated in

one area rather than spread out among several, British Airways can more accurately assess the time and resources needed for repair. It can also better assess how managers and mechanics are performing and reward top performers accordingly.

Facilities

British Airways has renovated existing structures or built entirely new facilities to accommodate many of the reengineered practices. These improvements have enabled British Airways to carry out the new storage and distribution practices, cellular operations, and various management philosophies. The new facilities have allowed for the most aggressive changes in these areas because they gave British Airways the freedom to start with a clean slate.

British Airways has focused renovation efforts on its primary maintenance and storage base at London's Heathrow Airport. Existing structures were refurbished to provide space for the consolidated inventories, cellular workshops, storage points for broken parts, and support staff work areas. They were also equipped with automated storage and retrieval systems and the pneumatic tube inventory delivery system. Previously, many of the inventory storage points, repair workshops, and staff offices were scattered among several locations. Inventory storage, retrieval, and delivery had also been largely manual.

British Airways constructed the new facilities away from existing operations. These green field sites, located 2 hours away in Wales, consist of separate avionics component overhaul and Boeing 747 aircraft overhaul facilities. The new facilities were built specifically to allow British Airways to incorporate state-of-the-art practices without being hindered by preexisting conditions. The airline undertook these projects after determining that it needed the additional capacity to accommodate continued fleet expansion and anticipated growth in its repair work for other airlines.

British Airways has set forth one overriding objective for each facility. For avionics, the goal is to achieve a 3-day repair turnaround time, measured from the time a broken item enters the facility until the time it leaves fully repaired. For the 747 facility, the goal is to repair the greatest number of aircraft possible, which also requires quick turnaround time. Moreover, each facility is a stand-alone business that must compete with outside repair vendors for British Airways work. All costs incurred by the facilities

are directly attributable to their operations, and their long-term survival depends on their ability to generate profits.

With these issues in mind, British Airways scrutinized every potential activity to be housed at the facilities and eliminated those that did not contribute each facility's primary objective. For example, both facilities have kept layers of inventory to a minimum. The avionics facility holds no bench stock,[2] and it eliminated selected work benches and other workshop furniture so that mechanics would have no place to stockpile inventory. All inventory must be requested through the facility's central automated storage, retrieval, and delivery system. The 747 facility also requires mechanics to request inventory through its central storage area, although it allows for a minimal amount of bench stock.

In addition, British Airways recruited a mostly new workforce to staff the facilities. This approach has provided for perhaps the most dramatic difference from existing operations because it enabled British Airways to build each facility's culture from the ground up. For example, each facility has only one labor union compared with several at existing operations, which has made for a more flexible workforce. Employees can be easily reassigned to other jobs as workload demand dictates. Moreover, to help create a labor-management partnership, each facility has established a council comprised of management and staff to oversee operations and address workplace issues. In addition, the facilities have stressed the importance of teamwork. At each facility, all employees, including managers, wear white coveralls, use the same entrance, and eat at the same cafeteria. The number of managers has also been kept to a minimum. The 747 facility, for example, has 18 managers out of a total workforce of 500.

When recruiting the new workforce, British Airways put applicants through a rigorous screening process. British Airways first developed a set of criteria defining the technical skills and personal characteristics required for the flexible, team-oriented environment envisioned. Applicants then passed through a series of steps, including a 2-hour test and interview, before finally being selected.

The results of these efforts show that these new approaches have had an effect on British Airways' operations. At the avionics facility, more than 23 percent of the items met the 3-day standard within the first 9 months of

[2]Bench stock typically consists of frequently used expendable items, and it is generally kept near work areas to allow for quick access by mechanics.

operations, and more are expected to do so as the facility matures. Shops began being moved from existing operations at Heathrow in December 1993, with the last shop transferred in October 1994. In addition, the avionics facility has been able to handle a greater volume of repairs than Heathrow with fewer staff. At the 747 facility, aircraft turnaround time as of November 1994 was 20 percent faster than similar operations at Heathrow. Planners originally thought the facility, which opened in June 1993, would take 2 years to overtake Heathrow's turnaround times.

Comments From the Department of Defense

Note: GAO comments supplementing those in the report text appear at the end of this appendix.

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ACQUISITION AND TECHNOLOGY
(L/MDM)

02 JAN 1996

Mr. David R. Warren
Director, Defense Management
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U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Warren:

This is the Department of Defense (DoD) response to the the General Accounting Office (GAO) draft report, "BEST MANAGEMENT PRACTICES: Reengineering the Air Force's Logistics System Can Yield Substantial Savings," dated November 1, 1995 (GAO Code 709002), OSD Case 1047. The Department generally concurs with the draft report.

