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INVENTORY MANAGEMENT

The Army Could Reduce Logistics Costs for Aviation Parts by Adopting Best Practices

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National Security and
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The Honorable Carl Levin
Ranking Minority Member
Committee on Armed Services
United States Senate

Dear Senator Levin:

This report is the 10th in a series of reports comparing the Department of Defense's (DOD) logistics practices with those of the private sector.[1] As you requested, we are continuously examining DOD's inventory management practices to identify areas where costs can be reduced and problems can be avoided if DOD adopts leading-edge practices that have been applied successfully by the private sector.

This report focuses on the Army's logistics system for aviation parts. It discusses the potential application of best practices to the Army's operations. The objectives of this review were to (1) examine the current performance of the Army's logistics system, (2) review the Army's efforts to improve the logistics system and reduce costs, and (3) identify opportunities where best practices could be incorporated into the Army's logistics operations.

Background

The private sector, driven by a global competitive environment, faces the challenge of improving services while lowering costs. As a result, many companies have adopted innovative business practices to meet customer needs and retain profitability. DOD faces a similar challenge of providing better service at a lower cost. With the end of the Cold War, DOD's logistics systems must support a smaller, highly mobile, high-technology force. Due to the pressures of budgetary constraints, DOD also must seek ways to make logistics processes as efficient as possible.

To provide reparable parts for its approximately 7,300 aircraft (primarily helicopters),[2] the Army uses an extensive logistics system that is based on a management process, procedures, and concepts that have evolved over time but are largely outdated.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, and landing gear. The Army's logistics system, often referred to as a

[1]See Related GAO Products.

[2]The Army also provides helicopter and component repair services to the Air Force and the Navy.

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. The Army's depot repair location for helicopters and aviation parts is the Corpus Christi Army Depot (CCAD), Texas.

The Army also relies on this pipeline for consumable parts (e.g., nuts, bearings, and fuses) that are used extensively to fix reparable parts and aircraft. The Defense Logistics Agency (DLA) provides most of the consumable parts that Army repair activities need and handles a large part of the warehousing and distribution of reparable parts.

Although not as large as the Army, commercial airlines have similar operating characteristics to the Army. They maintain fleets of aircraft that use reparable parts and operate logistics pipelines having similar activities. For both the Army and commercial airlines, time plays a crucial role in the responsiveness of logistics operations and the amount of inventory needed. Pipeline complexity also adds to logistics costs by increasing overhead and adding to pipeline times. Condensing and simplifying pipeline operations, therefore, will simultaneously improve responsiveness and decrease costs by reducing inventory requirements and eliminating the infrastructure (warehouses, people, etc.) that is needed to manage unnecessary material.

Over the last 10 years, we have issued more than 30 reports addressing the Army's logistics problems. These reports have highlighted issues related to large inventory levels, inefficient repair practices, and information system problems. While the Army has taken actions to correct its logistics problems, these problems have not been completely resolved.

Results in Brief

The Army's efforts to improve its logistics pipeline for aviation parts and reduce logistics costs could be enhanced by incorporating best practices we have identified in the private sector. The Army's current repair pipeline, characterized by a $2.6 billion investment in aviation parts, is slow and inefficient. For example, in one case we examined, it took the Army 4 times longer than a commercial airline to ship a broken part to the depot and complete repairs. Also, for 24 different types of items examined, we calculated it took the Army an average of 525 days to repair and ship the parts to field units. The Army estimates only 18 days (3 percent) should have been needed to repair the items. The remaining 507 days

(97 percent) were used to transport or store the parts or were the result of unplanned repair delays. Because of this lengthy pipeline time, the Army buys, stores, and repairs more parts than would be necessary with a more efficient system.

Several factors contribute to the long pipeline time. 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) repair depots are inefficiently organized, and (4) consumable parts are not available to mechanics when needed.

The Army has recognized that it must improve its logistics systems. Under a recently established program called "Velocity Management," the Army plans to focus on and improve four key areas: repair of components, order and shipment of parts, inventory levels, and financial management. The program is in the initial stages of development and has had limited success in actual Army-wide process improvements to date. At CCAD, depot officials are not actively pursuing this program's initiatives. Instead, depot officials are initiating process improvements under a local program designed to identify the actual cost of operations and improve the efficiency of CCAD operations.

Best practices used in the airline industry provide opportunities to build on the Army's efforts to improve its logistics pipeline. We identified key best practices to address each of the four factors contributing to the Army's long pipeline time:

- Third-party logistics services can assume warehousing and distribution functions and provide rapid delivery of parts and state-of-the-art information systems that would speed the shipment of parts between depots and field locations.
- Eliminating excess inventory and quickly initiating repair actions can reduce the amount of time parts are stored, improve the visibility of production backlogs, and reduce the need for large inventory to cover operations while parts are out of service.
- Cellular manufacturing techniques can improve repair shop efficiency by bringing all the resources (tooling, support equipment, etc.) needed to complete repairs to one location, thereby minimizing the current time-consuming exercise of routing parts to different workshops located hundreds of yards apart.

- Innovative supplier partnerships can increase the availability of consumable parts, minimize the time it takes to deliver parts to mechanics, and delay the purchase of parts until they are needed to complete repairs.

Although we cannot say that these practices can be successfully integrated into the Army's system, we believe they are compatible with many aspects of the Army's operations and the Velocity Management program. Because of the significant benefits realized by private firms that have adopted these practices, we further believe that the potential benefits in adopting these practices are enough to justify a demonstration project involving the Army and DLA. This demonstration project could determine with certainty the feasibility and cost-effectiveness of these practices.

The Army Operates a Slow, Inefficient, and Costly Logistics System

The Army's current depot repair pipeline, characterized by a $2.6 billion inventory investment, is slow, unreliable, and inefficient. For 24 different types of aviation parts examined, we calculated the Army's logistics system took an average of 525 days to ship broken parts from field units to the depot, repair them, and return the repaired parts to using units. We estimated 507 days (97 percent) of this time was the result of unplanned repair delays, depot storage, or transportation time. In another measure of efficiency, we calculated the Army uses its inventory 6 times slower than an airline in our comparison.

The amount of time required by the system is important because the Army must invest in enough inventory to resupply units with serviceable parts and cover the amount of time it takes to move and repair parts through this process. If this repair time were reduced, inventory requirements would also be reduced. For example, in an Army-sponsored RAND study, it was noted that reducing the repair time for one helicopter component from 90 days to 15 days would reduce inventory requirements for that component from $60 million to $10 million.[3]

Also, in a 1996 preliminary report to the Army, RAND concluded that "if non-value-added steps [in the repair process] were reduced or eliminated, repair cycle times could become much shorter and far less variable. The benefits for the Army would be greater weapon system availability, more regular and predictable supply of serviceable components, savings from

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

reduced pipeline inventory requirements, and a repair system more flexible and responsive in serving the needs of the combat commander."[4]

To calculate the amount of time the Army's 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 they were shipped to a field unit. For the parts we selected, it took the Army an average of 525 days to complete this process. Table 1 shows the fastest, slowest, and average time the Army took to complete each of the four pipeline segments.

