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REPORT BY THE U.S.



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# General Accounting Office

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## If Army Helicopter Maintenance Is To Be Ready For Wartime, It Must Be Made Efficient And Effective In Peacetime

The Army needs to improve its depot maintenance mobilization planning for its 8,000 helicopters. It must first determine realistic requirements and then the appropriate resources needed to meet the requirements.

To improve depot effectiveness, the Army should apply the reliability-centered maintenance concept--performing maintenance only when it is meaningful to safety, reliability, and economy--for engines and components as directed by the Secretary of Defense in 1976. Depot effectiveness could be further improved if the Army reduced concurrent rework of aircraft components and made greater use of batch processing.



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LCD-79-407  
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UNITED STATES GENERAL ACCOUNTING OFFICE

WASHINGTON, D.C. 20548

LOGISTICS AND COMMUNICATIONS  
DIVISION

B-140389

The Honorable Clifford L. Alexander, Jr.  
The Secretary of the Army

Dear Mr. Secretary:

This report discusses the problems that the Army has in determining its mobilization requirements for helicopter depot maintenance. Without a firm knowledge of mobilization requirements, attempts to properly size facility capability and capacity are limited and may result in unnecessary expenditures. In addition, opportunities exist for making peacetime operations at the Army depot facilities more efficient and effective.

This report contains recommendations to you. As you know, section 236 of the Legislative Reorganization Act of 1970 requires you to submit a written statement on actions taken on our recommendations to the House Committee on Government Operations and the Senate Committee on Governmental Affairs not later than 60 days after the date of the report and to the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

Copies of this report are being sent to the Chairmen, Senate Committees on Appropriations, Armed Services, and Governmental Affairs; the House Committees on Appropriations, Armed Services, and Government Operations; and the Secretary of Defense.

Sincerely yours,

A handwritten signature in cursive script, appearing to read "R. W. Gutmann".

R. W. Gutmann  
Director

D I G E S T

The current complex of Department of Defense aircraft maintenance depots needs to be coordinated more effectively with requirements. To this end, GAO recommended in a previous report that the Secretary establish or designate a single manager over aircraft depot maintenance. However, based on Defense's response to that report, GAO does not expect that the Department will do so in the near future.

Defense owns about 9,500 helicopters of which 8,000, or about 84 percent, belong to the Army. Routine maintenance normally is available at flight organizations or local repair shops. But, when maintenance requires more complex facilities, equipment, and skills, it is provided either at the Corpus Christi or New Cumberland Army depots or contractor plants. *Permit*

The Army spends over \$177 million annually for depot maintenance of helicopters and their components.)

For the present, the Army should attempt to match its helicopter depot maintenance resources more effectively with requirements. To do so, it must estimate its requirements realistically and match these with private industry and its capabilities and capacities.

The Army's plan setting forth its helicopter depot maintenance requirements for mobilization does not include requirements for the first 6 months of mobilization. Officials from the Corpus Christi and New Cumberland depots have made studies of their capacities to respond to mobilization, including the first months of mobilization.

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The Army's Troop Support and Aviation Materiel Readiness Command was evaluating these studies and preparing an updated plan. Moreover, the assumptions, data, and processes used to arrive at other requirements were not realistic; they were inconsistent with Army plans and otherwise lacked foundation, thereby reducing their credibility as a basis for planning.

The Army has not determined private industry's capability and capacity in regard to depot helicopter maintenance. Until a thorough assessment is made, the Army can neither effectively match requirements to available resources nor determine realistically to what extent it should fund its organic facilities.

#### DEPOT PEACETIME OPERATIONS

In fiscal year 1976, the Secretary of Defense directed the Army to begin using reliability-centered maintenance. This means replacing the former use of extensive scheduled maintenance only when it is meaningful to safety, reliability, and economy.)

Commercial airlines have been using this successfully for some time and have found that it greatly reduces aircraft maintenance costs and improves aircraft availability.

To date, the Army's use of reliability-centered maintenance has been limited to airframe-related programs. The Army has not introduced this method for engines and other components. Its implementation should improve depot operations and reduce some current inefficiencies such as:

- Overhauling engines without defects simply because they have reached a maximum allowed operating time--the number of flying hours beyond which the engines are considered

to be unsafe to operate. Of 548 engines GAO reviewed, 110 without defects were overhauled at a cost of about \$2 million.

--Overhauling engines and components if 50 percent of their maximum allowable operating times have been exceeded. In many cases, these engines and components could have been tested and repaired at about half the overhaul cost (see p. 19).

The Army currently is performing tests to ascertain how best to change these practices. Depot effectiveness could be further improved if the Army

--reduced concurrent rework of aircraft components and made greater use of the exchange method (see p. 29),

--made greater use of opportunities to batch process component repair (see p. 29),

--eliminated the practice of repairing components that are in long supply (see p. 29), and

--performed only work at the depots which could not be accomplished by field units (see p. 29).

The Corpus Christi Army depot's information system has some deficiencies that result in inaccurate information and thus limits management's effectiveness. GAO found that

--labor and production information were not being properly recorded and reported (see p. 31);

--the work measurement system could be more effective if (1) methods improvements studies had been performed before establishing standards (see p. 38), (2) standards had been regularly updated (see p. 38),

and (3) a significant number of standards had not been altered (see p. 38); and

--program costs were sometimes misstated due to costs transfers (see p. 40).

#### RECOMMENDATIONS

The Secretary of the Army should:

- Establish realistic mobilization helicopter depot maintenance requirements.
- Assess private industry's helicopter depot maintenance capability and capacity thoroughly so that the Army can match requirements effectively to resources.
- Implement the reliability-centered maintenance concept for engines and components.
- Eliminate repairing components that are in long supply.
- Discontinue routine concurrent component repair and make greater use of the exchange method.
- Batch process component repair when feasible.
- Study the Navy's practice of returning overhauled helicopters to the unit from which they came as part of its efforts to reduce the amount of field level work being done at depots.
- Require system discipline and integrity needed to improve existing inadequacies concerning labor, production, and costs reporting.
- Require that the Army's reporting system for rework be revised so that the costs of all rework are captured.

--Provide greater management support and reinforcement of the work measurement program so that methods improvements studies are made before standards are established and standards are updated regularly.

#### AGENCY COMMENTS

Army officials commented on this report as follows. The Army:

--Is revising the mobilization plan to include requirements for the initial months of mobilization. And, it would try to assess private industry's helicopter depot maintenance capability and capacity so that requirements could be better matched to resources.

--Is sending engines to the depots for overhaul when they reach the maximum allowable operating time. However, the Army is currently evaluating this practice and expects to change the overhaul criteria.

--Is doing concurrent repair of components rather than exchanging the item for a similar one from stock because the Army is required by regulation to identify component repair with the helicopter from which it was removed. Defense officials disagreed on this requirement.

--Agreed to evaluate depot work to determine if organizational level maintenance is being done at the depots and if there is any degree of "goldplating" done to overhauled helicopters.

--Stated that GAO's examples of labor and production reporting problems were taken from processing shops. It feels that these shops have inherent data reporting problems and are not representative of depot labor and production reporting accuracy. However, some of GAO's examples came from non-processing shops.