The DoD agrees that the Air Force logistics reengineering effort, known as Lean Logistics, should receive top-level DoD support in achieving its goals. The DoD also agrees that the Air Force should consider incorporation of additional leading-edge logistics practices into its reengineering effort. The Air Force will be asked to provide a report to the Office of the Secretary of Defense by July 1996 that will discuss the feasibility of including such additional practices in the Lean Logistics initiative and address other concerns raised by GAO. The Office of the Secretary of Defense will address obstacles identified in the Air Force report by October 1996.

The detailed DoD comments on the GAO draft report are provided in the enclosure. The Department appreciates the opportunity to comment on the draft report.

Sincerely,

FOR John P. Phillips
Deputy Under Secretary
of Defense (Logistics)

Enclosure

GAO DRAFT REPORT DATED NOVEMBER 1, 1995
(GAO CODE 709002) OSD CASE 1047

"BEST MANAGEMENT PRACTICES: REENGINEERING THE AIR FORCE'S LOGISTICS SYSTEM CAN YIELD SUBSTANTIAL SAVINGS"

DEPARTMENT OF DEFENSE COMMENTS

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FINDINGS

- **FINDING A: The Air Force Operates an Outdated Logistics System.** The GAO reported that under the current Air Force logistics system, the Air Force can spend several months or even years to contract for an item and have it delivered and several more months to repair the parts and then distribute them to the end user. The GAO found that the complexity of the repair and distribution process creates many different stopping points and layers of inventory as parts move through the system. The GAO pointed out that parts can accumulate at each step in the process which increases the total number of parts in the pipeline.

  The GAO found that the Air Force has developed both a three-level and a two-level maintenance concept to repair component parts. The GAO reported that the Air Force estimates that the three-level repair cycle takes an average of 63 days to complete. The GAO indicated that the Air Force estimate, however, was largely based on engineering estimates that do not provide an accurate measure of repair cycle time. The GAO concluded that the actual repair time may be significantly longer because the Air Force does not include the time a part sits in the repair shop or in storage awaiting repair. The GAO reported that, under the two-level maintenance concept, items that were previously repaired at the intermediate base maintenance level will be repaired at the depot level, thus significantly reducing the logistics pipeline, inventory levels, and maintenance personnel and equipment at the base level.

  According to the GAO, the Air Force has invested $33 billion in reparable aircraft parts and $3.7 billion in expendable parts, as of September 1994. The GAO indicated that the Air Force estimates that $20.4 billion of the inventory is needed to support daily operations

ENCLOSURE

Now on pp. 5 and 27-30.

and wartime reserve. The GAO further indicated that the Air Force allocates the remaining 44 percent to other types of reserves to ensure that parts will be available if needed. The GAO concluded that the Air Force has invested billions of dollars in parts that might not be necessary. (pp. 5-6, pp. 31-34/GAO Draft Report)

See comment 1.

DOD RESPONSE: Partially concur. While the GAO description of the Air Force logistics system is generally accurate, the first sentence should be corrected to read "...the Air Force can spend several months or even years to contract for an item or piece parts and have them delivered, or it may take several months to repair the parts and then distribute them to the end user." Furthermore, the DoD Supply System Inventory Report as of September 30, 1994 lists the Air Force as having $27.5 billion in reparable parts and $3.5 billion in consumable parts. Of the total secondary item inventory, the Air Force estimates that $23.5 billion is active inventory required through the. budget year and to support war reserves. The remaining $7.5 billion is inactive, or inventory in retention and potential excess categories.

- **FINDING B: The Air Force Recognizes the Need for Change**. The GAO reported that, according to Air Force officials, the Air Force can no longer continue current logistics practices if it is to effectively carry out its mission in today's environment. The GAO explained that the DoD emphasis today is on sustaining a military force that can respond quickly to regional conflicts, humanitarian efforts, and other nontraditional missions. The GAO noted that those changing roles and missions, combined with ongoing fiscal constraints has resulted in the call for a smaller, highly mobile, high-technology force and a leaner, more responsive logistics system. The GAO outlined the improvements included in the 1994 DoD strategic plan for logistics needs. (pp. 3-4, pp. 34-35/GAO Draft Report)

Now on pp. 2 and 30-31.

DOD RESPONSE: Concur.