Table 1: Average Days Used by the Army Depot Repair System for 24 Types of Aviation Parts

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

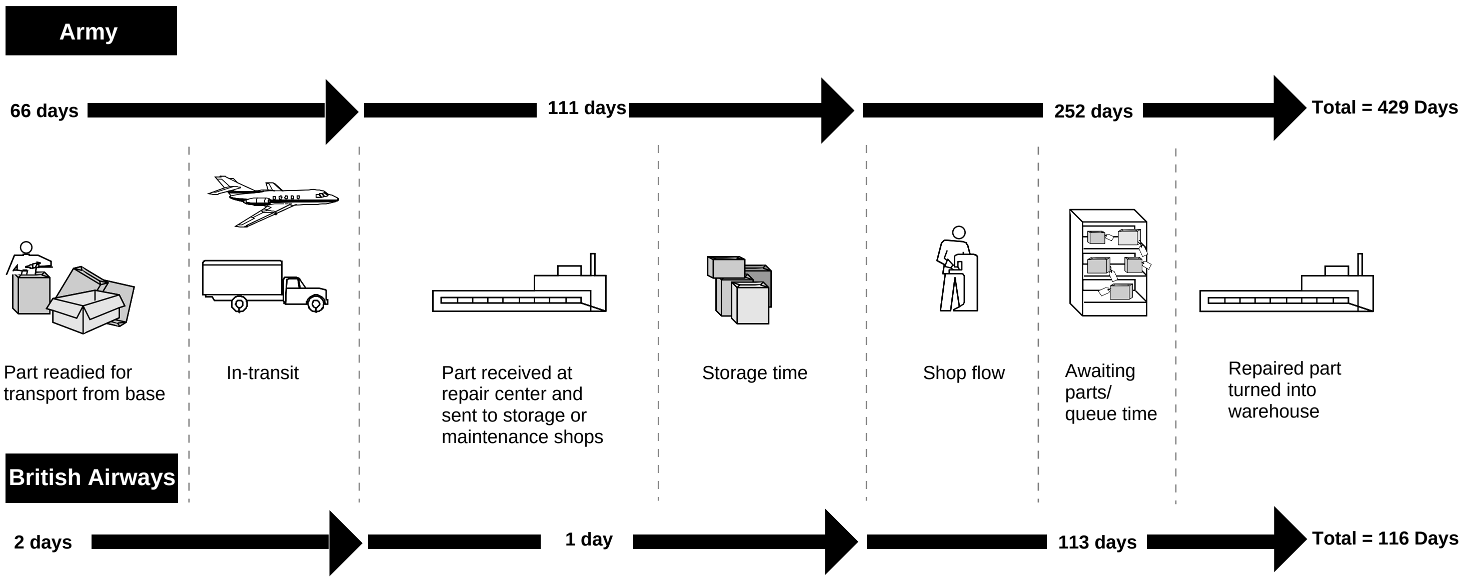
[a]It is inappropriate to sum the pipeline segments for the fastest and slowest times because these values represent the Army's pipeline performance on one component in each segment. The average time for each segment, however, is appropriate to sum because it represents the average time for all components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

As shown in table 1, the repair pipeline time was both long and highly variable. 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 days to more than 1,000 days.

In contrast, one airline we found to be using leading-edge practices, British Airways, took a much shorter period of time to move a part through its logistics system. As shown in figure 1, the average time to move a gearbox assembly through the first three segments was 116 days for British Airways while the Army's average time was 429 days, or about 4 times longer. While the Army's repair time was twice as long as British Airways, most of the Army's time occurred in the shipping and storage segments.

[4]RAND Annotated Briefing, Improving the Army's Repair Process: Baseline Repair Cycle Time Measures (DRR-1271-1-A, May 1996).

Figure 1: Comparison of the Army's and British Airways' Pipeline Times for a Gearbox Assembly

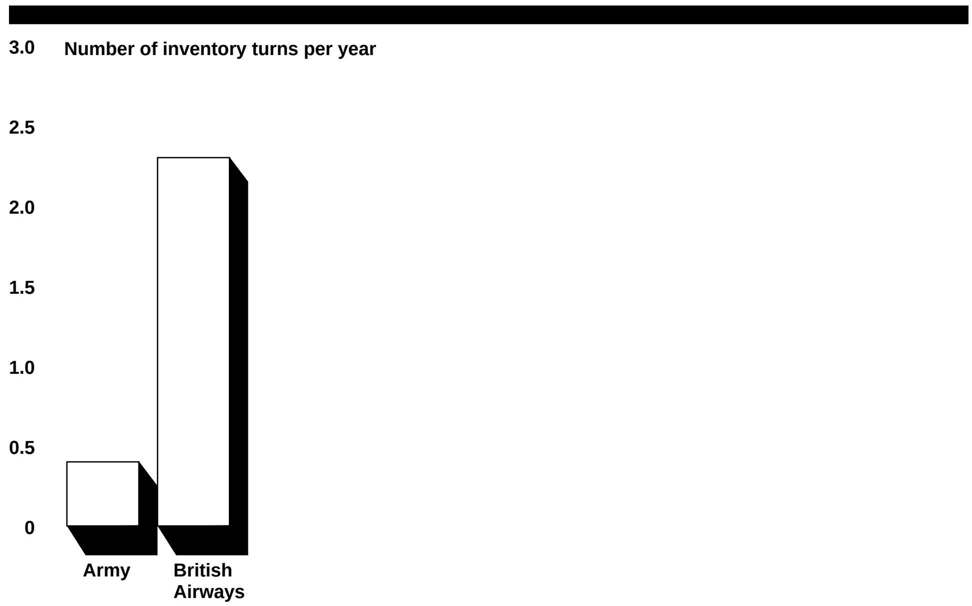


In part, because of this slow process, the Army has invested billions of dollars in inventory to support peacetime operations that is not used as effectively as it could be. DOD reported that as of September 1995, the value of the Army's reparable aviation parts inventory was $2.6 billion,[5] with 74 percent ($1.9 billion) allocated to support daily operations, 11 percent for war reserves, and 15 percent allocated as long supply— a term identifying stock that is excess to current Army requirements.