--Is not using the established standards for workloading and scheduling because the standards are unrealistic since they do not account for inefficiencies and unskilled labor. The Army Depot Systems Command has recognized the shortcoming and is developing a factor to account for certain inefficiencies.



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ABBREVIATIONS

DARCOM	U.S. Army Materiel Development and Readiness Command
DESCOM	U.S. Army Depot Systems Command
DIMES	Defense Integrated Management Engineering System
DOD	Department of Defense
GAO	General Accounting Office
MIS-Q	Management Information System - Quality
RCM	reliability-centered maintenance
TSARCOM	U.S. Army Troop Support and Aviation Materiel Readiness Command

## CHAPTER 1

### INTRODUCTION

The Department of Defense (DOD) owns about 9,500 helicopters and spends over \$200 million annually for their depot maintenance. 1/ The Army owns about 84 percent or 8,000 of these helicopters and spends about \$177 million for depot maintenance annually.

The U.S. Army Materiel Development and Readiness Command (DARCOM) is the major Army command responsible for helicopter maintenance. Inventory and maintenance management of helicopter airframes, engines, and components is the responsibility of one of DARCOM's subordinate commands, the U.S. Army Troop Support and Aviation Materiel Readiness Command (TSARCOM). TSARCOM is responsible for requirements computations, inventory management, supply and stock control, and procurement of aircraft, engines, and components. Scheduling and management of helicopter depot maintenance is the responsibility of the U.S. Army Depot Systems Command (DESCOM). This command is the central workloading agency for depot maintenance.

Although some depot maintenance for Army helicopters is performed by private contractors, most of it is done at either the Corpus Christi or the New Cumberland Army depot. The Corpus Christi depot overhauls UH-1 and AH-1 helicopters, while New Cumberland overhauls OH-58 2/ and CH-47 helicopters.

#### CORPUS CHRISTI ARMY DEPOT

The Corpus Christi Army depot, a Government owned and operated facility, is the Army's largest helicopter

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1/ Depot maintenance normally consists of inspection, test, repair, modification, alteration, modernization, conversion, overhaul, reclamation, or rebuilding parts, assemblies, subassemblies, components, equipment and equipment items, and weapon systems. It also includes manufacturing critical nonavailable parts and providing technical assistance to the intermediate maintenance organizations, user organizations, and other activities.

2/ Army officials said that beginning in fiscal year 1979, these helicopters will not be overhauled at New Cumberland.

maintenance depot. It can repair, modify, retrofit, test, and manufacture parts and modernize the complete array of Army rotary wing aircraft, engines, and components.

During fiscal year 1977, the Army assigned 2,265 civilians to the Directorate for Maintenance. As the chart below shows, this total is only slightly more than the 1974 total.

Civilians Assigned to the  
Directorate for Maintenance

<u>Fiscal year</u>	<u>Number assigned</u>
1974	2,196
1975	2,679
1976	2,395
1977	2,265

The following chart shows the number of helicopters, engines, and components overhauled and repaired at Corpus Christi during fiscal years 1975 through 1977 and the associated costs.

<u>Fiscal year</u>	<u>Work programs</u>			<u>Maintenance costs</u>	
	<u>Helicopters</u>	<u>Engines</u>	<u>Components</u>	<u>Labor</u>	<u>Materiel</u>
				(millions)	
1975	639	2,136	38,609	\$46.1	\$38.4
1976	569	1,672	35,503	48.1	36.2
1977	509	2,000	40,687	50.5	50.0

The depot is currently operating at about 55 percent of its peacetime capacity. The total fiscal year 1978 depot workload is about 3.6 million direct labor hours. Of this total, approximately 43 percent is for aircraft programs, 24 percent is for engine programs, 29 percent is for component programs, and the remaining 4 percent is for other programs.

## NEW CUMBERLAND ARMY DEPOT

Like Corpus Christi, New Cumberland overhauls, repairs, modifies, and fabricates aviation equipment.

The New Cumberland maintenance work force is about one-third the size of Corpus Christi's. As of December 30, 1977, 716 civilians and 11 military personnel were assigned to the Directorate for Maintenance at New Cumberland.

The depot is currently operating at about 45 percent of its peacetime capacity. The workload has decreased from about 1.2 million direct labor hours in fiscal year 1975 to 842,000 direct labor hours in fiscal year 1978. The fiscal year 1978 maintenance operating program is about \$26 million.

## SCOPE OF REVIEW

We reviewed Army policies, procedures, and practices for helicopter depot maintenance during peacetime and the Army's planning for similar work during mobilization. We also contacted Navy and Air Force officials and obtained information regarding their helicopter maintenance practices.

We did most of our work at the Corpus Christi Army depot because (1) the depot is the largest Army helicopter depot maintenance facility and (2) the Army is studying the feasibility of closing the helicopter maintenance operation at the New Cumberland Army depot and transferring the work to either Corpus Christi or private industry.

Our review was performed at the following locations from December 1977 through May 1978.

- Headquarters, U.S. Army, the Pentagon.
- DARCOM, Alexandria, Va.
- TSARCOM, St. Louis, Mo.
- DESCOM, Chambersburg, Pa.
- Corpus Christi Army depot, Corpus Christi, Tex.
- New Cumberland Army depot, New Cumberland, Pa.

--Naval Air Systems Command, Arlington, Va.

--Naval Air Logistics Center, Pautuxent River, Md.

--Warner Robins Air Logistics Center Robins Air Force  
Base, Ga.

## CHAPTER 2

### NEED TO IMPROVE MOBILIZATION PLANNING

The objective of depot maintenance mobilization planning is to provide a plan which will assure that U.S. Armed Forces will have the industrial resources needed to effectively support wartime operations. An effective plan requires that planners realistically estimate wartime requirements and identify resources needed to meet those requirements. Resources not available commercially or within DOD become needs under Defense procurement and modernization programs and require future expenditures.

We found that the Army's helicopter depot mobilization planning was incomplete and lacked realism because

- depot requirements for the first 6 months had not been determined,
- requirements estimates were inconsistent with Department of the Army plans and otherwise lacked foundation, and
- available commercial resources had not been adequately identified.

Without an effective plan, the Army cannot be sure that existing resources--both DOD and commercial--are sufficient to satisfy mobilization requirements.

### MATCHING REQUIREMENTS AND RESOURCES

To insure that helicopters are available for emergency or war contingencies while minimizing costs, planners must effectively match requirements and resources. Insufficient resources could degrade defense preparedness, while excess resources could be wasteful. In a budget-constrained operating environment, financial waste could reduce the amount of maintenance that could be done and, thus, degrade preparedness.

Valid requirements should be based on realistic assumptions regarding the various types and durations of possible emergency or war contingencies. Once requirements are identified, plans can be made for the sources of maintenance capacity and the resources needed

in terms of personnel and equipment. The two basic sources of maintenance capacity are commercial contractors and defense-operated helicopter depots. In distributing the capacity requirements between these two sources, planners should consider factors such as reliability, cost, system criticality, the ability to surge from a peacetime to a wartime operating level, and Federal policy.

