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INVENTORY MANAGEMENT

DOD Can Build on Progress by Using Best Practices for Reparable Parts

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The Honorable Strom Thurmond
Chairman
The Honorable Carl Levin
Ranking Minority Member
Committee on Armed Services
United States Senate

The Honorable Floyd Spence
Chairman
The Honorable Ike Skelton
Ranking Minority Member
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House of Representatives

Section 395 of the National Defense Authorization Act for Fiscal Year 1998 requires the Director of the Defense Logistics Agency (DLA) to develop and submit to Congress a schedule for implementing best practices for the acquisition and distribution of categories of consumable-type supplies and equipment listed in the section. Best practices were defined in the act as techniques that the Director of DLA determines will reduce inventory levels and costs and improve the responsiveness of the logistics system to user needs. The act also requires the implementation of such practices no later than November 2000. In addition, the act requires us to report on the feasibility of adding reparable parts to the list of items covered by section 395. This report responds to that mandate.

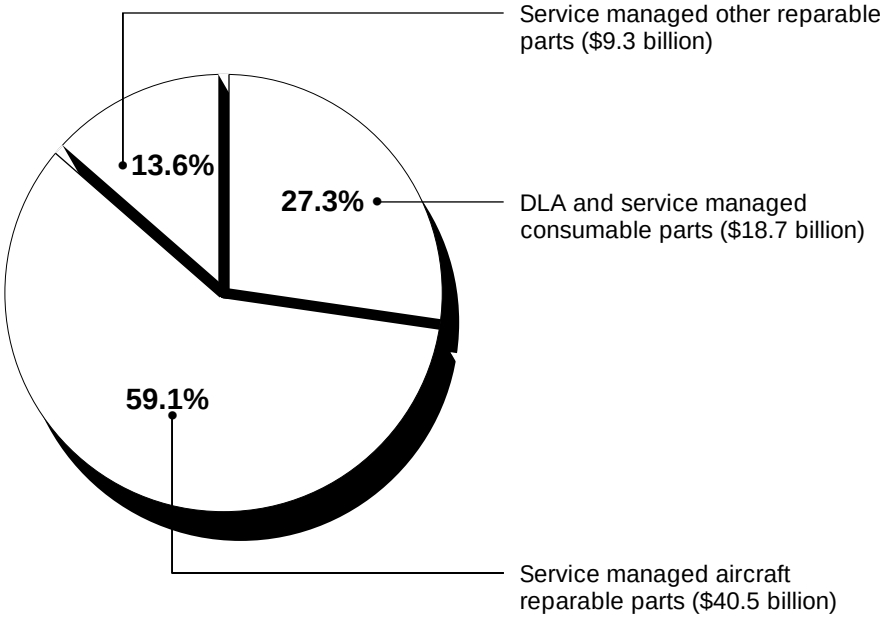
As agreed with your offices, this report specifically addresses (1) private sector practices that streamline logistics operations, (2) Department of Defense (DOD) initiatives to improve its logistics systems, and (3) best practices that can be used to improve the military services' aircraft reparable parts pipeline. Our analysis relates to work performed in public repair facilities rather than contractor repair operations. Because aircraft parts represent a large portion of DOD's secondary inventory investment, we focused our best practices analysis on DOD's management of these items. However, many of the logistics system improvements identified through our analysis could be applied to DOD's management of other reparable parts.[1]

[1]We have reported on the opportunities that exist for DOD to use best practices for consumable items as well. See Related GAO Products at the end of this report for a listing of these and other reports that discuss our best practices analyses of DOD logistics systems.

Background

As of September 30, 1996, DOD reported the value of its secondary inventory—consumable items and reparable parts—at $68.5 billion. Consumable items, such as clothing and medical supplies, are managed primarily by DLA. Reparable parts are generally expensive items that can be fixed and used again, such as hydraulic pumps, navigational computers, wing sections, and landing gear. Each military service manages reparable parts that are used for their operations. These management functions include determining how many parts will be needed to support operations, purchasing new parts, and deciding when broken parts need to be repaired. As shown in figure 1, aircraft reparable parts represent an estimated 59 percent of DOD's secondary inventory.

Figure 1: Estimated Composition of DOD's Secondary Inventory (as of Sept. 30, 1996)



To provide reparable parts for their aircraft, the military services use extensive logistics systems that were based on management processes, procedures, and concepts that have evolved over time but are largely outdated. Each service'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 investment in personnel, equipment, facilities, and inventory. In our recent reports on the Army, the Navy, and the Air Force logistics pipelines, we highlighted many of the problems and inefficiencies associated with the services' current logistics systems. Findings from these reports are summarized in appendix I.

Legislative Framework

DOD must operate its logistics activities within the framework of various legislative provisions and regulatory requirements. Various legislative provisions govern the size, composition, and allocation of depot repair workloads between the public and private sectors. For example, the allocation of the depot maintenance workload between the public and private sectors is governed by 10 U.S.C. 2466. According to the statute, not more than 50 percent of the funds made available for depot-level maintenance and repair can be used to contract for performance by nonfederal government personnel. Other statutes that affect the extent to which depot-level workloads can be converted to private sector performance include (1) 10 U.S.C. 2469, which provides that DOD-performed depot maintenance and repair workloads valued at not less than $3 million cannot be changed to contractor performance without a public-private competition and (2) 10 U.S.C. 2464, which provides that DOD activities should maintain a government-owned and operated logistics capability sufficient to ensure technical competence and resources necessary for an effective and timely response to a national defense emergency.

Another provision that may affect future DOD logistics operations is 10 U.S.C. 2474, added to the United States Code by section 361 of the Fiscal Year 1998 National Defense Authorization Act. Section 2474 requires the Secretary of Defense to designate each depot-level activity as a Center of Industrial and Technical Excellence for certain functions. The act further requires the Secretary to establish a policy to encourage the military services to reengineer their depot repair processes and adopt best business practices. According to section 2474, a military service may conduct a pilot program, consistent with applicable requirements of law, to test any practices that the military service determines could improve the efficiency and effectiveness of depot-level operations, improve the support provided by the depots for the end user, and enhance readiness by reducing the time needed to repair equipment.

Further, efforts to outsource functions other than depot-level maintenance and repair must be accomplished in accordance with the requirement of

the Office of Management and Budget Circular A-76, various applicable provisions of chapter 146 of title 10 of the United States Code, as well as recurring provisions in the annual DOD Appropriations Act.

Defense Reform Initiative

In November 1997, the Secretary of Defense announced the Defense Reform Initiative, which seeks to reengineer DOD support activities and business practices by incorporating many business practices that private sector companies have used to become leaner, more agile, and highly successful. The initiative calls for adopting modern business practices to achieve world-class standards of performance in DOD operations. The Secretary of Defense stated that reforming DOD support activities is imperative to free up funds to help pay for high priorities, such as weapons modernization.

Results in Brief

Our work shows it is feasible for the list of items covered by section 395 to be expanded to include reparable parts. In fact, all of the services and DLA have initiatives underway designed to improve their logistics operations by adopting best practices. Since 1996, we have issued a series of reports that identify other best practices that present opportunities for DOD to build on these improvement efforts. However, if section 395 were expanded to include reparable parts, the responsibility for the development and submission of a schedule to implement best practices would also have to be expanded to include the military services, since responsibility for service-managed reparable parts is beyond the purview of the Director of DLA.