One measure of the repair process efficiency is a calculation of how often an organization uses its inventory. This calculation is called the turnover rate. The higher the turnover rate, the more often a company is using its inventory. At one airline we visited—British Airways—the turnover rate for reparable parts was 2.3 times each year. In comparison, we calculated that, based on fiscal year 1995 repairs, the Army's turnover rate was 0.4 times, or about 6 times slower (see fig. 2). This calculation neither includes inventory the Army has allocated for war reserves nor inventory the Army has stored at field level organizations, which is classified as retail inventory.

[5]These inventory values were calculated by DOD using its standard valuation methodology—the value of reparable parts requiring repair was reduced by the estimated cost of repair, and excess inventory was valued at the estimated salvage price (2.5 percent of the fiscal year 1995 acquisition costs).

Figure 2: Comparison of British Airways and Army Inventory Turnover Rates



Comparing the Army's engineering estimate of the repair time that should be needed to complete repairs with the actual amount of time taken is another measure of the repair process' efficiency. Of the 525-day average pipeline time from our sample, the Army estimates an average of 18 days should be needed to repair the item(s). The remaining 507 days, or 97 percent of the total time, were spent to transport or store the part(s) or for unplanned repair delays.

Several Factors Contribute to This Slow System

Several factors contribute to the Army's slow logistics pipeline. Four of the factors are (1) slow processing and shipping of parts from the field to the repair depot, (2) delays in inducting parts into the repair shops, (3) inefficient organization of the depot repair process, and (4) lack of consumable parts needed to complete repairs. Because of these factors, parts sit idle or are delayed in the repair process, which lengthens the total repair time.

Slow Processing and Shipping of Parts to the Depot

Preparing and shipping a broken part from the operating unit to the depot for repair—a process called "retrograde"—took an average of 75 days for the items we examined. In contrast, British Airways estimated that only

2 days were needed to prepare and ship components from operating locations to its repair centers. In May 1996, RAND also found the Army's retrograde process to be slow; the median retrograde time for a sample of items it measured from the point when maintenance personnel determined a part was not reparable at the operating unit until it arrived at a DLA depot storage facility was 22 days and the longest time was more than 100 days.

Delayed Induction of Parts

Our sample data show that broken parts may sit in storage at the depot facility for a long period of time until a certain quantity of parts are moved to or are "inducted" into the repair shop. Because different operating units ship parts to the depot in various quantities, each part that is inducted for repair may be stored for different amounts of time. For example, the Army inducted helicopter gearboxes into the repair shop 5 times over a 2-year period. The average storage time for the parts inducted in each group ranged from 15 to 366 days. Table 2 shows the quantity of parts inducted and the average amount of days the parts were stored before being inducted.

Table 2: Gearbox Repair Inductions

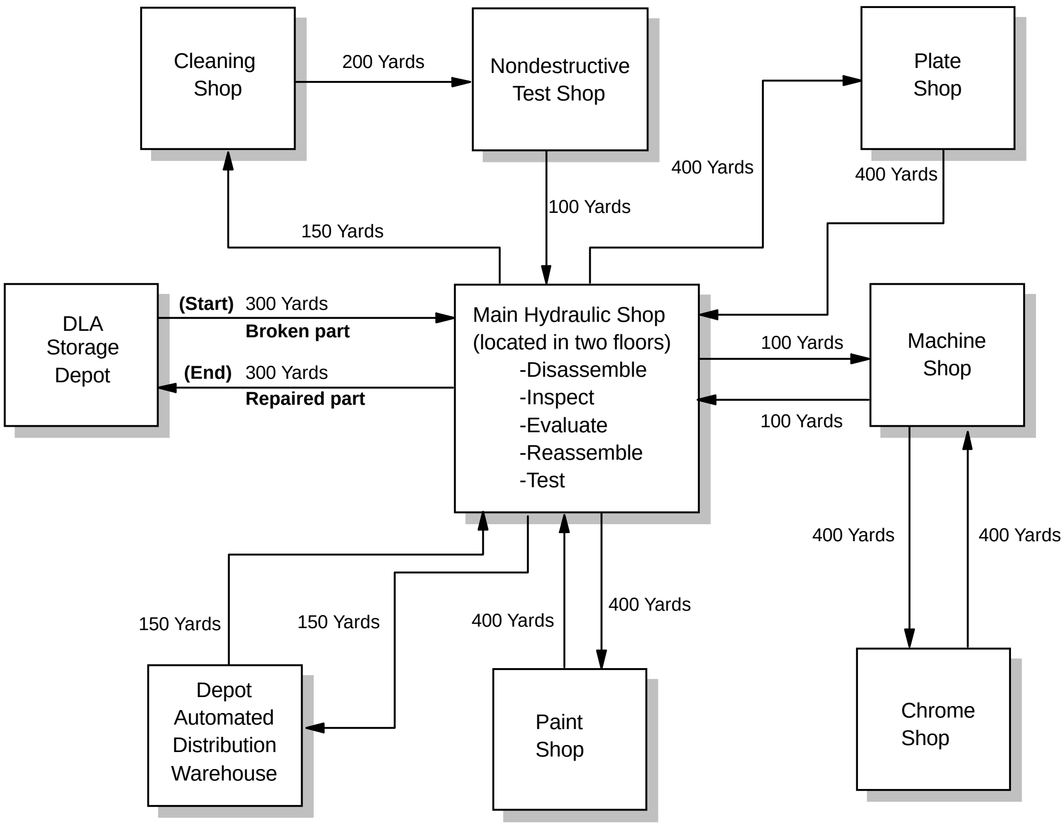
Group	Induction date	Average storage time (days)	Number of parts inducted
1	Sept. 8, 1994	27	11
2	Sept. 20, 1994	15	7
3	Dec. 9, 1994	32	8
4	Jan. 17, 1996	310	10
5	Apr. 24, 1996	366	1

According to Army officials, parts sit in storage before induction because of the method that is used to plan repair programs. Item managers periodically review and compare inventory levels and the projected requirements for parts. Based upon this analysis, an item manager determines how many parts should be either repaired or purchased to meet the Army's anticipated needs. For items that need to be repaired, the Army develops a repair program, which includes a funding estimate for the repairs. The depot can induct parts into the repair process only after this program and its related funding have been approved. Also, parts may sit in storage because an excessive amount of inventory is available to meet current and projected Army requirements. As previously discussed, 15 percent of the Army inventory is classified as long supply, or excess to current requirements.

Inefficient Organization of Repair Activities

The Army moves parts from one location to another several times during the repair process, which increases the time required to complete a repair. Functions such as testing, cleaning, and machining are sometimes done at separate shops that are hundreds of yards apart. Routing components through different shops reduces the efficiency of the process because each time a part is moved, it must be prepared for transportation, physically moved, and processed through the shop. For example, at CCAD, the repair of hydraulic components involves routing parts through six different shops, each located 100 to 400 yards from the main repair shop (see fig. 3), which adds time and reduces the efficiency of the process. For one hydraulic part we examined, the Army estimated the repair time of 31 days—only 3 days were estimated for direct labor to repair the item and 28 days (90 percent) were estimated to cover handling and moving the part to different shops, or anticipated repair delays.