Aircraft depot maintenance is managed independently by each of the military services. Based on each service's desire to be self-sufficient, each has created, with its own assets, an industrial complex capable of performing virtually any kind of depot maintenance. Thus, the services have duplicated each other's capabilities.

In view of this, we pointed out in a July 1978 report 1/ that the current complex of DOD aircraft maintenance depots needs to be more effectively matched with requirements. To accomplish this, we recommended that the Secretary of Defense designate or establish a single manager over aircraft depot maintenance. While DOD, in commenting on our report, did not agree with our findings regarding the severity of the efficiency problem, it did agree that a single manager may benefit aircraft depot maintenance. Based on DOD's response, it appears that Defense will not be designating a single manager in the immediate future. Therefore, in the interim, each service should attempt to properly size its aircraft maintenance depots.

#### MOBILIZATION REQUIREMENTS PLANNING

Mobilization requirements pose unique problems because of the uncertainties inherent in trying to predict the type of conflicts and the missions helicopters may be required to perform. Therefore, for planning purposes, DOD makes certain assumptions based on various scenarios. These assumptions are to be used in each service's contingency planning. Planning is generally geared to the "worst case" scenario--that with the greatest impact on helicopter depot maintenance--so all scenarios can be covered.

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1/"Aircraft Depot Maintenance: A Single Manager is Needed to Stop Waste" (LCD-78-406, July 12, 1978).



The Army depot maintenance mobilization plan for helicopters in effect during our review was formulated during 1976. We found that the requirements were incomplete and the assumptions and techniques caused some requirements to be overstated while others lacked credibility. The following factors have adversely affected the credibility of requirements.

- Depot effort programed for repair of combat damaged helicopters was overstated since it was based on Vietnam experience rather than on factors provided by the Department of the Army.
- Depot effort planned for inspection and repair of helicopters lacked adequate justification.
- Overstated peacetime requirements were used to project mobilization requirements.
- Component overhaul requirements were based on the assumption that sufficient airlift exists to transport helicopters from the United States to the overseas theater.
- Depot maintenance requirements were based on the assumption that during mobilization they will increase in a direct relationship to the increase in helicopter flying hours.
- No coordination with other services to insure adequacy of planned mobilization effort.

#### Approved plan

TSARCOM officials stated that the plan includes depot mobilization maintenance requirements for the 7th through the 18th month after mobilization and anticipates a 6-month buildup of capability to a level of effort to sustain production at the rate in the plan. The plan does not include any requirements for the first 6 months of mobilization because they were unknown and it would take most of this time to get the initial return of unserviceable components from the combat theater.

However, at the request of TSARCOM, Corpus Christi and New Cumberland officials during 1977 made studies of their capacities to respond to mobilization requirements,

including the initial months of mobilization. At the time of our review, TSARCOM was evaluating these studies and preparing an updated mobilization plan. The Air Force and Navy have determined their depot maintenance requirements for the initial months of mobilization.

Combat damage repair requirements overstated

The TSARCOM Maintenance Directorate prepared the depot maintenance workload plans, which included about 2.9 million labor hours for repair of 1,070 helicopters damaged in combat. The Directorate used the number of aircraft repaired during 1970-71 (Vietnam experience). It then compared this figure to the size of the fleet to develop a rate of anticipated repairs during mobilization.

In July 1976, the Department of the Army provided TSARCOM Directorate of Material Management guidance for computing mobilization flying hours. The guidance included factors to be used to compute helicopter attrition and combat damage. Use of these factors would have resulted in a requirement for combat damage repair of about 478 helicopters with a labor hour requirement of 1.3 million hours, or 1.6 million less than what is currently programed.

Maintenance Directorate officials stated that they were not given this guidance; however, current guidance 1/ will be used to compute the anticipated mobilization requirement for repair of combat damaged helicopters in a new plan which is expected to be completed during 1978.

Requirements for inspection and repair lacked adequate justification

The mobilization plan includes about 771,000 hours for helicopter inspection at a depot facility. We were initially told that the hours were required to bring aircraft based in the United States up to readiness standards prior to shipment to combat areas. Later we were told that these hours were for inspection and repair of aircraft being

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1/The Department of the Army gave the revised guidance to TSARCOM in April 1978.

returned from the combat theater to the United States, as newer models were sent as replacements to the new theater.

TSARCOM Maintenance Directorate personnel could provide no specific basis for assuming that helicopters, other than combat damaged ones, would be returned to the United States during the time period covered by the plan nor could they provide a basis for the quantities included in the plan. They eventually stated that these labor hours were to provide for a level of effort to cover a contingency they believed could exist.

Assumed relation between  
peacetime and mobilization  
overstates requirements

Mobilization depot maintenance requirements for all components, such as engines, transmissions, blades, and rotor hubs, are derived by applying a change factor to peacetime requirements. The change factor represents a ratio of mobilization flying hours to peacetime flying hours. This process assumes that (1) the peacetime requirements are valid, (2) the basis for mobilization flying hours has credibility, and (3) maintenance requirements will increase proportional to changes in flying hour programs.

Peacetime requirements overstated

Since mobilization requirements are based on peacetime overhaul requirements, the overstatement or understatement of peacetime requirements will result in a corresponding overstatement or understatement of mobilization requirements. In this regard, we found that the Army was overhauling some components unnecessarily. For example, Corpus Christi depot's engine overhaul program is based on a maximum operating time concept. Under this concept, an engine is returned to the depot for overhaul on the basis of hours flown without regard to the engine's condition. Our review of T63-A700 engines inducted for overhaul at Corpus Christi during the first 4 months of fiscal year 1978 indicated that about 35 percent of these engines had no defects and, therefore, did not need to be overhauled. Furthermore, the Corpus Christi depot was repairing components that were in long supply. The engine overhaul and component repair programs at Corpus Christi are discussed in greater detail in chapter 3.

The impact of overstating peacetime requirements for the T63-A700 engine by 35 percent is illustrated by the following example. Current peacetime requirement of 678 engines times a 2.1 change factor 1/ equals a mobilization requirement of 1,424 engines. If the peacetime requirement were reduced by 35 percent, the mobilization requirement would be 926 engines, or 498 less.

#### Flying hour base is uncertain

TSARCOM computes total mobilization flying hours by theater using Department of the Army guidance which defines the anticipated monthly flying hours per helicopter by series, the attrition and combat damage rates, and planned total deployment quantities by area. The Army guidance does not give the quantities of aircraft which will be moved monthly, when they will be deployed, or methods of transporting the helicopters. Therefore, TSARCOM personnel arrived at deployed monthly quantities on the basis of assumed C-5 airlift capability to transport helicopters to the theater. The transportation capability has not been coordinated by TSARCOM with the Department of the Army or the Air Force to establish its validity.