- **FINDING C: Significant Changes Envisioned Through Air Force Initiatives**. The GAO reported that the Air Force Materiel Command (AFMC) is spearheading initiatives, called Lean Logistics, to improve logistics systems. The GAO indicated that the AFMC began testing certain

Now on pp. 31-32.

practices through small-scale demonstration projects in October 1994, with promising results to date. The GAO pointed out that the test projects have demonstrated that the Air Force could sustain operations with significantly fewer parts. (pp. 35-37/GAO Draft Report)

DOD RESPONSE: Concur.

- **FINDING D: Air Force Can Test Additional Leading Edge Practices**. The GAO reported that, while the AFMC has recently developed a plan for implementing its Lean Logistics concepts command-wide and although those concepts could substantially improve operations, the Air Force efforts to date are not as extensive as they could be. The GAO listed a number of leading-edge practices that are not currently included in the Lean Logistics program. According to the GAO, a number of those practices would require new relationships between the Air Force and commercial suppliers, distributors, and other third parties. The GAO maintained that, to develop those relationships, the Air Force and the Defense Logistics Agency (DLA) must work together because, under the current system, DLA is the primary supplier to the Air Force for expendable items and provides a storage and distribution service for Air Force reparable parts. (pp. 5-6, pp. 38-39/GAO Draft Report)

Now on pp. 5-6 and 33-34.

DOD RESPONSE: Concur. The DoD notes, however, that the initiatives the GAO cites as not included in the Air Force plan are being considered as initiatives that would aid in the reduction of pipelines and lead times. The potential benefits of transferring inventory management responsibilities to third parties is being addressed in the privatization efforts of both the Air Force and DLA. DLA has undertaken a series of initiatives to shift support to the private sector, including direct vendor delivery, prime vendor, flexible manufacturing, and aggressive use of commercial transportation. Furthermore, DLA and the Air Force have worked closely together to ensure that support for the Lean Logistics initiative is incorporated into DLA's reinvention efforts. DLA representatives are members of the Lean Logistics steering group and users group that meet monthly to discuss new ideas and implement approved strategies.

See comment 2.

- **FINDING E: Obstacles May Prevent the Air Force From Making Necessary Changes**. The GAO reported that several major obstacles stand in the way of the Air Force efforts to institutionalize the reengineered logistics system. The GAO discussed the following obstacles to/principles for effective reengineering:

  - current and future Air Force initiatives will be seriously hindered unless there is top-level DoD commitment, and all affected Air Force organizations and other DoD components--specifically DLA and the Joint Logistics Systems Center (JLSC)--fully support the Air Force efforts.

  - lack of expendable parts needed to complete repairs. The GAO strongly urged DLA to endorse the use of aggressive just-in-time concepts to transfer inventory management responsibilities to key distributors.

  - existing Air Force information systems have not been significantly improved in 15 years. The GAO noted that, as a result, much of the data used to run the Lean Logistics demonstration projects have been collected manually--a task that project leaders said would be impossible under an Air Force-wide program.

  - material management and depot maintenance information systems are under the control of the JLSC. The GAO pointed out that the JLSC is trying to standardize data systems across DoD. The GAO noted that, however, those systems will not be fully deployed throughout the Air Force for 5 to 10 years.

  - according to an Air Force official, the Air Force may have trouble pursuing and adopting short-term solutions because funding for systems outside the JLSC is severely limited. (p. 4, pp. 40-42/GAO Draft Report)

Now on pp. 6 and 34-37.

DOD RESPONSE: Partially concur. The DoD does not agree with the GAO implication that DLA is an obstacle to Air Force efforts to institutionalize the reengineered logistics system, nor with the GAO assertion on page 39 of the draft report that "...DLA is unsure of how it should manage such parts in the future and interface with the other Services." As discussed in the DoD response to Finding D above, DLA is aggressively working with its customers, including the Air Force, to develop creative, tailored methods of support that will provide expendable parts in a timely manner that avoids repair work stoppages. DLA is now developing a Broad Area

See comment 3.

Announcement to seek creative industry approaches targeted at the industrial maintenance overhaul process. The Broad Area Announcement will involve one or more contractor demonstration projects for total logistics support to the targeted area, using the best mix of Government and commercial sources of supply. Preliminary discussions are underway between DLA and Warner Robins Air Force Base. Discussions with other potential Service participants will begin during December 1995.

* * * * *

RECOMMENDATIONS

- **RECOMMENDATION 1:** The GAO recommended that the Secretary of Defense, to build on the existing Air Force reengineering efforts and achieve major logistics system improvements, commit and engage top-level DoD managers to support and lead Air Force reengineering efforts to ensure its success. (p. 6, pp. 42-43/GAO Draft Report)

Now on pp. 6 and 37.