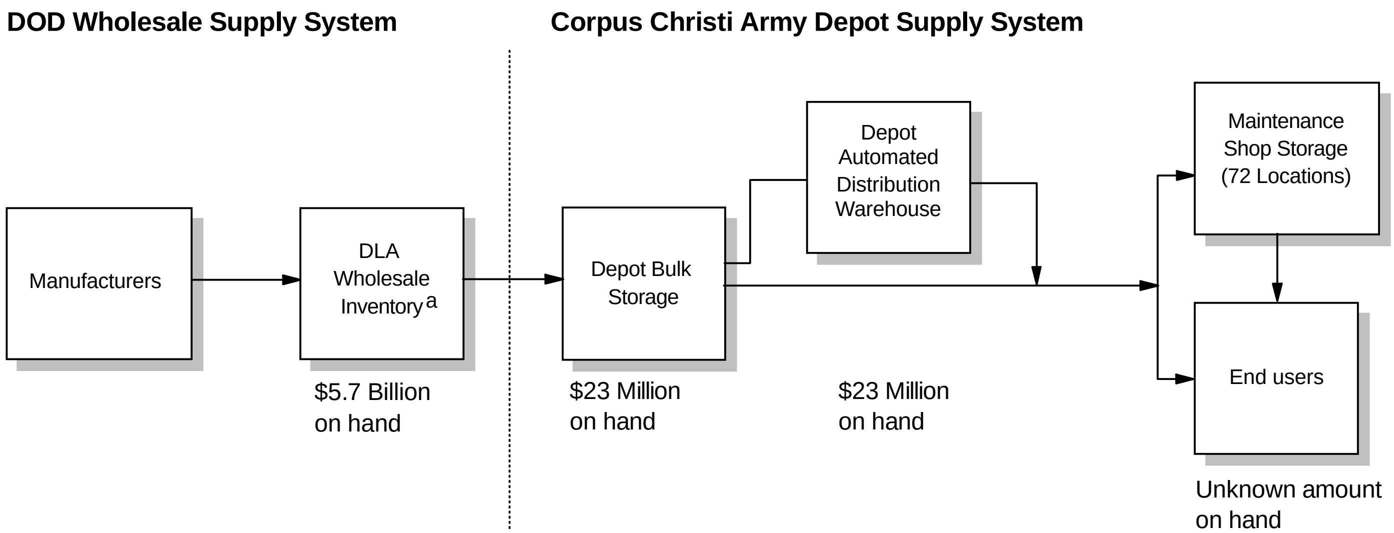
Figure 3: The Army's Repair Process for a Hydraulic Component



Inadequate Piece Part Support

Another cause of delays is mechanics often do not have the necessary consumable parts that are used in large quantities to repair aircraft components. According to CCAD officials, the lack of piece parts is the primary cause for repair delays at the depot. The traditional DOD supply system used at CCAD to provide piece parts to mechanics involves several inventory storage locations at the depot and a wholesale inventory system managed by DLA (see fig. 4).

Figure 4: Multilayered Inventory System for Consumable Parts



[a]DLA inventory is stored at multiple locations nationwide to support all DOD customers.

This process has created as many as four layers of inventory in the CCAD supply system. As of August 1996, the first two layers (depot bulk storage and the automated distribution warehouse) stored inventory valued at $46 million. For the next two layers (maintenance shop storage and end-user storage), the Army does not centrally track inventory levels or supply effectiveness. Therefore, CCAD officials could not provide us with consolidated information on the amount or value of the inventory stored in these locations or if the inventory was the right type of material or in the appropriate quantity to meet the mechanics' needs. Figure 5 shows the CCAD automated storage and distribution warehouse where $23 million of inventory is stored. Figure 6 shows 1 of the 72 maintenance shop storage locations and is an example of the size of some of these facilities.

Figure 5: CCAD Automated Distribution Warehouse

Figure 6: CCAD Maintenance Shop Inventory Storage Location

Despite this investment in inventory, the supply system frequently fails to completely fill orders when they are placed by mechanics or other CCAD customers. According to Army records, the CCAD bulk storage warehouse did not have an adequate supply of inventory to meet customer demands 75 percent of the time during the first 11 months of fiscal year 1996.[6] When parts are not available at the bulk storage facility, the maintenance shops can request (backorder) them from the DLA wholesale system, which may take several days or even months for delivery. As of August 1996, CCAD mechanics had more than $40 million worth of parts on backorder, of which 34 percent was still unfilled after 3 months.

Depot officials identified several options available to minimize repair delays that are caused by part shortages. For example, depot personnel can buy the part from local vendors or fabricate the part in its machine

[6]The Army calculated this fill rate by comparing total demands with the total number of times a demand was completely filled by the inventory on hand at depot storage locations. At times, a demand is partially filled by inventory on hand, with the remaining unfilled demands placed on backorder, and filled at a later time. These "partial fills" are not included in the 75-percent calculation.

shops. In other cases, mechanics remove parts from one component that has just entered the repair shop and install the part on one that is nearing completion. This is called a “rob-back” of parts. Depot officials did not have any records that specifically quantify the number of rob-back actions in the depot, but they indicated that it was a common practice among maintenance personnel.

Effects of the Army’s Process

The following examples of parts we examined illustrate the effects of the Army’s slow and inefficient logistics pipeline. First, in fiscal year 1995, the Army repaired 25 helicopter rotor heads. The average time to ship these units from field locations and complete the repair of each item was 723 days. Of the 723-day average, 577 days involved shipping and storage time and 146 days involved repair time. The Army’s engineering estimate indicates the optimum repair shop time should be 35 days. At the end of fiscal year 1995, the Army had 134 units on hand, valued at $20.9 million. Using historical demand data, this inventory could satisfy Army requirements for the next 3.5 years.

Also, in fiscal year 1995, the Army repaired 79 helicopter transmissions. It took the Army an average of 414 days to ship and repair each of these items. This 414-day average was comprised of 67 days for shipping, 229 days for storage, and 118 days for repair. The Army’s engineering estimate indicates 37 days should be needed for repair shop time. At the end of fiscal year 1995, the Army had 204 transmissions on hand, which should satisfy routine requirements for 4.7 years.