In this regard, we previously reported 2/ that strategic airlift aircraft could not meet the need. Consequently, the planned deployment of Army helicopters to the combat theater could be delayed, which could reduce the number of flying hours currently planned during the initial mobilization period, which could in turn affect the anticipated level of depot maintenance. Furthermore, a Joint Chiefs of Staff strategic mobility study, dated February 8, 1977, indicated a serious lift delivery shortfall (both sea and air) for two North Atlantic Treaty Organizations' reinforcing scenarios. In light of the reported delivery shortfall, it does not seem reasonable for TSARCOM to assume that large quantities of helicopters will be delivered to the combat theater without coordinating the requirement with the Air Force and getting the necessary priorities assigned by the Joint Chiefs of Staff.

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1/Increase of mobilization flying hours to peacetime flying hours.

2/"Determining Requirements for War Reserve Spares and Repair Parts--Importance of the Wartime Planning Process" (LCD-78-407A, June 6, 1978).

Projecting maintenance requirements on flying hours may not be realistic

The Army assumes that depot maintenance requirements during mobilization will increase in a direct relationship to the increase in helicopter flying hours. Using the number of sorties 1/ and mission types, instead of flying hours, may improve the accuracy of these requirements.

The Air Force and independent agencies, such as the Rand Corporation and the Boeing Aircraft Corporation, have extensively examined the relationships of sorties and flying hours to maintenance requirements. Generally these studies indicated that (1) the number of sorties were more reliable than flying hours in predicting maintenance requirements, (2) aircraft will surge to a higher level of activity and fly longer sorties during wartime, and (3) with longer missions, component failures per flight hours were less. Thus, maintenance requirements in turn would not increase at the same rate as flying hours.

While the above studies have evaluated sorties for fixed-wing aircraft, it is possible that a similar relationship would exist for rotary wing aircraft. If so, this approach would provide a more reliable basis for computing mobilization requirements.

Interservice support

The Army overhauls some H-1 series helicopters for the Navy during peacetime. Annual quantities overhauled during fiscal years 1975 through 1977 averaged 68. The Army mobilization plan requires that 40 Navy helicopters be overhauled. The Army arbitrarily included a level of effort in the mobilization plan without coordinating it with the Navy.

NEED TO DETERMINE RESOURCES

A determination of resources available should include both contractor and DOD depot capabilities to respond to a surge in maintenance requirements. Workload scheduling

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1/In this report, we define a sortie as one takeoff and landing.

should include an assessment of how much work could and should be handled by commercial contractors considering DOD depot limitations and contractor capability.

#### Contractor support--potential not identified

The Army has not identified how much contractor support would be available in mobilization. Therefore, the Army is uncertain as to how much work private industry can do and is unable to adequately plan for organic 1/ mobilization support.

Federal policy, as covered in Office of Management and Budget Circular A-76, is to rely on the private enterprise system to supply its needs, except when the national interest compels the Government to provide its own products and services. DOD recognizes that both organic and contractor sources play a major role in providing resources for depot maintenance. Basically DOD views organic maintenance as (1) a controlled source of competence, (2) an assurance of an initial surge capability, and (3) a base for expansion. Contractors are to provide a broader maintenance base capable of expansion in wartime.

DOD Directive 4151.1 "Use of Contractor and Government Resources for Maintenance of Material," provides guidance regarding service implementation of A-76. The Directive specifically states that each military department should plan organic depot maintenance capacity to accomplish no more than 70 percent of its gross mission-essential workload. 2/ To the maximum extent feasible, all non-mission-essential workloads are to be handled commercially.

In fiscal year 1978, contractors did 29 percent of the peacetime Army helicopter depot maintenance. Of this total, about 10 percent was for overhaul of aircraft, engines, and components and 19 percent was primarily for aircraft modification or conversions.

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1/Organic depot maintenance is performed by a military department using Government owned or controlled facilities and military or Federal civilian personnel.

2/Mission-essential is that material which is authorized and available to combat support, combat service support, and readiness training forces to accomplish their assigned missions.

The Army plans to have contractors accomplish about 17 percent of its mobilization requirements. Contractors will do all battle damage repairs on the CH-54 and CH-47 and some component repairs on these and other helicopters.

The results of the Army's mobilization planning runs counter to the requirements of the above-mentioned guidance. In essence, in terms of percent of total Army requirements, the Army is asking private industry to make less of a contribution during mobilization than peacetime. Since DOD considers private industry a base for expansion, it seems logical to assume that the Army's reliance on private contractors during mobilization will at least equal their peacetime contribution and probably increase, rather than decrease, as presently planned.

In our prior reports, we emphasized the need for DOD to improve its industrial planning process, to assess industry potential to accelerate war reserve item deliveries, and to identify long lead-time items that need to be stocked. A May 1977 report 1/ pointed out the inadequacies of DOD's planning with industrial suppliers for wartime mobilization needs. DOD officials generally concurred with our findings and promised increased management attention to improve the effectiveness of the Industrial Preparedness program. These improvements are essential if greater reliance is to be placed on the private sector to reduce the Government's investment in war reserve items.

#### Organic capability

As discussed on page 7, at the request of TSARCOM officials, Corpus Christi and New Cumberland made studies of their capacities to respond to mobilization requirements. Although we did not thoroughly evaluate these studies, we did note that each study indicated that requirements for organic facilities would exceed capacity during the initial mobilization period. We also noted that as part of these studies, the Army did not make a comprehensive evaluation of the capacity and capability of private contractors.

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1/"Restructuring Needed of Department of Defense Program for Planning With Private Industry for Mobilization Production Requirements" (B-140389, May 13, 1977).

## CURRENT ARMY ACTIONS

The Army believes that there will be a mobilization workload requirement not supportable by the present Army aviation depot facilities and skilled resources. Therefore, a study was initiated to examine the ability of the Army National Guard to help satisfy mobilization maintenance needs.

The study proposed that three Army National Guard transportation aircraft repair shops be reorganized into aviation repair activity depots--two would be deployed overseas in the event of mobilization and the third would be integrated into the production work at Corpus Christi but could deploy overseas if required. A fourth Army National Guard aircraft repair shop would remain in the United States. The Army believes the overseas depot maintenance capability would shorten the supply pipeline, reduce the retrograde to U.S. depots, and return aircraft to the user sooner.

The Army approved the study's proposed concept in October 1978 and asked that DARCOM and the National Guard Bureau work out the details to implement the concept.

## CONCLUSIONS

The current complex of DOD aircraft maintenance depots needs to be more effectively matched with requirements. To do this, we previously recommended that the Secretary of Defense establish or designate a single manager over aircraft depot maintenance. Based on Defense's response to our earlier report, we feel that DOD will not do so in the immediate future. In the interim, the Army should attempt to more effectively match its helicopter depot maintenance resources with requirements. In order to achieve this, the Army must realistically estimate its requirements and match these requirements with private industry and organic capabilities and capacities.

The Army's plan setting forth its helicopter depot maintenance requirements for mobilization does not include requirements for the first 6 months of mobilization. Officials from the Corpus Christi and New Cumberland depots have made studies of their capacities to respond to mobilization requirements, including the initial months of mobilization. TSARCOM was evaluating these studies and preparing an updated plan. Moreover, the assumptions,



data, and processes used to arrive at other requirements were not realistic as they were inconsistent with Department of the Army plans and otherwise lacked foundation, thereby, reducing their credibility as a basis for planning.