DOD RESPONSE: Concur. The Office of the Deputy Under Secretary of Defense (Logistics) will be the focal point for ensuring maximum support within DoD for Air Force logistics reengineering efforts.

- **RECOMMENDATION 2**: The GAO recommended that the Secretary of Defense direct the Secretary of the Air Force to incorporate additional leading-edge logistics concepts into the existing Lean Logistics program, where feasible. The GAO outlined specific concepts that have been proven to be successful and should be considered, but have not been incorporated in the current Air Force program. (p. 6, p. 43/GAO Draft Report)

Now on pp. 6 and 37.

DOD RESPONSE: Concur. As discussed in the DoD response to Finding D, the initiatives the GAO cites as not included in the Air Force plan are being considered as initiatives that would aid in the reduction of pipelines and lead times. The Air Force will be requested to report on the results of that review by July 1996.

- **RECOMMENDATION 3**: The GAO recommended that the Secretary of the Air Force prepare a report to the Secretary of Defense that defines its strategy to adopt leading practices and expand the reengineering program Air Force wide. The GAO stated that the Secretary of the Air Force

should establish milestones for the preparation and issuance of the report and should identify at a minimum the following:

- barriers or obstacles that would hinder the Air Force from adopting those concepts;
- investments (people, skills, and funding) required to begin testing those new concepts and the projected total costs to implement them Air Force-wide;
- potential savings that could be realized; and
- Air Force and other DoD components whose support will be needed to fully test those new concepts. (p. 6, p. 43/GAO Draft Report)

Now on pp. 6 and 38.

DOD RESPONSE: Concur. The report due by July 1996 cited in the DoD response to Recommendation 2 will also address these issues.

- **RECOMMENDATION 4**: The GAO recommended that the Secretary of Defense use the Air Force report to set forth the actions and milestones to alleviate any barriers or obstacles (such as overcoming resistance to organization change and improving outdated inventory information systems), provide the appropriate resources, and ensure the collaboration between the Air Force and other DoD components that would enable the Air Force to achieve an integrated approach to reengineering its processes. (p. 6, pp. 43-44/GAO Draft Report)

Now on pp. 6 and 38.

DOD RESPONSE: Concur. Following the submission of the Air Force report, the Office of the Deputy Under Secretary of Defense (Logistics) will address these matters and issue findings by October 1996.

- **RECOMMENDATION 5**: The GAO recommended that the Secretary of Defense, once the steps in the recommendation are taken, direct the Secretary of the Air Force to institutionalize a reengineering effort that is consistent with successful private sector reengineering efforts to include the following:
  - communicate reengineering goals and explain them to all levels of the organization;

Now on pp. 6 and 38-39.

- train employees in skills to enable them to work across functions and modify the training, as necessary, to support the reengineering process; and

- tailor rewards and incentives to encourage and reinforce desired behaviors. (pp. 6-7, p. 44/GAO Draft Report)

DOD RESPONSE: Concur. The Air Force will take steps to accomplish these goals by December 1996.

The following are GAO's comments on the Department of Defense's (DOD) letter dated January 2, 1996.

GAO Comments

1. DOD noted that the Supply System Inventory Report as of September 30, 1994, lists the Air Force as having $27.5 billion in reparable parts and $3.5 billion in consumable parts. DOD also notes that $23.5 billion (76 percent) of this inventory is active inventory and $7.5 billion (24 percent) is inactive. In contrast, we reported inventory values of $33 billion for reparable parts, $3.7 billion for consumable items, and provide a more detailed breakout of this inventory, illustrating that 66 percent is allocated by the Air Force for daily operations and war reserves, with the remaining 44 percent allocated to other categories.

We now explain in this report that our inventory values differ because DOD reduces the value of excess inventory to 2 percent of its acquisition cost and reparable inventory is reduced by the cost to repair an item. The values we use are calculated by the Air Force to reflect the full value of the inventory computed at the last acquisition cost for each item. The allocation of inventory to "active" and "inactive" stock differs because DOD considers safety and numeric stock objective items as active inventory, while we have reported it as reserves designed to ensure the Air Force will not run out of parts if they are needed.