Private sector companies have developed new business strategies and practices that have cut costs and improved customer service by streamlining logistics operations. The most successful improvement efforts included a combination of practices that are focused on improving the entire logistics pipeline—an approach known as supply-chain management. The combination of practices we have observed include the use of highly accurate information systems, various methods to speed the flow of parts through the pipeline, and the shifting of certain logistics functions to suppliers and third parties.

DOD recognizes that it needs to make substantial improvements to its logistics systems. The Army's Velocity Management program, the Navy's regionalization and direct delivery programs, and the Air Force's Lean Logistics initiative are designed to improve logistics operations and make

logistics processes faster and more flexible. Although these initiatives have achieved some limited success, significant opportunities for improvement remain.

Our work indicates that best practices developed by private sector companies are compatible with DOD improvement initiatives. However, we recognize the use of these best practices must be accomplished within the existing legislative framework and regulatory requirements relating to defense logistics activities, such as the Office of Management and Budget Circular A-76 .

Private Sector Practices Streamline Logistics Operations

We previously reported that several 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 tasks to suppliers; and having third parties handle parts repair, storage, and distribution functions. One airline, British Airways, has substantially improved its logistics operations over a 14-year period. British Airways approached the process of change as a long-term effort that requires steady vision and a focus on continual improvement. Although the airline has reaped significant gains from improvements, it continued to reexamine operations and make improvements to its logistics system. Adopting practices similar to British Airways and other commercial airlines could help DOD's repair pipelines become faster and more responsive to customer needs.

Commercial Airline Reengineering Efforts

British Airways used a supply-chain management approach to reengineer its logistics system. 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 officials described how a combination of supply-chain improvements 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. The reductions also 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.

Four specific practices used by British Airways and other airlines that appear to be suited to DOD operations to the extent they can be implemented within the existing legislative and regulatory framework include the (1) prompt repair of items, (2) reorganization of the repair process, (3) establishment of partnerships with key suppliers, and (4) use of third-party logistics services. These initiatives are interrelated and, when used together, can help maximize a company's inventory investment, decrease inventory levels, and provide a more flexible repair capability. They appear to address many of the same problems DOD faces and represent practices that could be applied to its operations. We recommended in our reports that DOD test these concepts in an integrated manner to maximize their potential benefits.

Repairing Items Promptly

Certain airlines begin repairing items as quickly as possible, which prevents the broken items from sitting idle for extended periods. Minimizing idle time helps reduce inventories because it lessens the need for extra "cushions" of inventory to cover operations while parts are out of service. In addition, repairing items promptly promotes flexible scheduling and production practices, enabling maintenance operations to respond more quickly as repair needs arise.

Prompt repair involves inducting parts into maintenance shops soon after broken items arrive at repair facilities. However, prompt repair does not mean that all parts are fixed. The goal is to quickly fix only those parts that are needed. One commercial airline routes broken items directly to holding areas next to repair shops, rather than to stand-alone warehouses, so that mechanics can quickly access these broken parts. The holding areas also give mechanics better visibility of any backlog. It is difficult to specifically quantify the benefits of repairing items promptly because that practice is often used with other ones to speed up pipeline processes. One

airline official said, however, that the airline has kept inventory investment down partly because it does not allow broken parts to remain idle.

Reorganizing the Repair Process

One approach to accelerate the repair process and promote flexibility in the repair shop is the "cellular" concept. Under this concept, an airline moved all of the resources that are needed to repair broken parts, such as tooling and support equipment, personnel, and inventory, into one location or repair center "cell." This approach simplifies the repair of parts by eliminating the time-consuming exercise of routing parts to workshops in different locations. It also ensures that mechanics have the technical support to ensure that operations run smoothly. In addition, because inventory is placed near workshops, mechanics have quick access to the parts they need to complete repairs more quickly. British Airways adopted the cellular approach after determining that parts could be repaired as much as 10 times faster using this concept. Figure 2 shows a repair cell used in British Airways' maintenance center at Heathrow Airport. Another airline that adopted this approach in its engine-blade repair shop was able to reduce repair time by 50 to 60 percent and decrease work-in-process inventory by 60 percent.

Figure 2: A British Airways Repair Center Cell

Establishing Partnerships With Key Suppliers

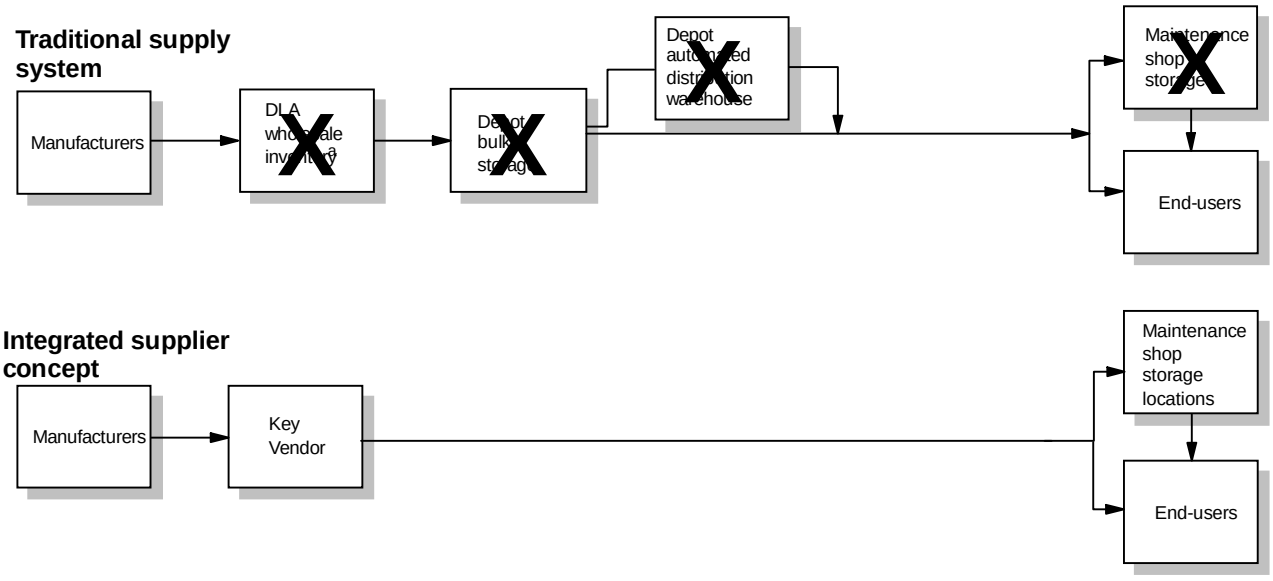
Several airlines and manufacturers have worked with suppliers to improve parts support and reduce overall inventory. Two approaches—the use of local distribution centers and integrated supplier programs—specifically seek to improve the management and distribution of consumable items, such as nuts, bolts, and fuses. These approaches help ensure that the consumable items for repair and manufacturing operations are readily available, which prevents parts from stalling in the repair process and helps speed up repair time. In addition, by improving management and distribution methods, such as streamlined ordering and fast deliveries, these approaches enable firms to delay the purchase of inventory until a point that is closer to the time it is needed. Firms, therefore, can reduce their stocks of "just-in-case" inventory.

Local distribution centers are supplier-operated facilities that are established near a customer's operations and provide deliveries of parts within 24 hours. One airline that used this approach has worked with key suppliers to establish more than 30 centers near its major repair operations. These centers receive orders electronically and, in some cases, handle up to eight deliveries a day. Airline officials said that the ability to get parts quickly has contributed to repair time reductions. In addition, the officials said that the centers have helped the airline cut its on-hand supply of consumable items nearly in half. Figure 3 shows a local distribution center, located at Heathrow Airport, that is operated by the Boeing Company.