The Army has not determined private industry's capability and capacity in regard to depot helicopter maintenance. Until a thorough assessment is made, the Army can neither effectively match requirements to available resources nor realistically determine to what extent it should fund its organic facilities.

#### RECOMMENDATIONS

We recommend that the Secretary of the Army establish more realistic helicopter depot maintenance requirements for mobilization. The Secretary of the Army should:

- Evaluate peacetime requirements to insure that they are realistic before they are used as a basis for mobilization requirements.
- Coordinate the movement of helicopters from the United States to the combat theater to insure the reasonableness of planning assumptions.
- Evaluate the feasibility of using sorties, rather than flying hours, to project mobilization requirements.
- Coordinate anticipated mobilization requirements with other services where appropriate.

We also recommend that the Army make a thorough assessment of private industry's helicopter depot maintenance capability and capacity so that it has a basis for effectively matching requirements to available resources.

#### AGENCY COMMENTS

Army officials said that establishment of realistic helicopter mobilization depot maintenance requirements is a constant process. TSARCOM is revising the mobilization plan to include requirements for the initial months of mobilization. Army officials also said that they would attempt to assess private industry's helicopter depot maintenance capability and capacity so that requirements could be better matched to resources.

## CHAPTER 3

### OPPORTUNITIES EXIST TO INCREASE

#### DEPOT MAINTENANCE EFFICIENCY

Reliability-centered maintenance (RCM) is an innovative approach to aircraft maintenance. It has replaced the historical approach of using extensive scheduled maintenance in favor of performing maintenance only when it is meaningful to safety, reliability, and economy. Commercial airlines have been using it successfully for some time and have found that it greatly reduces aircraft maintenance costs and improves aircraft availability.

In fiscal year 1976, the Secretary of Defense directed the services to begin using RCM. To date, the Army has used RCM only on airframe-related programs. The Army has not introduced this approach for engines and other aircraft components.

If the Army would expand the RCM approach to helicopter engines and components, it would eliminate unnecessary engine and component parts overhauls and improve the effectiveness of its depots.

We noted that significant improvement was being made in testing engines after overhaul. At Corpus Christi during 1977, 71 percent of the engines tested failed for one reason or another. Depot effectiveness could be further improved if the Army

- reduced concurrent rework of aircraft components and made greater use of batch processing,
- eliminated the practice of repairing components that are in long supply, and
- performed only work at the depots which could not be accomplished by field units.

Depot engineers said that the high number of engine rejections occurred because engines were being tested for vibrations at speeds greater than the prescribed limits. They estimated that the rework caused by these rejections cost the depot over \$800,000 in 1977. Depot officials plan to correct these problems by limiting vibration tests to the prescribed limits and by purchasing new balancing equipment.

## THE RCM PROGRAM

Prior to 1963, the services and the commercial airlines used maximum operating time standards as a basis for determining the frequency of complete overhaul. In an attempt to cut maintenance costs, larger commercial air carriers developed a different concept of maintenance in the mid-1960s, based on findings that only certain components required periodic overhauls at predictable intervals. The carriers also concluded that the overhaul of entire engines was rarely warranted. The alternative concept was called "on condition maintenance," and was approved by the Federal Aviation Administration.

The airline industry has successfully used this maintenance concept. It has proven safe and has provided a basis for large reductions in labor and material costs. One major airline said it saved \$65 million over 5 years by using this concept.

Because of the proven advantages of such a system, the Secretary of Defense directed in the Planning and Programming and Consolidated Guidance Documents, that the military departments apply this type of maintenance concept to all equipment for 5 consecutive years (fiscal years 1976 through 1980). In DOD, and in this report, the concept used was termed RCM. We discussed DOD's use of RCM 1/ in a November 1976 report.

The Army's implementation of RCM is designed to limit depot overhauls to those helicopters with the worst structural deterioration. Evaluation teams inspect helicopters in the field, study the deterioration of airframes, and assign each helicopter a condition-profile number. When a profile number exceeds a predetermined limit, the helicopter becomes an overhaul candidate. Normally, only a helicopter which exceeds the condition profile number is sent to the depot for overhaul.

Since the decision to overhaul helicopters is based on the airframe condition and not the condition of the

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1/"Management Action Needed in the Department of Defense to Realize Benefits from a New-System of Aircraft Maintenance" (LCD-76-443, Nov. 10, 1976).

engine and other major components, many helicopters arrive at depots with engines and components needing minor repair 1/ and in some cases, no repair. Nevertheless, depots repair or overhaul engines and components simply because they are on airframes that are in need of overhaul.

#### ENGINE OVERHAULS COULD BE REDUCED

An excessive number of engines are being overhauled because the Army is (1) overhauling engines with no defects and (2) overhauling engines that could be repaired at less cost. We estimated that these practices could cost the Army about \$9.6 million in fiscal year 1978. Eliminating these practices and using the RCM concept could reduce future years expenditures and improve depot maintenance effectiveness.

Currently, the Army's engine overhaul program operates under the time-between-overhaul concept. Under this concept, the Army assigns each engine type a maximum number of flying hours (the maximum allowable operating time) beyond which the engine is considered to be unsafe to operate. When an engine reaches its maximum allowable operating time, a unit removes it from the helicopter and returns it to the depot for overhaul. The depot also receives engines which fail before they reach the maximum allowable operating times and which supposedly cannot be repaired in the field.

Army instructions also require that all engines returned to the depot must be overhauled if elapsed time since the last overhaul exceeds 50 percent of the maximum allowable operating time. The TSARCOM Time Component Change Board last reviewed engine maximum operating times about 1972, shortly before the board was abolished.

To determine the impact the Army's overhaul criteria had on depot effectiveness, we selected 548 engines overhauled at Corpus Christi. We found that 110 had no defects listed, but they were returned to the depot because they had

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1/Minor repair includes only the inspections and repairs necessary to correct deficiencies and return the engine and component to serviceable status. Minor repairs are less costly than overhauls and many times are one-half or less the overhaul costs.

reached the maximum operating times. The cost to overhaul these engines was about \$2 million, as shown by the chart below.

Engine type	Number of no-defect engines	Engine overhaul cost	Total overhaul cost
T53-L13B	30	\$21,117	\$ 633,510
T63-A700	74	14,735	1,090,390
T55-L11D	5	44,778	223,890
T55-L7C	<u>1</u>	29,016	<u>29,016</u>
Total	<u>110</u>		<u>\$1,976,806</u>

If the rate of no-defect engines we reviewed is representative of the number of engines unnecessarily overhauled at Corpus Christi during fiscal year 1978, we estimate that the depot spent \$5.2 million to overhaul engines with no defects, as shown below.

Engine type	Projected number of engines overhauled without defects	Overhaul cost	Cost to overhaul no-defect engines
T53-L13B	73	\$21,117	\$1,541,541
T63-A700	206	14,735	3,035,410
T55-L11D	13	44,778	582,114
T55-L7C	3	29,016	<u>87,048</u>
Total			<u>\$5,246,113</u>

We also found that 178 of the 548 engines were overhauled simply because they had been flown more than 50 percent of their maximum operating times. The cost to overhaul these engines was \$3.7 million. As the chart on the next page shows, these engines could have been repaired for \$2 million.