2. DOD noted that the initiatives cited in this report are being considered to aid in the reduction of pipeline and lead times, such as privatization efforts, direct vendor delivery programs, prime vendors, flexible manufacturing, and aggressive use of commercial transportation. We agree that DOD is taking steps to reduce pipeline and lead times and have highlighted the most promising initiatives being pursued by the Air Force as of March 1995. We also recognize that DOD is constantly evaluating new initiatives.

We believe, however, that DOD can be more aggressive in using these new techniques and apply them over a wider range of items that it manages. For example, direct vendor delivery programs still involve DOD in the management of inventory. Some of the more aggressive techniques highlighted in this report, such as the integrated supplier concept, have the potential to minimize DOD's inventory management responsibilities for these items, while simultaneously reducing repair cycle times and inventory levels.

3. DOD noted that the Defense Logistics Agency (DLA) is not an obstacle to Air Force efforts to institutionalize its reengineering efforts, and that DLA is aggressively working with the Air Force to develop creative, tailored methods of support for expendable parts. We agree that DLA is not an obstacle to Air Force reengineering efforts and have revised the report to reflect that position. Since June 1993, when we recommended the Secretary of Defense direct the services and DLA to develop test programs that will determine the applicability of commercial practices to the military industrial centers, including the use of supplier parks, DLA has studied the supplier park and other concepts. As DOD notes, DLA is about to issue a broad area announcement that will seek creative industry approaches to support industrial maintenance centers. DLA is discussing with the Air Force a contractor demonstration program at the Warner Robins Air Logistics Center, and expects to enter into similar discussions with the other services.

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Related GAO Products

High Risk Series: Defense Inventory Management (GAO/HR-95-5, Feb. 1995).

Defense Supply: Acquisition Leadtime Requirements Can Be Significantly Reduced (GAO/NSIAD-95-2, Dec. 20, 1994).

Defense Management: Impediments Jeopardize Logistics Corporate Information Management (GAO/NSIAD-95-28, Oct. 21, 1994).

Organizational Culture: Use of Training to Help Change DOD Inventory Management Culture (GAO/NSIAD-94-193, Aug. 30, 1994).

Air Force Logistics: Improved Backorder Procedures Will Save Millions (GAO/NSIAD-94-103, Apr. 20, 1994).

Defense Management Initiatives: Limited Progress in Implementing Management Improvement Initiatives (GAO/T-AIMD-94-105, Apr. 14, 1994).

Defense Management: Stronger Support Needed for Corporate Information Management Initiative to Succeed (GAO/AIMD/NSIAD-94-101, Apr. 12, 1994).

Air Force Logistics: Base Maintenance Inventories Can Be Reduced (GAO/NSIAD-94-8, Dec. 15, 1993).

Air Force Logistics: Some Progress, But Further Efforts Needed to Terminate Excess Orders (GAO/NSIAD-94-3, Oct. 13, 1993).

Defense Inventory: More Accurate Reporting Categories Are Needed (GAO/NSIAD-93-31, Aug. 12, 1993).

Depot Maintenance: Issues in Management and Restructuring to Support a Downsized Military (GAO/T-NSIAD-93-13, May 6, 1993).

Financial Systems: Weaknesses Impede Initiatives to Reduce Air Force Operations and Support Costs (GAO/NSIAD-93-70, Dec. 1, 1992).

Air Force Requirements: Cost of Buying Aircraft Consumable Items Can Be Reduced by Millions (GAO/NSIAD-93-38, Nov. 18, 1992).

Defense Logistics Agency: Why Retention of Unneeded Supplies Persists (GAO/NSIAD-93-29, Nov. 4, 1992).

Financial Management: Internal Control Weaknesses Impede Air Force's Budgeting for Repairable Items (GAO/AFMD-92-47, Aug. 26, 1992).

Air Force Logistics: Improved Redistribution of Retail Inventories Needed (GAO/NSIAD-91-165, July 10, 1991).

Financial Audit: Air Force's Base-Level Financial Systems Do Not Provide Reliable Information (GAO/AFMD-91-26, Jan. 31, 1991).

Strategic Missiles: Logistics Support for Advanced Cruise Missile Based on Outdated Plans (GAO/NSIAD-90-178, Sept. 13, 1990).

Air Force Logistics: Increased Costs for Spare Parts Safety Levels Are Not Justified (GAO/NSIAD-90-148, Aug. 23, 1990).

Defense Inventory: Growth in Air Force and Navy Unrequired Aircraft Parts (GAO/NSIAD-90-100, Mar. 6, 1990).

Financial Audit: Air Force Does Not Effectively Account for Billions of Dollars of Resources (GAO/T-AFMD-90-10, Feb. 23, 1990).

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