Figure 3: A Local Distribution Center at Heathrow Airport

Integrated supplier programs involve shifting inventory management functions to suppliers. Under this arrangement, a supplier is responsible for monitoring parts usage and determining how much inventory is needed to maintain a sufficient supply. The supplier's services are tailored to the customer's requirements and can include placing a supplier representative in customer facilities to monitor supply bins at end-user locations, place orders, manage receipts, and restock bins. Other services can include 24-hour order-to-delivery times, quality inspection, parts kits, establishment of data interchange links and inventory bar coding, and vendor selection management. One manufacturer that used an integrated supplier received parts 98 percent of the time within 24 hours of placing an order, which enabled the manufacturer to reduce inventories for these items by $7.4 million—an 84-percent reduction. Figure 4 illustrates how an integrated supplier could reduce or eliminate the need for at least three inventory storage locations in a typical DOD repair facility.

Figure 4: Potential Impact of an Integrated Supplier on DOD's System



Using Third-Party Logistics Providers

Third-party logistics providers can be used to reduce costs and improve performance. Third-party firms take on responsibility for managing and carrying out certain logistics functions, such as storage and distribution. As a result, companies can reduce overhead costs because they no longer need to maintain personnel, facilities, and other resources that are required to do these functions in house.

Third-party firms also help companies improve various aspects of their operations because these providers can offer expertise that companies often do not have the time or the resources to develop. For example, one airline contracts with a third-party logistics provider to handle deliveries and pickups from suppliers and repair vendors, which has improved the reliability and speed of deliveries and reduced overall administrative costs. The airline receives most items within 5 days, which includes time-consuming customs delays, and is able to deliver most items to repair vendors in 3 days. In the past, deliveries took as long as 3 weeks.

In addition, third-party providers can assume other functions. One third-party firm that we visited, for example, can assume warehousing and shipping responsibilities and provide rapid transportation to speed parts to end users. The company can also pick up any broken parts from a customer and deliver them to the source of repair within 48 hours. In addition, this company maintains the data associated with warehousing and in-transit activities, offering real-time visibility of assets.

Potential Impact of Best Practices on DOD Operations

If DOD were to adopt a combination of best practices, similar to those employed by commercial airlines, the time items spend in the services' repair pipelines could be substantially reduced. For example, the cellular concept enables a repair shop to respond more quickly to different repair needs. An integrated supplier can provide the consumable parts needed to complete repairs faster and more reliably. Both of these concepts are needed to establish an agile repair capability, which in turn enables a company to repair items more promptly. A much faster and responsive repair pipeline would allow DOD to buy, store, and distribute significantly less inventory and improve customer service. For example, an Army-sponsored RAND study noted that reducing the repair time for one helicopter component from 90 to 15 days would reduce inventory requirements for that component from $60 million to $10 million.[2]

[2]Weapon System Sustainment Management: A Concept for Revolutionizing the Army Logistics System, RAND Arroyo Center Documented Briefing, 1994.

Figures 5 and 6 uses the Army's pipeline for reparable parts to illustrate the potential impact that the integrated use of best practices would have on DOD's logistics system. Figure 5 illustrates the current repair pipeline at Corpus Christi Army Depot, including the average number of days it took to move the parts we examined through this pipeline and the flow of consumable parts into the repair depot. The consumable parts flow includes hardware inventory stored in DLA warehouses and repair depot inventory, which in 1996 totaled $5.7 billion and $46 million, respectively. Despite this investment in inventory, the supply system was completely filling customer orders only 25 percent of the time. Also, as of August 1996, mechanics had more than $40 million in parts on backorder, 34 percent of which was still unfilled after 3 months. In addition, reparable parts flowing through this system took an average of 525 days to complete the process.