Engine type	Quantity overhauled	Total overhaul cost	Projected repair cost	Difference between over-haul and repair cost
T53-L13B	120	\$2,534,040	\$1,350,240	\$1,183,800
T63-A700	44	648,340	194,304	454,036
T55-L11D	10	447,780	382,260	65,520
T55-L7C	<u>4</u>	<u>116,064</u>	<u>59,932</u>	<u>56,132</u>
Total	<u>178</u>	<u>\$3,746,224</u>	<u>\$1,986,736</u>	<u>\$1,759,488</u>

Two examples of T53-L13B engines which were overhauled and could have been repaired follow.

--One engine (#LE-16752) with a maximum operating time of 1,800 hours had been flown 1,308 hours since its last overhaul. Since the engine had been flown more than 50 percent of its maximum allowable operating time, it was overhauled. Depot records indicate that the engine had some corrosion. We were told that it is not necessary to do a complete overhaul to correct corrosion problems.

--Another engine (#LE-17330) with the same maximum operating time had been flown 1,171 hours since its last overhaul. Depot records show "leaking" as the reason for overhaul, a condition not normally considered a major problem. Normally leaking problems can be corrected with minor repairs.

If the rate of engines overhauled because they exceeded 50 percent of their maximum operating times is representative of the number of engines unnecessarily overhauled at Corpus Christi during fiscal year 1978, we estimate that the depot spent \$4.4 million to overhaul engines rather than to repair them, as the chart on the following page shows.

Engine type	Projected number of engines overhauled with 1/2 maximum operating time	Overhaul cost	Repair cost	Difference
T53-L13B	291	\$6,145,047	\$3,274,332	\$2,870,715
T63-A700	122	1,797,670	538,752	1,258,918
T55-L11D	25	1,119,450	955,650	163,800
T55-L7C	11	<u>319,176</u>	<u>164,813</u>	<u>154,363</u>
Total		<u>\$9,381,343</u>	<u>\$4,933,547</u>	<u>\$4,447,796</u>

In February 1977, the Deputy Chief of Staff for Logistics, Department of the Army, recognized that RCM had not been implemented in the Army and requested DARCOM to make a detailed review of all depot maintenance work requirements, using RCM techniques. In order to conserve funds, DARCOM was to identify and eliminate maintenance requirements which were not absolutely essential. Further, a June 1978 Defense Audit Service report stated that the Army had not effectively implemented the RCM concept for engines.

The Corpus Christi Army depot commander acknowledged that the maximum operating time was no longer a significant factor in determining engine suitability for overhaul or repair and asked TSARCOM to change the criteria.

Furthermore, according to Corpus Christi Army depot officials, the current overhaul practices for engines and other components are being reviewed. In cooperation with TSARCOM, the officials are testing 50 T53-L13B and 30 T63-A700 engines to determine whether it is economically feasible to repair, rather than to overhaul, these engines. In addition, TSARCOM and the Corpus Christi Army depot are jointly preparing to study the implementation of RCM at the depot.

#### CHANGES NEEDED IN CONCURRENT REPAIR PRACTICES

The Corpus Christi Army depot's efficiency and effectiveness could be improved by (1) reducing concurrent rework of aircraft components and obtaining these components

directly from supply, (2) eliminating the practice of repairing items that are in long supply, and (3) processing of batches of similar components.

Concurrent repair occurs when components are removed from a helicopter and are repaired simultaneously while the helicopter is being overhauled. The components are routed to component shops, tested, repaired, and returned to the helicopter for reassembly. This practice is a time-consuming and expensive method since a considerable number of parts are involved--about 450 to 500 components per helicopter.

In a previous report 1/ we noted that concurrent repair was occurring during depot maintenance at Naval Air Rework Facilities. Navy officials stated that concurrent rework (1) increased aircraft turnaround time for some models, (2) created inefficiencies and reduced productivity, (3) increased overhead costs because separate routing cards were maintained for similar components, and (4) resulted in understating component usage.

As at the Navy facilities, the concurrent repair practices at Corpus Christi are inefficient. For example, extensive time is required to remove, route, inspect, and repair components. Also, components are not being returned for reassembly on the helicopter in time. Officials said that sometimes 50 to 60 components are missing from the reassembly kits when helicopters reach the reassembly point. This problem causes personnel to remove components from other helicopters or from kits assigned to other helicopters in order to meet production schedules and to reduce idle time.

Depot officials advised us that concurrent repair is occurring extensively at Corpus Christi, in part, because if serviceable components are obtained from the supply system, the stock list price of the components must be charged to the helicopter program. But, when the item is repaired concurrently, only the cost of the repairs--which is generally significantly less than the stock list price--is charged to the end item.

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1/"Navy Aircraft Overhaul Depots Could Be More Productive" (LCD-75-432, Dec. 23, 1975).



DOD Depot Maintenance and Maintenance Support Cost Accounting and Production Reporting Handbook 7220.29-H states that

"When investment type assemblies, subassemblies, and components are designated as 'exchangeables' an 'average cost to repair' will be determined and catalogued. The average cost to repair \* \* \* will be obtained from past experiences in actually repairing the item \* \* \*. The average cost to repair will be charged to the job order when the exchange takes place and is not dependent upon decisions to repair the items removed."

The Handbook also states that

"When component parts of an end-item are routed for maintenance at the same time the end-item is being processed, 'concurrent' maintenance is performed. This is an alternative to 'exchange' and is essentially a different maintenance strategy. Usually the strategy selected is the one which expedites completion of the work. It is clear that concurrent maintenance and exchange need not result in the same costs, and no attempts should be made to force costs for work performed in the two separate modes into agreement. Rather, concurrent maintenance should be costed to the end-item job order (not commingled with component repair job orders), so that the total job order costs may be determined."

DOD officials interpret the above statements to allow the depot commander the option to use the exchange or concurrent method depending on the particular circumstances. For example, if a particular part was not available in stock, the exchange method could not be used and the concurrent method would have to be used.



(Courtesy of the Department of the Army)

#### AIRFRAMES BEING REPAIRED AT CORPUS CHRISTI ARMY DEPOT

Concurrent repair inefficiencies are compounded when repairs are made to components which are in long supply. In these cases, repairs unnecessarily involve costly direct labor hours that could be used to do work needed. We found, however, that approximately 2,000 items which are in long supply are being repaired concurrently. In addition, 44 supply programs at Corpus Christi involve the repair of components in long supply.

The repair of AH-1G tailbooms is an illustration of work being performed on long-supply items. At Corpus Christi, AH-1G helicopter tailbooms were being overhauled under a fiscal year 1977 supply program and reworked concurrently with the AH-1G overhaul program. On May 1, 1978, Army supply had 87 tailbooms in stock, 34 more than required. When TSARCOM and Corpus Christi Army depot officials became aware of this status, they reduced a fiscal year 1978 program from 35 tailbooms to 4. These four were already being overhauled. The program reduction saved \$230,000.