The Army Has Targeted Logistics System Improvements

The Army has recognized that it must develop a faster and more flexible logistics pipeline. In early 1995, the Army’s Deputy Chief of Staff for Logistics directed the Army logistics community to implement a program called “Velocity Management” to speed up key aspects of the logistics system and reduce the Army’s need for large inventory levels. Under this program, the Army has established Army-wide process improvement teams for the following four areas: (1) ordering and shipping of parts, (2) the repair cycle, (3) inventory levels and locations, and (4) financial management. Also, under this program, the Army is establishing local-level site improvement teams to examine and improve the logistics operations of individual Army units. As of September 1996, however, Velocity Management has had no impact on CCAD operations and has had only limited success in improving overall logistics operations.

The Army established the Velocity Management program with the goals, concepts, and top-management support that parallel the 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. Like the private sector, the Army plans to achieve these improvements by changing its processes, not by refining the existing system that tends to gain only incremental improvements. The Army also recognizes the importance of top-management support to the ultimate success of these initiatives. The Army's current leadership has strongly endorsed the program as a vehicle for making dramatic improvements to its current logistics system.

As of September 1996, CCAD was not actively involved in the Velocity Management program. Instead, depot officials established a program to improve CCAD operations. Under this program, depot officials have focused on changing the management culture, measuring the actual cost of operations, and redesigning some of the local repair processes. The first major initiative pursued by depot officials was to measure the actual cost of completing repairs using an activity-based cost analysis of certain depot processes. Depot officials have also redesigned the repair process for helicopter blades, moving all of the resources needed to complete repairs into one facility, which is intended to reduce the repair cycle time. Unless CCAD's local program is expanded to include other DOD organizations, such as DLA, substantial reductions in the total pipeline time may not be possible.

Industry Best Practices Can Be Used to Build on Army Initiatives

The airline industry has developed leading-edge practices that focus on reducing the time and complexity of the logistics pipeline. As discussed in our reports on Air Force and Navy reparable parts logistics operations, we identified four best practices in the airline industry that have the potential for use in military systems and have resulted in significant improvements and reduced logistics costs for several airlines, especially British Airways. These practices are the prompt repair of items, the reorganization of the repair process, the establishment of partnerships with key suppliers, and the use of third-party logistics services. When used together, they can help maximize a company's inventory investment, decrease inventory levels, and provide a more flexible repair capability. In our opinion, they address many of the same problems the Army is facing and represent practices that could be applied to Army operations.

Repairing Items Promptly

Certain airlines streamlined their repair process by eliminating excess inventories and initiating repair actions as quickly as possible, which prevented the broken items from sitting in storage 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. In contrast, as discussed earlier in this report, the Army sometimes holds parts for more than a year before they are inducted for repair. Prompt repair does not mean that all parts are fixed, however. The goal is to quickly fix only those parts that are needed. One airline that uses this approach routes broken parts directly to holding areas next to repair shops, rather than to stand-alone warehouses, so that mechanics can quickly access broken parts when it comes time to repair them. These holding areas also give the production managers and the mechanics better visibility of any backlogs.

Reorganizing the Repair Process

One approach to simplify the repair process is the "cellular" concept, which brings all the resources, such as tooling and support equipment, personnel, and inventory that are needed to repair a broken part into one location, or one "cell." This approach simplifies the flow of parts through the process by eliminating the time-consuming exercise of routing parts to workshops in different locations. It also ensures that mechanics have the technical support so that operations run smoothly. In addition, because inventory is placed near the workshops, mechanics have quick access to the parts they need to complete the 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. Another airline that adopted this approach in its engine blade shop reduced its repair time by as much as 50 percent to 60 percent and decreased work-in-process inventory by 60 percent.

One airline we visited has also adapted the cellular concept to its aircraft overhaul process. The airline established work cells adjacent to the aircraft bays that contain a variety of tooling and support equipment that enable mechanics to overhaul a variety of aircraft parts alongside the aircraft. At this location, the airline completes a majority of aircraft repairs planeside, using this cellular approach.

Establishing Partnerships With Key Suppliers

Several airlines and manufacturers that we visited have worked with suppliers to improve parts support while reducing overall inventory. The use of local distribution centers and integrated supplier programs are two approaches that specifically seek to improve the management and distribution of consumable items. These approaches help ensure that the consumable parts for repair and manufacturing operations are readily available, which prevents items from stalling in the repair process and is crucial in speeding up repair time. In addition, by improving management and distribution methods, such as using streamlined ordering and fast deliveries, firms can delay the purchase of inventory until 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 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 per 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.

Integrated supplier programs involve the shifting of inventory management functions to suppliers. Under this arrangement, a supplier monitors parts usage and determines 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's 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 inspections, parts kits, establishment of electronic data interchange links and inventory bar coding, and vendor selection management. Table 3 summarizes the types of services, reductions, and improvements achieved by an integrated supplier (TriStar Aerospace Corporation) for some of its customers (designated as A through E) under the integrated supplier program.

Table 3: Integrated Supplier Program Results for Five Companies

Company	A	B	C	D	E
Date established	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)[a]	98.0	88.7	96.7	99.0	94.3
Order ship time[b] (hours)	24	48	48	24	24
Frequency of deliveries	Daily	Daily	Daily	Daily	Daily
Number of orders filled daily	300	200	150	15	75

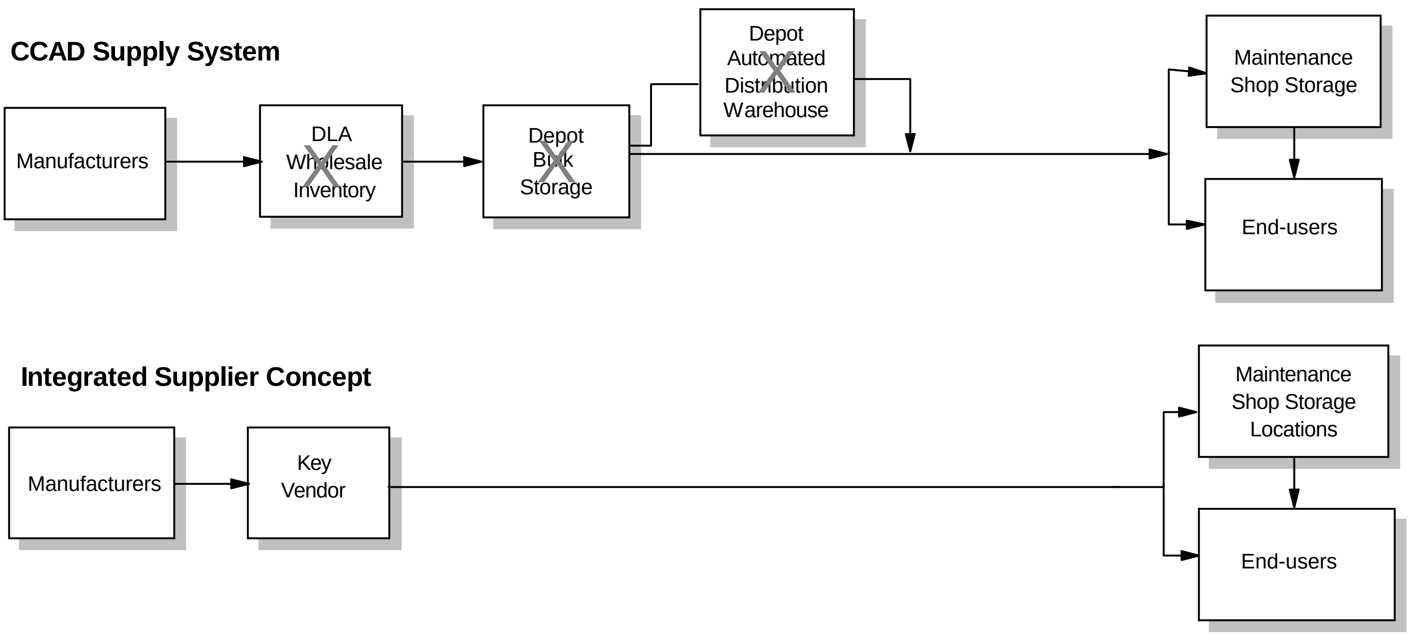
[a]Fill rate is the number of times the inventory requested is on hand and delivered to the customer, expressed as a percent of total orders.