Figure 5: Current Repair Pipeline at Corpus Christi Army Depot

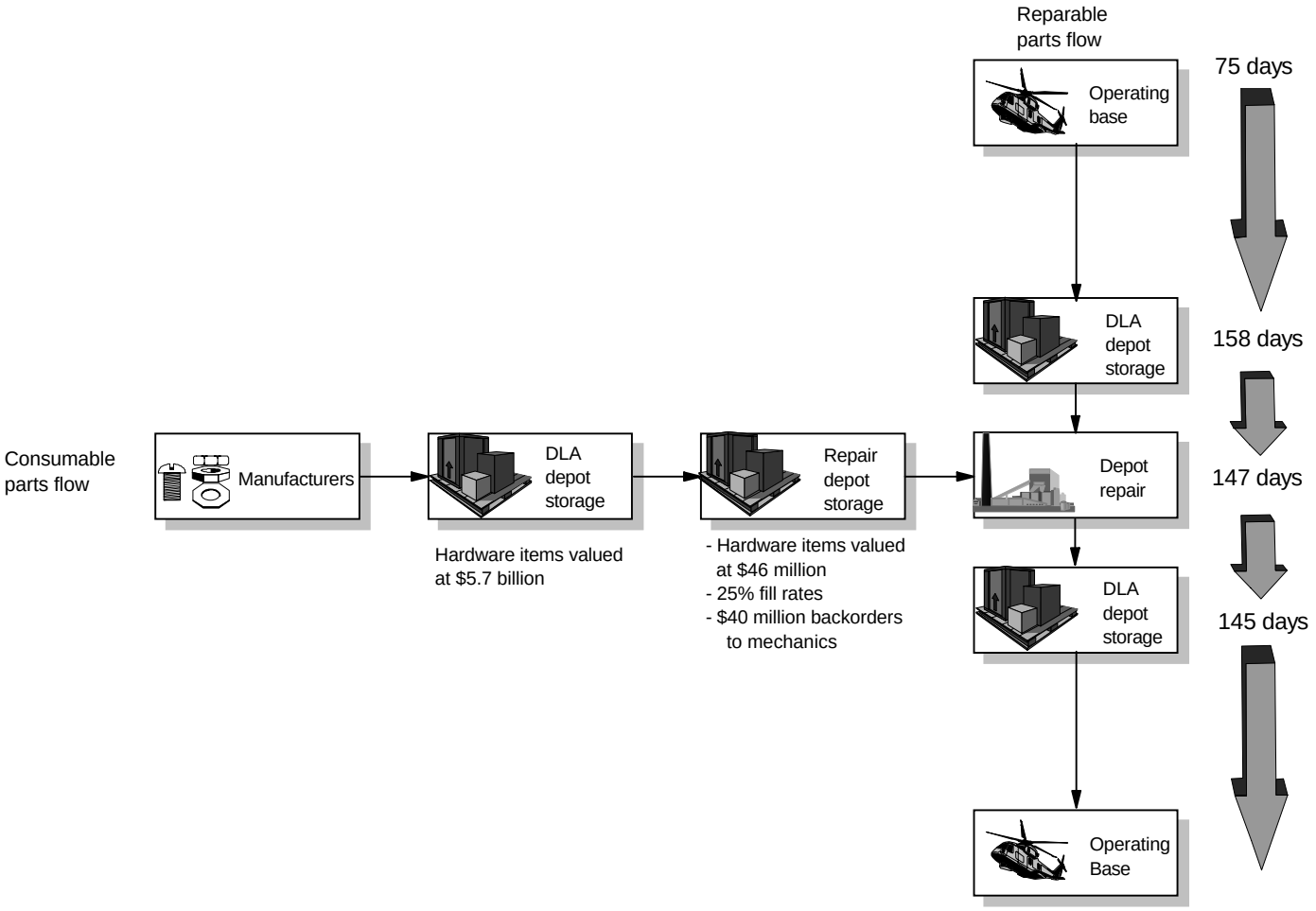
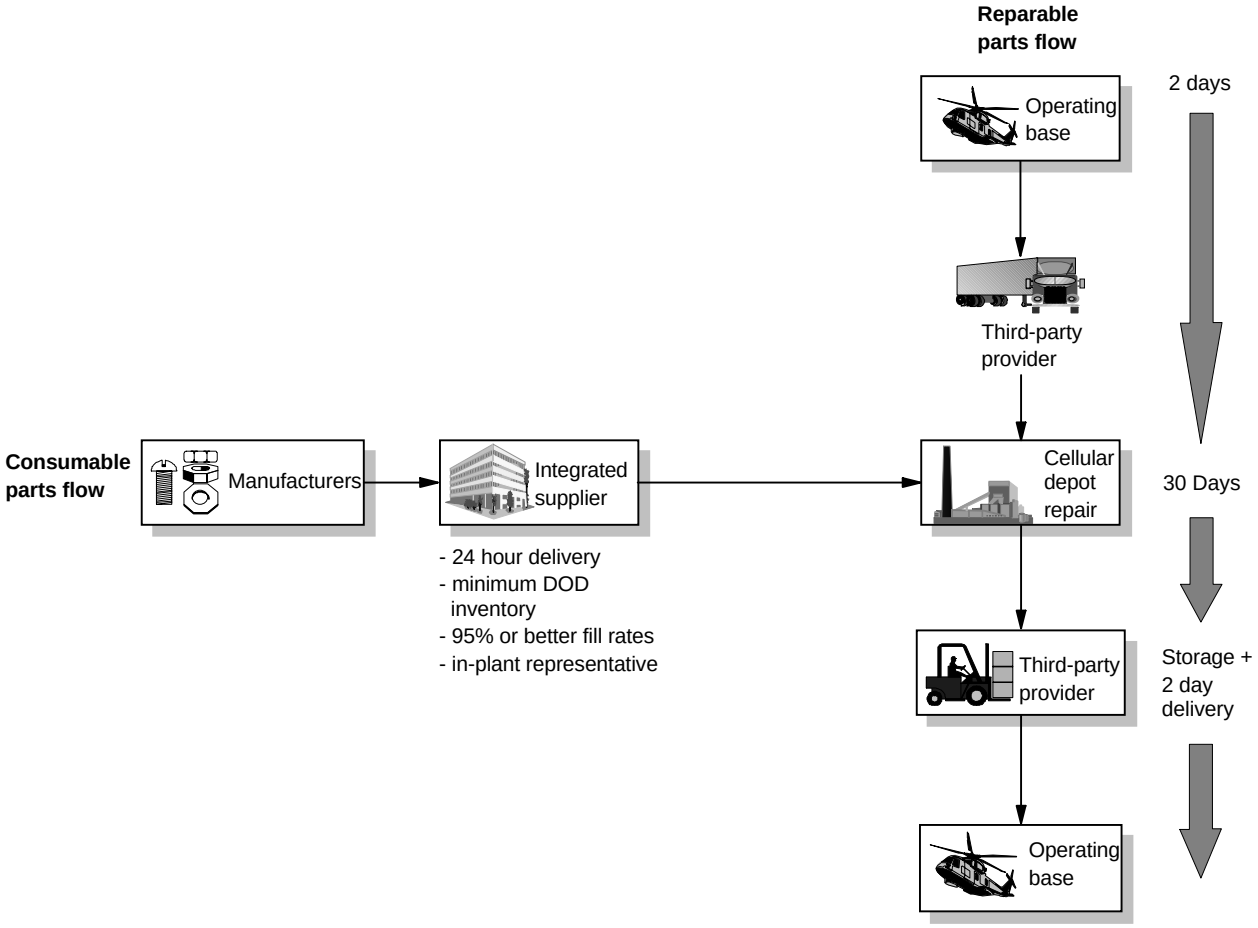


Figure 6 illustrates a modified Army system, incorporating the use of an integrated supplier for consumable items, third-party logistics services, parts induction soon after they arrive at the depot, and cellular repair shops. If the military services were to adopt these practices, they could substantially reduce the number of days for a part to flow through the repair pipeline and reduce or eliminate much of the inventory in DLA and repair depot storage locations.

Figure 6: Best Practices Applied to the Army's Repair Pipeline for Aircraft Parts



DOD's application of concepts such as third-party logistics and integrated suppliers, however, may require a cost comparison between government and commercial providers in accordance with Office of Management and Budget Circular A-76. This circular requires, in general, that a public-private competition must be held before contracting out of functions, activities, and services that were being accomplished by more than 10 DOD employees. Our work has consistently shown that this process is cost-effective because competition generates savings—usually through a reduction in personnel—whether the competition is won by the government or the private sector.[3]

[3]Defense Outsourcing: Challenges Facing DOD as It Attempts to Save Billions in Infrastructure Costs (GAO/T-NSIAD-97-110, Mar. 12, 1997).

Current DOD Initiatives Seek to Improve Logistics Systems

Each of the military services has programs underway to improve logistics operations and make its processes faster and more flexible. The Army established its Velocity Management program to eliminate unnecessary steps in the logistics pipeline that delay the flow of parts through the system. The Navy is using a regionalization concept to reduce redundant capabilities in supply and maintenance and is testing a direct delivery concept for a few component parts. The Air Force established its Lean Logistics initiative to dramatically improve logistics processes. Although these initiatives have been underway for several years, the results are limited, and the overall success of these programs is uncertain.

Army Velocity Management Program

In January 1995, the Army established its Velocity Management program to develop a faster, more flexible, and more efficient logistics pipeline. The program's goals, concepts, and top management support parallel improvement efforts found in private sector companies. The overall goal of the program is to eliminate unnecessary steps in the logistics pipeline that delay the flow of parts through the system. The Army plans to achieve this goal in a similar manner as the private sector: by changing its processes and not by refining the existing system. The Army's Vice Chief of Staff has strongly endorsed the program as a vehicle for making dramatic improvements to the current logistics system. In anticipation of these improvements, the Army has reduced its operating budgets for fiscal years 1998 through 2003 by $156.5 million.

The Velocity Management program consists of Army-wide process improvement teams for the following four areas: ordering and shipping of parts, the repair cycle, inventory levels and locations (also known as stockage determination), and financial management. For each of these areas, the Army is examining its current processes and attempting to identify ways to improve them. The Army's implementation strategy for these improvement areas includes three phases: defining the process, measuring process performance, and improving the process. As shown in table 1, the four improvement areas are in various implementation phases.

Table 1: Status of the Army's Velocity Management Program

	Velocity Management improvement areas			
Implementation phase	**Order and shipping**	**Stockage determination**	**Repair cycle**	**Financial management**
Phase 1: Define the process	Completed	Completed	Completed	Underway
Determine customer needs				
Understand process				
Phase 2: Measure process performance	Completed	Underway	Underway	Not yet started
Define metrics and identify data				
Determine baseline performance				
Develop progress reports				
Phase 3: Improve the process	Underway	Not yet started	Not yet started	Not yet started
Establish goals				
Develop improved processes				
Implement changes				

The order and shipping improvement area is in phase 3 and the farthest along in the implementation process. In this area, the Army has reduced the time it takes to order and deliver parts to a customer located in the United States from approximately 22 to 11 days, or by 50 percent. According to Army officials, this improvement was achieved by automating the ordering process and having delivery trucks dedicated to servicing a single customer. The Army plans to continue work on other functions in this area, such as the receiving process.