Our report 1/ to the Secretary of the Army discusses in more detail the Army's depot repair programs that involve items in long supply.

Depot officials said that during the Vietnam era very little concurrent repair occurred. At that time, emphasis was placed on helicopter turnaround time, and therefore, when components were removed from helicopters during overhaul, similar parts were obtained from the supply system.

#### Batch processing

As discussed above, an alternative to concurrent repair is exchanging the item that needs repair for an item from supply. When this method is used, similar items can be scheduled for repair overhaul in economical lot sizes. This is referred to as batch processing.

During our review of Navy aircraft overhaul, we found that the batching process offered several advantages over concurrent repair. The program's basic concept is that, through analysis of the total component repair program, those items which are repaired repetitively and consume the most resources can be processed to (1) reduce scheduling interruptions, (2) promote greater worker efficiency, (3) promote better equipment utilization, (4) reduce repair turnaround time, and (5) reduce the repair cost of components while increasing production quantities.

In our prior report we recommended that the Navy discontinue routine concurrent rework of components and limit this to only essential testing and/or minor repair. We also recommended that the Navy concentrate on opportunities to batch process component repair. The Navy agreed with our recommendations and promised to take steps to discontinue concurrent rework except for those items in short supply.

#### Other repair problems

Army regulations limit the cost of repair to 65 percent of acquisition price. To assure that repair costs do not exceed repair limits, depot personnel usually annotate

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1/"The Army Should Use Available Serviceable Parts to Avoid Repairs" (LCD-79-205, Jan. 31, 1979).

the acquisition prices and repair limits on the "shop travelers" 1/ which accompany the components. This practice does not guarantee, however, that the repair limit will not be exceeded. For example, one work center was repairing linear actuators from UH-1H helicopters by replacing a motor costing \$223, although the actuator's acquisition price of \$160 and the repair limit of \$96 were printed on the shop traveler. After we brought the matter to shop personnel's attention, they stopped replacing the motor.

In another case, the acquisition cost and repair limit for a retaining plate were not annotated on the shop traveler, therefore, the repair cost could easily have exceeded the repair limit. This item's acquisition price is \$49.19 which is about the cost of 2 hours labor at the current depot labor rate. However, the shop traveler indicated that as many as 15 work centers could work on the item. If the item were sent to all work centers, the time to route and process this item alone would require more than 2 hours.

Since labor hours for concurrent repair are reported to the end item rather than the component, management cannot review the cost of this repair. Therefore, shop supervisors become responsible for assuring that the repair limits are not exceeded on components.

MORE HELICOPTER MAINTENANCE COULD  
BE DONE AT BELOW DEPOT FACILITIES

The Army is currently performing some maintenance tasks at its helicopter depots which could be done at below depot facilities. One factor contributing to this is the Army's induction and repair cycle float policies.

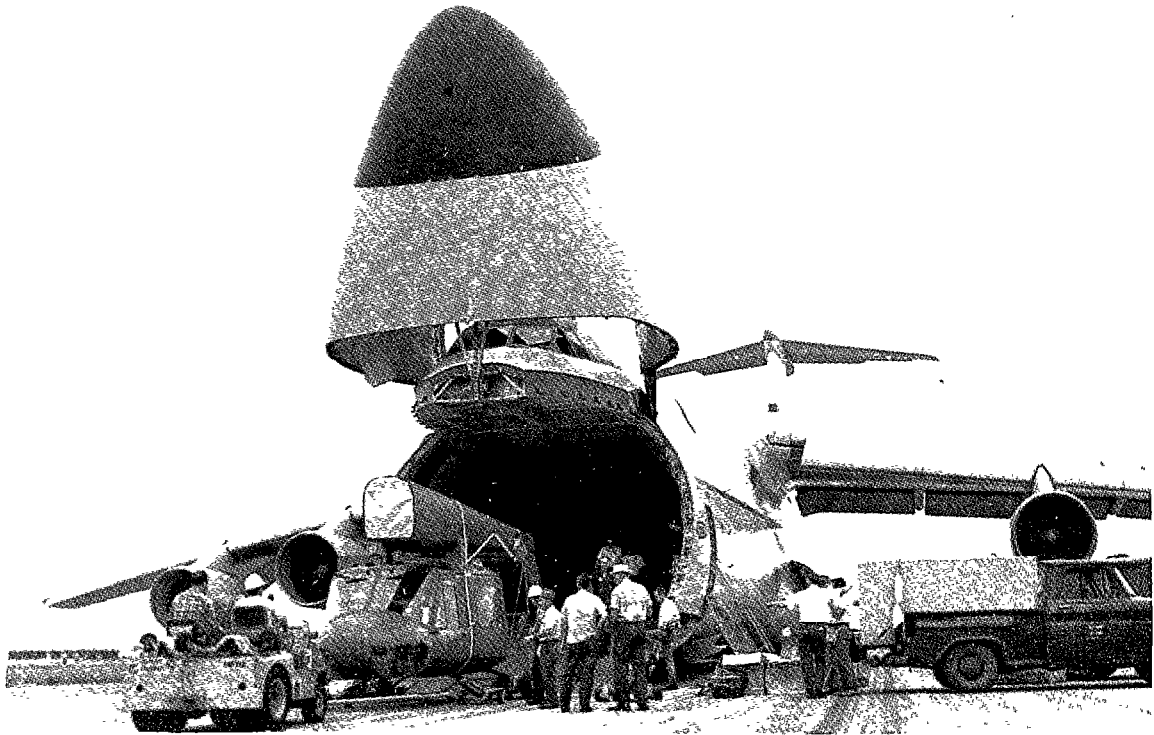
Army repair cycle float policy

Before Army units release a helicopter for depot overhaul, they generally receive a replacement from a pool of helicopters which has been established for this purpose. After the depot overhauls a helicopter, the depot assigns the helicopter to the pool. Under this practice, receiving units desire "defect free" or like new helicopters. As a result, depots perform maintenance tasks which could be done

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1/A document that normally remains with the component throughout the repair or overhaul process.

at lower maintenance levels. For example, the Army requires that a phased inspection be performed and all discrepancies be corrected during overhaul. The work required for phased inspections could be accomplished by field units.



(Courtesy of the Department of the Army)

#### HELICOPTERS BEING LOADED ON C-5A FOR SHIPMENT TO UNIT

In contrast, overhauled Navy helicopters are returned to the same organization from which they were received. In addition, the Navy does not allow depots to perform phased inspections and correct discrepancies that can be performed by field units. This practice results in depots doing considerably less work. For example, during overhaul of the Navy helicopter, about 75 components are removed and routed to the shops for repair, whereas when an Army UH-1 is overhauled, about 450 to 500 components are routed to shops for repair. The differences in the two practices contribute to the significant cost difference to overhaul helicopters at Corpus Christi. For example, Navy AH-1Gs are overhauled for \$76,000, while Army AH-1Gs cost \$119,000.