[b]Order ship time is the amount of time it takes Tri-Star to deliver inventory to the customer after receiving an order.

Source: TriStar Aerospace Corporation.

The use of an integrated supplier program would significantly alter the current DOD process of providing piece parts to mechanics at the repair depot or in the field. Figure 7 compares using the DOD system at CCAD with using the integrated supplier concept. As shown, the integrated supplier concept provides the opportunity to reduce or eliminate inventory in the DLA wholesale system, the depot bulk storage location, and the automated distribution warehouse.

Figure 7: DOD Supply System at CCAD Compared to an Integrated Supplier Concept



Using Third-Party Logistics Providers

The airlines we contacted provided examples of how third-party logistics providers can be used to reduce costs and improve performance. Third-party providers manage and carry out certain functions, such as inventory storage and distribution. They can also offer management expertise that companies often do not have the time or the resources to develop.

For example, one airline contracts with a third-party provider to handle deliveries and pickups from suppliers and repair vendors, which has improved the reliability and speed of deliveries. 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.

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

Integrated Best Practices May Produce Significant Savings

Some combination of the four best practices discussed in this report may, in our opinion, significantly reduce the Army's repair pipeline time and inventory requirements. The current repair pipeline at CCAD, 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, is shown in figure 8. A modified Army system incorporating the use of an integrated supplier for consumable items, third-party logistics services, inducting parts soon after they arrive at the depot, and cellular repair shops is shown in figure 9. A comparison of figures 8 and 9 shows the potential reductions possible using these key best practices.

Figure 8: Current Repair Pipeline at CCAD

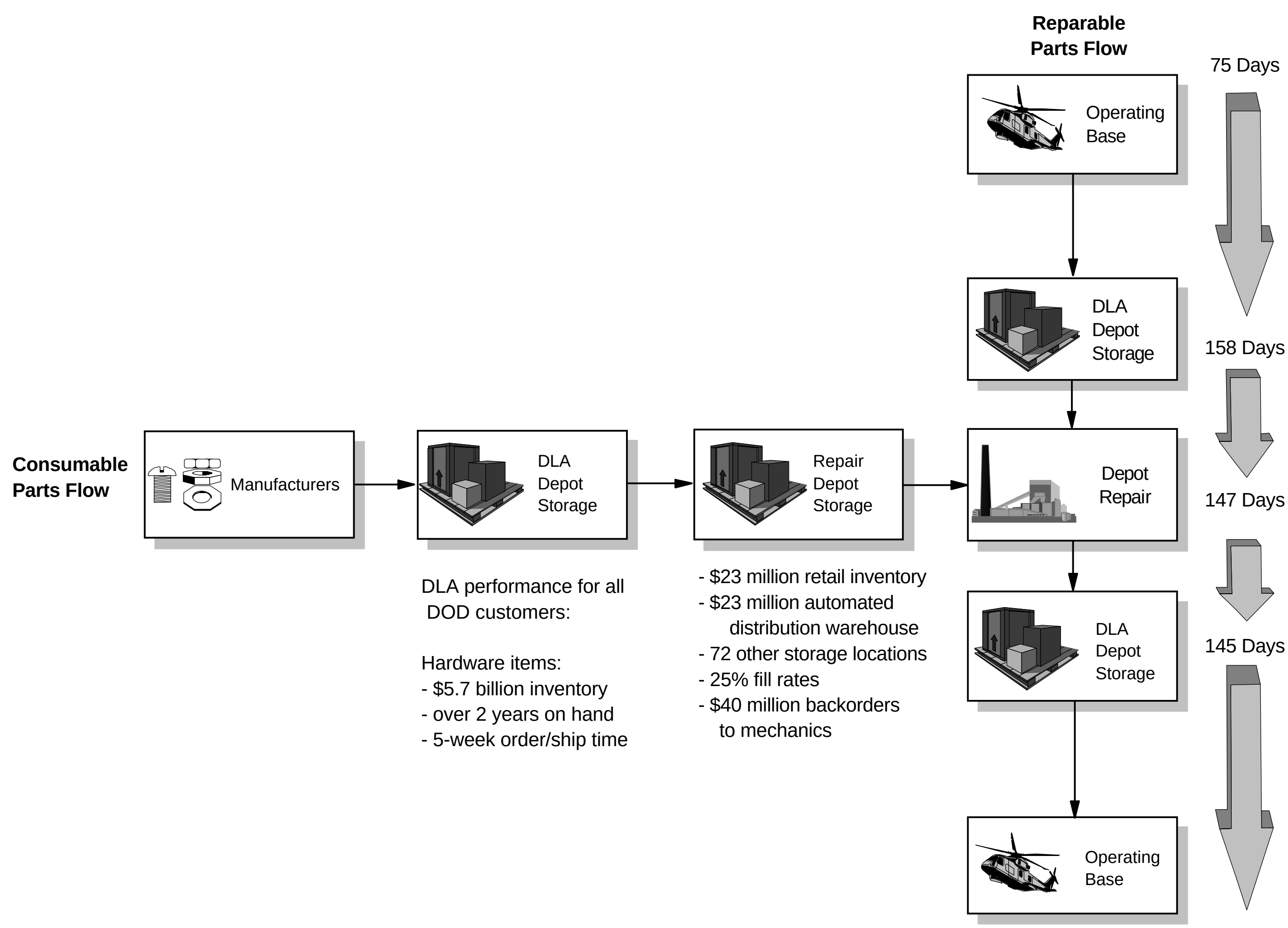
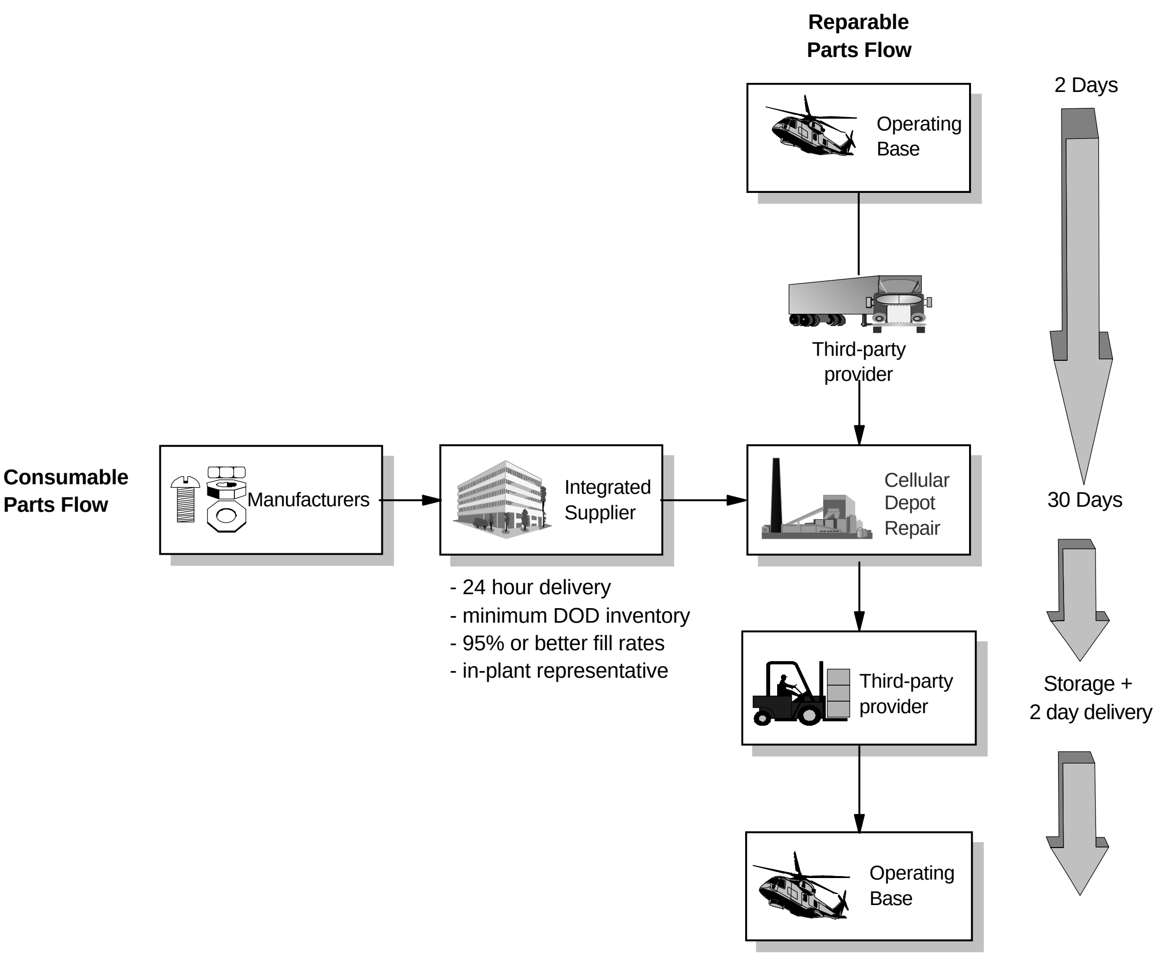