The stockage determination and repair cycle initiatives are both in phase 2. According to Army officials, these improvement areas have not advanced as quickly as planned due to difficulties in obtaining reliable data to measure the current processes. Also, Army officials have not precisely determined what metrics to use for measuring future improvements. The financial management area, the last initiative to be started, is currently in phase 1.

Navy Regionalization and Direct Delivery Programs

The Navy has three major improvement efforts underway that are aimed at reducing infrastructure costs and streamlining operations. The first

initiative, called regional supply, consolidates decentralized supply management functions into seven regionally based activities. Under the old system, naval bases, aviation repair depots, and shipyards each had supply organizations to manage needed parts. These activities often used different information systems and business practices and their own personnel and facilities. This initiative does not consolidate inventories into fewer storage locations. The consolidation is intended to provide central management of spare parts for these individual operations, improve parts visibility, and reduce the overhead expenses associated with separate management functions. The Navy hopes that the centralized management approach will lead to a better sharing among locations and reductions in inventories. In fiscal year 1997, the Navy reported inventory reductions of $4.9 million through its regional supply program, and it expects to reduce inventories by an additional $24 million in fiscal year 1998. The Navy expects that 90 percent of the supply management consolidations will be completed by the end of fiscal year 1998.

The second initiative, called regional maintenance, similarly identifies redundant maintenance capabilities and consolidates these operations into regionally based repair facilities. For example, in one region the Navy is consolidating 32 locations used to calibrate maintenance test equipment into 4 locations. The regional maintenance program is mainly focused on reducing infrastructure costs, but its other objectives include improving maintenance processes, integrating supply support and maintenance functions, and providing compatible information systems. Through fiscal year 1996, the Navy identified a total of 102 regional maintenance initiatives: 55 were started in fiscal year 1997, and 47 are to be implemented between fiscal years 1998 and 2001. The Navy estimates that its regional maintenance efforts will save $944 million between fiscal years 1994 and 2001.

We recently reported that, although the Navy has made progress in achieving its infrastructure streamlining objective under regional maintenance, the progress thus far has not been as great as anticipated and challenges remain for accomplishing future plans.[4] Full implementation, initially projected for fiscal year 1999, is now projected for fiscal year 2000 and could take longer. Many of the initiatives identified have not been completed, and projected savings are not being achieved. For example, one initiative to consolidate planning and engineering functions for certain repairs is not progressing as planned, delaying

[4]Navy Regional Maintenance: Substantial Opportunities Exist to Build on Infrastructure Streamlining Progress (GAO/NSIAD-98-4, Nov. 13, 1997).

planned personnel reductions and affecting up to $92 million in savings projected to occur between fiscal years 1998 and 2001. The Navy has classified many of its initiatives as high risk because of barriers to implementation, including institutional resistance to change, inadequate information systems, and poor visibility over maintenance-related costs.

The Navy's third initiative, called direct vendor delivery, is a logistics support technique intended to reduce the costs of the inventory management and distribution functions. Under this initiative, a contractor (typically an original equipment manufacturer) will be responsible for repairing, storing, and distributing weapon system components. The contractor agrees to meet certain delivery timeframes and supply availability rates for the components. When a component fails at an operating location, it is sent directly to the contractor rather than to a Navy repair facility. The contractor in turn ships a replacement part back to the operating location. If a future demand for the item is anticipated, then the contractor fixes the broken component so it can be used again. According to the Navy, the direct vendor delivery concept will motivate the contractor to increase the reliability of the component so it needs to be repaired less frequently, which may reduce the component's life-cycle costs.

The direct vendor delivery concept is in the early stages of development. As of January 1998, the Navy had placed only 3 subsystems, consisting of 96 components, under contract. The value of these three contracts represent about 1 percent of the Navy's fiscal year 1998 purchase and repair budget. The Navy plans, however, to apply this concept to additional weapon system components in the future.

Air Force Lean Logistics Program

In 1994, the Air Force initiated a reengineering effort called Lean Logistics to dramatically improve logistics processes. The Air Force describes Lean Logistics as the cornerstone of all future logistics system improvements. This effort, spearheaded by the Air Force Materiel Command, is aimed at improving service to the end user while reducing pipeline time, excess inventory, and other logistics costs. The Air Force expects to save $948 million in supply costs between fiscal years 1997 and 1999 as a result of Lean Logistics initiatives.

Under Lean Logistics, the Air Force developed a program to redesign the current repair pipeline. In June 1996, the Air Force began testing certain concepts at 10 repair shops, and the tests involve less than 1 percent of the

Air Force's inventory items. The concepts include repairing items quickly after they break, using premium transportation to rapidly move parts, organizing support (supply and repair) personnel into teams, and deploying new information systems to better prioritize repair actions and track parts. Each shop tested some of these concepts and identified system improvements needed to adopt these practices on a broader scale.

As part of its demonstration projects, the Air Force tracked overall performance in four general areas: customer impact, responsiveness to the customer, repair depot efficiency, and operating costs. According to an October 1997 cost-benefit analysis of these projects, the tests were not a complete success. For example, 70 percent of the shops showed improvement in depot repair efficiency, but only 10 percent of the shops showed improvements in improving the responsiveness to the customer. Also, three of the four performance areas showed mixed results for 50 percent or more of the shops. According to the Air Force analysis, full implementation of the concepts may need to be re-evaluated and refined to achieve desired improvements in customer service and operating costs. Table 2 shows the impact of the demonstration projects on the four performance areas.

Table 2: Results of the Air Force's Lean Logistics Demonstration Projects

Figures in percents

Performance area	Shops with improved performance	Shops with decreased performance	Shops with mixed performance
Customer impact	20	30	50
Responsiveness to the customer	10	20	70
Repair depot efficiency	70	0	30
Operating costs	30	20	50

Notwithstanding the results of the demonstration projects, the Air Force began expanding these concepts servicewide in April 1997 and plans to complete this effort by the spring of 1998. According to the Air Force, the concepts will be refined as implementation continues.

Best Practices Can Be Applied to Reparable Parts

The military service's current improvement efforts could be expanded to include a wider application of the best practices discussed in this report. In addition, the services have not established specific locations where a combination of several practices could be tested to achieve maximum

benefits. These expanded efforts would be consistent with recent legislative provisions and the Defense Reform Initiative, which encourage the adoption of best business practices. However, a wider application of best practices by DOD must be accomplished within the current legislative framework and regulatory requirements.

Our previous reports recommended the testing and implementation of best practices, specifically, prompt repair of items, cellular repair, supplier partnerships, third-party logistics, as well as an integrated test of these practices. The Navy and the Air Force have initiated programs to adopt certain forms of supplier partnerships, and the Air Force is pursuing the prompt repair of items throughout its operations. Table 3 summarizes the status of the services' efforts in implementing best practices.