Figure 9: Best Practices Applied to the Army Repair Pipeline



The reparable parts pipeline time could be reduced by hundreds of days with the application of third-party logistics providers, the cellular concept, and quick induction of parts into repair. The consumable parts flow could be improved and inventories substantially reduced by using the integrated supplier concept. If the Army were able to adopt these practices and achieve savings similar to the private sector, inventory and related management costs could be substantially reduced.

Recommendations

As part of the Army's current efforts to improve the logistics system's responsiveness and reduce its complexity, we recommend that the Secretary of Defense direct the Secretary of the Army, working with DLA, to develop a demonstration project to determine the extent to which the Army can apply best practices to its logistics operations. We also recommend that the Secretary of the Army appoint an accountable "change agent" for this program who will periodically report back to the Secretary on the progress of the demonstration project. In addition, we recommend that the Secretary of the Army identify the Army facilities that will participate in this project, establish specific test program milestones, and identify the performance measures that will be used to quantify process improvements and reductions in the overall pipeline time. The practices should be tested in an integrated manner, where feasible, to maximize the interrelationship many of these practices have with one another. The specific practices that should be considered, where feasible, are

- eliminating excess inventory and inducting parts at repair depots soon after they break, consistent with repair requirements, to prevent parts from sitting idle;
- using the cellular concept to reduce the time it takes to repair parts;
- establishing innovative supplier partnerships to increase the availability of parts needed to complete repairs at the depot, such as local distribution centers and integrated supplier programs; and
- using third-party logistics providers to store and distribute spare parts between the depot and end users to improve delivery times.

We further recommend that this project be used to quantify the costs and benefits of these practices and to serve as a means to identify and alleviate barriers or obstacles that may inhibit the expansion of these practices. After these practices have been tested, the Army should consider expanding and tailoring the use of these practices, where feasible, so they can be applied to other locations.

Agency Comments

In its comments on a draft of this report, DOD agreed with the findings and recommendations. DOD indicated that the Army is participating in DLA's Virtual Prime Vendor pilot program, which is intended to improve supply support to depot maintenance activities. DOD stated that contractors under that program will determine, working with DLA, the best method of support to meet the performance criteria of the program.

DOD estimates that the Army will initiate a Virtual Prime Vendor pilot at an Army depot by October 1998. DOD stated that, after the pilot is successfully implemented at an Army site, the Army plans to assess the applicability of this approach at other locations. However, an implementation date for future projects has not been set. In addition, the Army plans to identify and appoint an accountable change agent for these programs by June 1997. DOD's comments are included in appendix I.

Scope and Methodology

We reviewed documents and interviewed officials on the Army's inventory 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.; the Army Materiel Command, Alexandria, Virginia; the Army's Aviation and Troop Command, St. Louis, Missouri; and the Army Industrial Operations Command, Rock Island Arsenal, Rock Island, Illinois.

To examine the Army's logistics operations and improvement efforts, we visited the DLA Defense Distribution Depot, Corpus Christi, Texas; the DLA Premium Services System, Memphis, Tennessee; CCAD, Corpus Christi, Texas; and the (Army) 101st Airborne Division (Air Assault), Fort Campbell, Kentucky. At these locations, we discussed with supply and maintenance personnel the operations of the Army's current logistics system, customer satisfaction, planned improvements to their logistics system, and the potential application of private sector logistics practices to their 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. We did not test or otherwise validate the Army's data.

To calculate the amount of time the Army's system takes to repair and distribute parts using the current depot repair process, we judgmentally sampled 24 components—9 of the components, provided to us and currently stored by the Defense Distribution Depot, Corpus Christi, were ones with an active fiscal year 1996 repair program, and 15 components were selected from the top 20 repair programs managed by the Army's Aviation and Troop Command based on dollar value, impact on readiness, and numbers of backorders.

To identify leading commercial practices, we used information from our February 1996 report that compared Air Force logistics practices to those of commercial airlines. This information, which was collected by making an extensive literature search, identified leading inventory management concepts and detailed examinations and discussions of logistics practices used by British Airways, United Airlines, Southwest Airlines, American Airlines, Federal Express, Boeing, the Northrop-Grumman Corporation, and TriStar Aerospace. We also participated in roundtables and symposiums with recognized leaders in the logistics field to obtain information on how companies are applying integrated approaches to their logistics operations and establishing supplier partnerships to eliminate unnecessary functions and reduce costs. Finally, to gain a better understanding on how companies are making breakthroughs in logistics operations, we attended and participated in the Council of Logistics Management's Annual Conferences in San Diego, California, and Orlando, Florida. We did not independently verify the accuracy of logistics costs and performance measures provided by private sector organizations.

We conducted our review from January 1996 to December 1996 in accordance with generally accepted government auditing standards.

We are sending copies of this report to the appropriate congressional committees; the Secretaries of Defense and the Army; the Directors of DLA and the Office of Management and Budget; and other interested parties. We will also make copies available to others upon request.

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

Sincerely yours,

David R. Warren, Director
Defense Management Issues

Contents

Abbreviations

CCAD	Corpus Christi Army Depot
DLA	Defense Logistics Agency
DOD	Department of Defense

Comments From the Department of Defense

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ACQUISITION AND TECHNOLOGY

14 MAR 1997

(L/MDM)

Mr. David R. Warren
Director, Defense Management
and NASA 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: The Army Could Reduce Logistics Costs for Aviation Parts by Adopting Best Practices," dated February 10, 1997 (GAO Code 709176/OSD Case 1293). The Department generally concurs with the report.

The Army continues to aggressively pursue efficiencies in the entire depot repair cycle, from customer retrograde of an unserviceable item, through repair, storage and return to the customer. These efficiencies will contribute to reductions in both inventory and the price of spares. The Army is participating with the Defense Logistics in its virtual Prime Vendor pilot program to provide enhanced supply support to depot maintenance activities. The planned initiation of a Virtual Prime Vendor pilot at an Army maintenance activity will allow "best practices" as proposed by contractors to be thoroughly tested and assessed.

The Department's detailed comments on the draft report's recommendations are at the enclosure. The Department appreciates the opportunity to comment on the draft report.

Sincerely,

James B. Emahiser
Assistant Deputy Under Secretary
(Materiel and Distribution
Management)

Enclosure

GAO DRAFT REPORT - DATED FEBRUARY 10, 1997
(GAO CODE 709176) OSD CASE 1293

"INVENTORY MANAGEMENT: THE ARMY COULD REDUCE LOGISTICS COSTS FOR AVIATION PARTS BY ADOPTING BEST PRACTICES"

DEPARTMENT OF DEFENSE COMMENTS TO THE RECOMMENDATIONS

Now on p. 23.

- **RECOMMENDATION 1**: The GAO recommended that the Secretary of Defense direct the Secretary of the Army, working with the Defense Logistics Agency (DLA), to develop a demonstration project to determine the extent to which the Army can apply best practices to its logistics operations. (p. 26/GAO Draft Report)

  DOD RESPONSE: Concur. The Army is implementing a wide range of logistics improvements under the Velocity Management initiative, such as moving to a cellular maintenance shop arrangement for some repairs at Tobyhanna Army Depot. In addition, the Army is piloting a rapid retrograde, repair, and return program for circuit cards between Tobyhanna and Fort Bragg. Finally, the Army is participating with DLA in its Virtual Prime Vendor pilot program to provide enhanced supply support to depot maintenance activities. We estimate that an Virtual Prime Vendor pilot will be initiated at an Army maintenance activity by October 1998.

Now on p. 23.

- **RECOMMENDATION 2**: The GAO recommended that the Secretary of the Army appoint an accountable "change agent" for this program who will periodically report back to the Secretary on the progress of the demonstration project. (p. 16/GAO Draft Report)

  DOD RESPONSE: Concur. The Army will identify the responsible "change agent" by June 1997.

- **RECOMMENDATION 3**: The GAO recommended that the Secretary of the Army identify the Army facilities that will participate in this project, establish specific test program milestones, and identify the performance measures that will be used to quantify process improvements and reductions in the overall pipeline time. The practices should be tested in an integrated manner, where feasible, to maximize the interrelationship many of these practices have with one another. The specific practices that should be considered are:

- eliminating excess inventory and inducting parts at repair depots soon after they break, consistent with repair requirements, to prevent parts from sitting idle;

- using the cellular concept to reduce the time it takes to repair parts;

- establishing innovative supplier partnerships to increase the availability of parts needed to complete repairs at the depot, such as local distribution centers and integrated supplier programs; and

- using third party logistics providers to store and distribute spare parts between the depot and end users to improve delivery times. (p. 26/GAO Draft Report)

Now on p. 23.

DOD RESPONSE: Concur. As discussed in the DoD response to Recommendation 1, the Army is moving to a cellular maintenance shop arrangement for some repairs at Tobyhanna Army depot as well as piloting a rapid retrograde, repair, and return program for circuit cards between Tobyhanna and Fort Bragg. The planned initiation of a Virtual Prime Vendor pilot at an Army maintenance activity will allow "best practices" as proposed by contractors to be throroughly tested and assessed.

- **RECOMMENDATION 4**: The GAO recommended that the Secretary of the Army use this project to quantify the costs and benefits of these practices and to serve as a means to identify and alleviate barriers or obstacles that may inhibit the expansion of these practices. After these practices have been tested, the Army should consider expanding and tailoring the use of other locations. (p. 26/GAO Draft Report)

Now on p. 23.

DOD RESPONSE: Concur. After the initial Virtual Prime Vendor pilot at an Army site is implemented, the Army will assess the applicability of this approach to other locations.

Major Contributors to This Report

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Related GAO Products

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 Exist to Reduce Aircraft Engine Support Costs (GAO/NSIAD-91-240, June 28, 1991).

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