Table 3: Status of Recommended Best Practices for Aircraft Reparable Parts

	Best practices				
Service	**Prompt repair of items**	**Cellular repair**	**Supplier partnerships**	**Third-party logistics**	**Integrated test of practices**
Air Force	Yes	No	Limited use	No	No
Army	No	Limited use	No	No	No
Navy	No	No	Test planned	No	No

As part of its Lean Logistics program, the Air Force has adopted the concept of prompt repair of items to help speed the flow of parts through the repair process. In February 1997, the Air Force also began using a prime vendor program to support the C-130 propeller repair shop at the Warner Robins Air Logistics Center.[5] In fiscal year 1998, the Air Force plans to expand the prime vendor program at Warner Robins and begin programs at two other Air Force repair depots. The Navy plans to test the prime vendor concept at two depots during 1998. As of April 1997, the Army was using the cellular repair concept at two maintenance shops in the Corpus Christi Army depot. The Army, however, has not initiated any additional tests of the practices recommended in our reports at the Corpus Christi depot. Finally, none of the services have developed a plan to combine these new practices at one facility.

In commenting on a draft of this report, DOD highlighted additional initiatives that it believes demonstrate the use of best commercial practices. For example, the Army is pursuing an initiative to rapidly repair

[5]The prime vendor concept is a form of a supplier partnership in which a vendor buys inventory from a variety of suppliers, stores the inventory in its own warehouse, and delivers inventory to the customer within hours of receiving the order.

20 different circuit cards at two Army depots and return the cards using premium transportation. The Army plans to expand this concept later this year to engine components. DOD also highlighted Navy efforts to reduce the administrative lead times involved in repairing maritime parts and have a third-party provider build repair kits for hydraulic parts. In addition, DOD cited an Air Force initiative related to the contractor support for certain C-17 aircraft parts. Under this arrangement, the contractor is responsible for interim contractor support, depot repair, materiel and program management, and system modifications.

Military Services and DLA Responsibilities for Adopting Best Practices

Section 395 of the National Defense Authorization Act for Fiscal Year 1998 requires the Director of DLA to develop and submit to Congress a schedule for implementing best practices for the acquisition and distribution of categories of consumable-type supplies and equipment listed in the section. However, each military service manages reparable parts that are used in its operations; DLA stores and distributes these parts and manages consumable items. Each service and DLA, therefore, would be responsible for developing and implementing a strategy to adopt best practices for the items they manage if section 395 were broadened to include reparable parts.

Conclusions

Our work shows it is feasible for the list of items covered by section 395 to be expanded to include reparable parts. For example, each of the services and DLA have initiatives underway designed to improve their logistics operations by adopting best practices. Our reports identify additional best practices that present opportunities for DOD to build on these improvement efforts. However, if section 395 were expanded, the responsibility for the development and submission of a schedule to implement these practices would go beyond the purview of the Director of DLA. Thus, expanding the list of items covered by the provisions included in section 395 would also appear to warrant broadening the responsibility for responding to the legislation to include the military services.

Our previous reports recommended that DOD test and adopt best practices where feasible; therefore, we are not repeating those recommendations in this report. However, testing a combination of several key best practices is an option that DOD has yet to explore as it considers the extent to which successful techniques used in the private sector could be applied to its logistics operations. This action would be consistent with recently enacted Centers of Industrial and Technical Excellence legislation and the Defense

Reform Initiative. This wider application of best practices by DOD must be accomplished within the framework of existing legislative and regulatory requirements.

Matters for Congressional Consideration

If Congress decides it wants to expand the provisions of section 395 to include reparable parts, it may wish to consider (1) broadening the responsibility for responding to this legislation to include the military services and (2) developing provisions, similar to those in section 395, to encourage DOD to test combinations of best practices using a supply-chain management approach.

Agency Comments and Our Evaluation

In written comments on a draft of this report, DOD agreed that further progress is possible in using best practices for reparable parts. However, DOD has concerns in two areas. First, DOD believed that our draft report did not include all ongoing initiatives by the military services to adopt best business practices in the management of reparable parts. Second, DOD did not agree with our Matters for Congressional Consideration that the Congress may wish to consider developing statutory guidance related to best practices for reparable parts. DOD believed that, because of its actions underway, statutory guidance is not needed. DOD's comments appear in appendix II.

We incorporated several of the examples DOD provided into our report. However, some of these initiatives, particularly the newly awarded contract for C-17 aircraft support, involve integrated supplier support and third-party logistics predominately on the part of the contractor. Our past work and this report have been concerned with efforts to improve the existing in-house repair pipeline through the use of proven best practices adopted in the private sector, especially for aircraft parts, once the decision has been made to keep the repair function at public facilities. This C-17 contract represents a different arrangement and we are not in a position to comment on the merits of that approach.

With regard to the Matters for Congressional Consideration, our intent is to highlight two actions that we believe may be useful to Congress if it decides to expand section 395 to include reparable parts. Therefore, we modified this section to clarify our intent.

Scope and Methodology

We used information from our three prior reports that compared Army, Navy, and Air Force logistics practices to those of commercial airlines. For these reports, we examined operations at 20 DOD locations involved in the logistics pipeline. At these locations, we discussed with supply and maintenance personnel the operations of DOD's current logistics system, customer satisfaction, planned improvements to the logistics system, and the potential application of private sector practices to DOD operations. We also reviewed and analyzed detailed information on inventory levels and usage, repair times, supply effectiveness and response times, and other related logistics performance measures. Unless otherwise noted, inventory values reflect DOD's standard valuation methodology, in which excess inventory is reported at an estimated salvage value and reparable parts requiring repair are reduced by an average estimate of repair costs.

We also used information from our reports to identify leading commercial practices. This information, which was collected by making an extensive literature search, and through detailed examinations and discussions of logistics practices with officials from British Airways, United Airlines, Southwest Airlines, American Airlines, Federal Express, Boeing, Northrop-Grumman Corporation, and Tri-Star Aerospace. We also participated in roundtable discussions and symposiums with recognized leaders in the logistics field to obtain information on how companies are applying integrated approaches to their logistics operations.

We reviewed documents and interviewed officials on DOD's policies, practices, and efforts to improve its logistics operations. We contacted officials at the Office of the Deputy Under Secretary of Defense for Logistics, Washington, D.C.; Army Headquarters, Washington, D.C.; Army Materiel Command, Alexandria, Virginia; Naval Supply Systems Command, Mechanicsburg, Pennsylvania; Naval Inventory Control Point, Mechanicsburg, Pennsylvania; Air Force Headquarters, Washington, D.C.; and Air Force Materiel Command, Wright-Patterson Air Force Base, Ohio. Also, officials at these locations provided us with detailed information on their efforts to adopt the specific best practices we recommended in prior reports.

We conducted our review from December 1997 to January 1998 in accordance with generally accepted government auditing standards.

We are sending copies of this report to other congressional committees; the Secretaries of Defense, the Army, the Navy, and the Air Force; the

Directors of the Defense Logistics Agency and the Office of Management and Budget; and other interested parties. We will also make copies available to others on request.

Please contact me on (202) 512-8412 if you or your staff have any questions concerning this report. Major contributors to this report are listed in appendix III.

David R. Warren, Director
Defense Management Issues

Contents

Abbreviations

DLA	Defense Logistics Agency
DOD	Department of Defense

The Department of Defense Logistics Pipelines

The Department of Defense's (DOD) depot repair pipelines for reparable parts are slow and inefficient. Since February 1996, we have issued three reports that compared commercial logistics practices with similar Army, Navy, and Air Force operations for reparable aircraft parts. In these reports, we highlighted four factors that contributed to the services' slow and inefficient repair pipelines. These factors are (1) broken reparable parts move slowly between field units and a repair depot, (2) reparable parts are stored in warehouses for several months before and after they are repaired, (3) work processes at repair depots are inefficiently organized, and (4) consumable parts are not frequently available to mechanics when needed. As a result, the services can spend several months or even years to repair and distribute repaired parts to the end user. The amount of time it takes to repair parts is important because DOD must invest in enough inventory to resupply units with serviceable parts during the time it takes to move and repair broken parts.

Army Logistics Pipeline

In April 1997, we reported that the Army's current repair pipeline, characterized by a $2.6-billion investment in aviation parts, is slow and inefficient.[1] To calculate the amount of time the Army system takes to repair and distribute parts using the current depot repair process, we judgmentally selected 24 types of Army aviation parts and computed the time the parts spent in four key segments of the repair process. The key segments were (1) preparing and shipping the parts from the bases to the depot, (2) storing the parts at the depot before induction into the repair shop, (3) repairing the parts, and (4) storing the parts at the depot before being shipped to a field unit. The parts we selected took an average of 525 days to complete the repair process. The fastest time the Army took to complete any of the four pipeline segments was less than 1 day, but the slowest times ranged from 887 to more than 1,000 days. Table I.1 details the fastest, slowest, and average times the Army needed to complete each of the four pipeline segments.

[1]Inventory Management: The Army Could Reduce Logistics Costs for Aviation Parts by Adopting Best Practices (GAO/NSIAD-97-82, Apr. 15, 1997).

Table I.1: Amount of Time Used by the Army Depot Repair System for 24 Types of Aviation Parts

Figures in days

Pipeline segment	Fastest time	Slowest time	Average time
Part preparation and shipment to the depot	Less than 1	899	75
Depot storage before repair	Less than 1	887	158
Depot repair time	1	1,067	147
Depot storage before issue	Less than 1	1,196	145
Total depot repair pipeline time[a]	**Not applicable**	**Not applicable**	**525**

[a]It is inappropriate to sum the pipeline segments for the fastest and slowest times because these values represent the Army's pipeline performance on one component in each segment. The average time for each segment, however, is appropriate to sum because it represents the average time for all components that passed through that pipeline segment.

A comparison of the Army's engineering estimate of the repair time that should be needed to complete repairs with the actual amount of time taken is a measure of repair process efficiency. Of the 525-day average pipeline time from our sample, the Army estimates that an average of 18 days should be needed to repair items. The remaining 507 days, or 97 percent of the total time, was spent transporting or storing parts or was due to unplanned repair delays.

Another measure of repair process efficiency is a calculation of how often an organization uses its inventory, called the turnover rate. The higher the turnover rate, the more often a company is utilizing its inventory. At British Airways, the inventory turnover rate for reparable parts was 2.3 times each year. In comparison, we calculated that the Army's turnover rate for fiscal year 1995 repairs was 0.4 times, or about 6 times slower than British Airways.

Navy Logistics Pipeline

In July 1996, we reported that the Navy's system, characterized by a $10 billion inventory of reparable parts, is slow and complex and often does not respond quickly to customer needs.[2] For example, customers wait an average of 16 days at operating bases and 32 days on aircraft carriers to receive parts from the wholesale system. If the wholesale system does not have the item in stock, customers wait over 2-1/2 months. Many factors contribute to this situation, but among the most prominent is a slow and complex repair pipeline. Within this pipeline, broken parts can

[2]Inventory Management: Adopting Best Practices Could Enhance Navy Efforts to Achieve Efficiencies and Savings (GAO/NSIAD-96-156, July 12, 1996).

pass through as many as 16 steps, taking as long as 4 months, before they are repaired at a repair depot and are available again for use.

Specific problems that prevent parts from flowing quickly through the pipeline include a lack of consumable parts needed to complete repairs, slow distribution, and inefficient repair practices. For example, the Navy's practice of routing parts through several workshops at repair depots increases the time needed to complete repairs. One item we examined had a repair time of 232 hours, only 20 hours of which was spent actually repairing the item. The remaining 212 hours, or 91 percent of the total time, was spent handling and moving the part to different locations.

In contrast, leading firms in the airline industry, including British Airways, hold minimum levels of inventory that can turn over four times as often as the Navy's. Parts are more readily available and delivered to the customer within hours. The repair process is faster, taking an average of 11 days for certain items at British Airways compared with the Navy's 37-day process for a similar type of part. Table I.2 compares several key logistics performance measures of British Airways and the Navy.

Table I.2: British Airways and Navy Logistics Performance Measures

Key performance measure	British Airways (1994)	Navy (1995)
Consumer-level supply availability rates		
Reparable parts	86 percent	75 percent
Consumable parts	97 percent	57 percent[a]
Average order-ship time	1 to 5 days	16 to 32 days[b]
Inventory turnover		
Reparable parts	1 time every 5 months	1 time every 2 years[c]
Consumable parts	1 time every 8 months	1 time every 2 years[c]
Avionics repair times	11 days	37 days[d]

[a]This figure applies to Defense Logistics Agency-managed items only.

[b]This range represents the time it takes to obtain an item through the wholesale system when it is unavailable at the consumer level (including requisition submission, inventory control point processing, stock point processing, transportation hold, and transportation times).

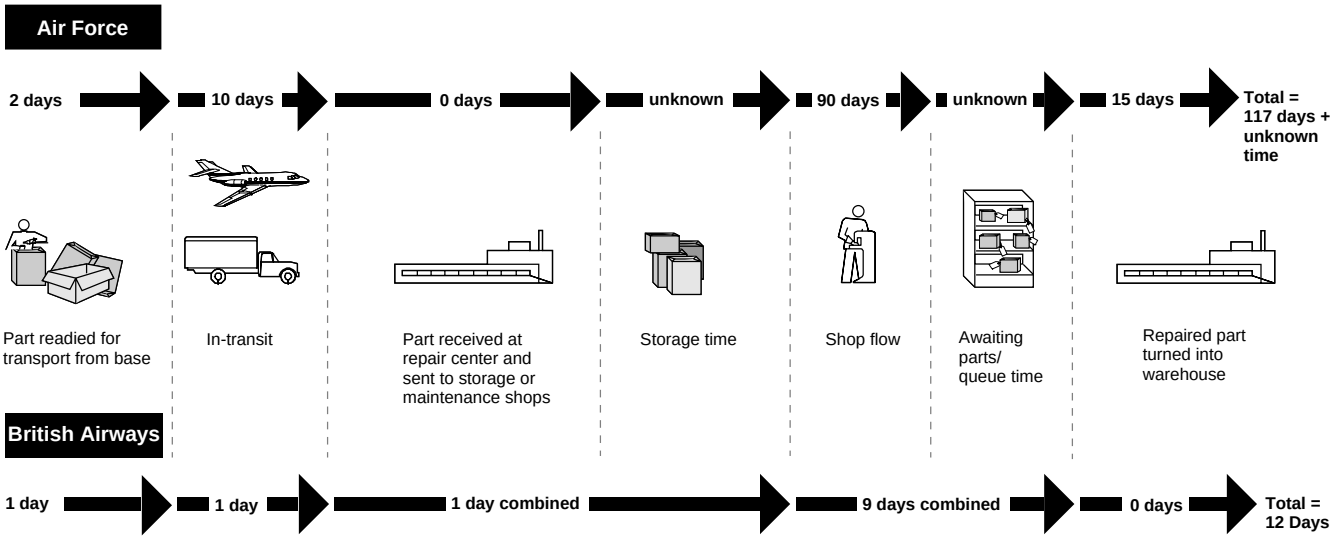
[c]The Navy's turnover rate includes retention stocks that are kept for future peacetime needs.

[d]This figure does not include time awaiting parts.

Air Force Logistics Pipeline

In February 1996, we reported that Air Force had invested about $36.7 billion in aircraft parts.[3] Of this amount, the Air Force estimated $20.4 billion, or 56 percent, was needed to support daily operations and war reserves, and the remaining $16.3 billion was divided among safety stock, other reserves, and excess inventory.[4] These large inventory levels were driven in part by the slow logistics pipeline process. For example, one part we examined had an estimated repair cycle time of 117 days; it took British Airways only 12 days to repair a similar part. We reported that the complexity of the Air Force's 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. Figure I.1 compares the Air Force's pipeline times with British Airways' times for a landing gear component.

Figure I.1: Air Force's and British Airways' Pipeline Times for a Landing Gear Component



[3]Best Management Practices: Reengineering the Air Force's Logistics System Can Yield Substantial Savings (GAO/NSIAD-96-5, Feb. 21, 1996).

[4]These Air Force inventory values are based on an item's last acquisition cost. With the use of DOD's standard valuation methodology, in which excess inventory is at salvage values and reparable parts requiring repair are reduced by the estimated cost of repair, the Air Force's $36.7 billion would be valued at about $31 billion.

Comments From the Department of Defense

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ACQUISITION AND TECHNOLOGY
(L/MDM)

18 FEB 1998

Mr. David R. Warren
Director, Defense Management Issues
National Security and International
Affairs Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Warren:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report, "INVENTORY MANAGEMENT: DoD Can Build on Progress by Using Best Practices for Reparable Parts," dated February 10, 1998 (GAO Code 709231/OSD Case 1544). The Department agrees that further progress is possible in using best practices for reparable parts, but has concerns in two areas. First, the draft report does not include all ongoing initiatives to adopt best business practices in the management of reparable parts by the Military Departments. Examples of initiatives not included are detailed in the attachment.

Now on p. 21.

Second, the Department does not agree with the GAO suggestion, in "Matters for Congressional Consideration" on page 22 of the draft report, that Congress consider developing statutory guidance to guide the implementation of best practices for reparable parts. In addition to the progress cited in the attachment, other actions now underway address areas discussed by the GAO. For example, the Military Departments have been directed to identify at least one maintenance depot as a test site for the integrated supplier concept. In addition, the Army has been directed to identify at least one maintenance depot to test the prime vendor concept. The GAO recommended these actions, and stated that it will closely monitor DoD's progress in its report, "DEFENSE INVENTORY MANAGEMENT: Expanding Use of Best Practices for Hardware Items Can Reduce Logistics Costs," (GAO/NSIAD-98-47). In view of the actions underway, statutory guidance is not needed. The Department appreciates the opportunity to comment on the draft report.

Sincerely,

James B. Emahiser

James B. Emahiser
Acting Principal Assistant Deputy
Under Secretary of Defense (Logistics)

Attachment

ADDITIONAL "BEST PRACTICES" EXAMPLES

ARMY: Repairing Items Promptly: The Army implemented a program in June 1997 to provide equipment and parts at Tobyhanna and Letterkenny Army depots so that 20 types of circuit cards can be shipped directly from Fort Bragg via Federal Express and immediately repaired and returned. To date over 350 cards have been repaired in an average of 10 days and at an average price of 18 percent of the replacement costs. This program is being expanded to include larger items such as engine components, with testing scheduled to begin by June 1998.

Cellular Repair: The Army is repairing several types of equipment using the cellular repair concept. These include T-53 helicopter engines, helicopter blades, satellite dishes, and communications vans.

NAVY: Repairing Items Promptly: The Navy has implemented concurrent carcass movement and repair delivery order initiation to reduce administrative lead time in the repair cycle by 25 days for 50% of maritime reparables. In addition, aviation carcasses are direct shipped for induction to commercial repair sites based on negotiated schedules, set quarterly. These assets, shipped and tracked from failure site to commercial repair site, have funded job orders at the repair site and are inducted immediately (up to the negotiated repair quantity).

Third Party Logistics: The Shambam Company, a manufacturer of hydraulic parts and a Defense Logistics Agency contractor employing direct vendor delivery, is supporting the Navy Depot in North Island, California, by combining technical and inventory management expertise to build hydraulic repair kits. Shambam gathers all parts needed to repair hydraulic components and places them in kits. Evaluation of this effort (underway since 1995) continues, with changes to parts and supported components under continual review.

AIR FORCE: Integrated Supplier Support and Third Party Logistics: The Air Force has a flexible sustainment contract with Boeing for the C-17 that encompasses integrated supplier support and third party logistics elements (supplier partnerships). Specifically, C-17 flexible sustainment encompasses a commercial-like support structure to support the fleet. Boeing will provide this support, and be the materiel manager for C-17 peculiar items. This program includes traditional interim contractor support, depot repair, materiel management functions, program management functions and modifications. Key characteristics of C-17 flexible sustainment include use of commercial practices, the ability to surge for contingencies, and intelligent partnership with the Air Logistics Command infrastructure, such as receiving and responding to requisitions for fill actions, shipping and receiving parts and maintaining inventory levels. For C-17 peculiar spares management, the transition plan calls for management of the propulsion system to transfer to Boeing in early calendar year 1998, consumable items to transfer during fiscal years 1998 through 2000, and the aircraft systems in fiscal year 2000. The contract was awarded on December 17, 1997.

ATTACHMENT

Major Contributors to This Report

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Related GAO Products

Defense Inventory Management: Expanding Use of Best Practices for Hardware Items Can Reduce Logistics Costs (GAO/NSIAD-98-47, Jan. 20, 1998).

Inventory Management: Greater Use of Best Practices Could Reduce DOD's Logistics Costs (GAO/T-NSIAD-97-214, July 24, 1997).

Inventory Management: The Army Could Reduce Logistics Costs for Aviation Parts by Adopting Best Practices (GAO/NSIAD-97-82, Apr. 15, 1997).

Defense Inventory Management: Problems, Progress, and Additional Actions Needed (GAO/T-NSIAD-97-109 Mar. 20, 1997).

Inventory Management: Adopting Best Practices Could Enhance Navy Efforts to Achieve Efficiencies and Savings (GAO/NSIAD-96-156, July 12, 1996).

Best Management Practices: Reengineering the Air Force's Logistics System Can Yield Substantial Savings (GAO/NSIAD-96-5, Feb. 21, 1996).

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).

Commercial Practices: Leading-Edge Practices Can Help DOD Better Manage Clothing and Textile Stocks (GAO/NSIAD-94-64, Apr. 13, 1994).

Commercial Practices: DOD Could Save Millions by Reducing Maintenance and Repair Inventories (GAO/NSIAD-93-155, June 7, 1993).

DOD Food Inventory: Using Private Sector Practices Can Reduce Costs and Eliminate Problems (GAO/NSIAD-93-110, June 4, 1993).

DOD Medical Inventory: Reductions Can Be Made Through the Use of Commercial Practices (GAO/NSIAD-92-58, Dec. 5, 1991).

Commercial Practices: Opportunities Exists to Reduce Aircraft Engine Support Costs (GAO/NSIAD-91-240, June 28, 1991).

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