Other opportunities to  
reduce depot workload

We selected 20 UH-1D/H helicopters, inspected by the Army in fiscal year 1977, which exceeded the overhaul profile index threshold of 150 points. Those selected had indexes ranging from 153 to 175. Of the 20 selected, 12 received 102 points each for a single defect-splitting of the center service engine deck. As of March 1978, 9 of the 12 had been inducted for depot overhaul based on the profile index received in fiscal year 1977.

Air Force officials stated that a damaged center service engine deck on their UH-1 series helicopter would be repaired or replaced in the field. Air Force technical manuals for the UH-1 helicopters provide detailed procedures for field repair or replacement of the center service engine deck at the unit level with depot team assistance.

The Army's cost to overhaul a UH-1D/H helicopter at the depot in fiscal year 1978 was about \$135,500. This is compared to the \$6,500 the Air Force spent to repair the center service engine deck in the field.

If the Army had repaired the UH-1D/H center service engine decks at field installations, the profile index would have been well below the 150 points required for overhaul. Thus, these helicopters would not have been scheduled for depot overhaul, thereby, allowing depot personnel to be available for more urgent work. Further, the Army could have deferred the expenditure of about \$129,000 per helicopter or a total of \$1,161,000 for the nine helicopters overhauled by repairing them in the field.

The Army is studying the feasibility of reducing the depot maintenance workload by having more tasks performed at field installations. For example, the Army has determined that of 382 OH-58 helicopters exceeding the profile index overhaul threshold from fiscal years 1976 to 1978, all but 2 could have been reduced below the threshold if 3 honeycomb panels had been repaired or replaced in the field. Correction of these defects in the field would have alleviated the need of returning the helicopters to the depot for a complete overhaul.

## CONCLUSION

The Army can improve helicopter depot maintenance efficiency and reduce maintenance costs if the RCM maintenance concept is accelerated and applied to helicopter engines and components. Other depot efficiencies can be gained by limiting engine testing to prescribed limits, discontinuing routine concurrent component repair and making greater use of the exchange method, concentrating on opportunities to batch process component repair, eliminating the practice of repairing components that are in long supply, and eliminating tasks currently being done at the depot which can be accomplished at field units. At the time of our review, the Army was studying some of these opportunities.

## RECOMMENDATIONS

We recommend that the Secretary of the Army

- implement the RCM concept for engine and component overhaul programs,
- eliminate the practice of repairing components that are in long supply,
- discontinue routine concurrent component repair and make greater use of the exchange method,
- concentrate on opportunities to batch process component repair, and
- study the Navy's practice of returning overhauled helicopters to the units from which they came as part of its efforts to reduce the amount of field level work being done at depots.

## AGENCY COMMENTS

Army officials agreed that engines are sent to the depot when the maximum allowable operating times are reached. However, the Army is currently evaluating the practice and expects to change the overhaul criteria.

Because of the Army's desire to identify the actual costs to repair or overhaul a helicopter and its components, the depot concurrently repairs components rather than

exchanging an inoperable component for a similar component, from stock. Army officials added that they are required to identify the cost to repair components to the helicopter from which it was removed. DOD officials disagreed with the Army's position.

Army officials said that the helicopters being sent to the depot for overhaul are the ones in the worst condition. They do not want to issue these helicopters to units with any defects--even defects that could be accomplished at field installations. Therefore, they did not believe the Navy practice of returning helicopters to the units from which they were received was a viable alternative. They agreed that the depot should not be "goldplating" helicopters. In this regard, they said that they would determine if Corpus Christi was performing organizational maintenance that should not be done at the depot.



CHAPTER 4  
IMPROVEMENTS NEEDED IN  
DEPOT MANAGEMENT SYSTEM

Effective and efficient depot management requires timely and accurate maintenance information for measuring productivity, developing performance and cost standards, determining where the greatest emphasis for management improvement needs to be directed, and evaluating the effectiveness of resource use. The Corpus Christi Army depot's information system has some deficiencies that result in inaccurate information and, thus, limits management's effectiveness. Improvements are needed in production reporting, work measurement, and cost accounting.

LABOR AND PRODUCTION REPORTING

The labor and production reporting system was developed to provide managers with information and tools for the analysis and evaluation of organizational performance and workload planning and control. However, accuracy tests of the labor and production reporting system revealed that the system contained erroneous maintenance information. As a result, the reliability of system information as a management tool is questionable.

Inaccurate labor reporting reduces the usefulness of the work measurement system as a management tool, prevents the development of reliable historical data, and produces inaccurate production planning and control management reports. The lack of valid historical data has and may ultimately contribute to continuous cost over or underruns. Invalid reports make it difficult to identify, analyze, correct, or prevent these cost variances.

During the first half of fiscal year 1978, the Army reported, through the labor and production reporting system, \$35 million as direct labor and applied overhead. This accounted for 59 percent of the total reported maintenance costs. Consequently, system discipline should be maintained to assure accurate reporting.

Work center reporting of labor hours and production counts generally originates with individual operators who prepare labor and production tickets. Work center supervisors or designated personnel collect and summarize the data on labor and production cards. The summarized data is then submitted to cost accounting.

To test the accuracy of the information contained in the labor and production reporting system, we compared labor and production tickets to labor and production cards. Also, we reviewed the procedures used in selected work centers for compliance with regulations to determine if they assure the collection and reporting of reliable labor and production data. This test revealed numerous examples of inaccurate reporting and some cases where reporting procedures were not being followed.

Specifically, the following examples were identified during the review.

- Labor and production tickets for one work center indicated that work had been performed on 17 separate job orders. However, the related labor and production cards, which were retained in cost accounting, indicated that only two job orders had been actually charged with labor hours and production counts. Also, the reported production counts were derived by dividing the actual hours worked by the standard hours required to produce one unit of production.
- In five work centers, operators were not recording labor and production counts on labor and production tickets. Instead, the work center supervisors maintained their own logs to prepare labor and production cards. This practice is contrary to the Corpus Christi procedure which requires that each production employee provide his supervisor with a daily report on labor and production tickets, reflecting actual hours expended by job order/work measurement code. Also, in two of these centers, the supervisors' logs did not agree with labor and production cards.
- In another work center, standard hours and not actual labor hours were recorded on labor and production cards. In this case, job orders were obviously not charged for actual labor.

Several work center supervisors gave the following reasons for not accurately reporting labor and production information.

- Labor and production reporting was manipulated to maintain acceptable performance efficiency ratios.

- Job order/program control numbers were often closed before work was completed on all components. This created a need to record the costs to an overhead account or an open job order.
- Work was sometimes started before job order program control numbers were opened, thus creating a need to record costs to another open job order or to establish an overhead job order.
- Labor was not prorated when several job orders were being worked in batches.
- Production control personnel unofficially closed job order/program control numbers early. The result, if not the purpose, would be to reduce potential cost overruns.

Depot officials were aware that the reported labor and production data were inaccurate. A branch chief stated in a memorandum to his supervisors that "numerous reviews have resulted in the conclusion that historical data is questionable, if not erroneous."

Depot officials believe the examples cited are not a valid test of system accuracy. They state that an employee obtains the job order/program control number for a labor and production ticket from a routing document, referred to as a "shop traveler," and therefore, the data on the labor and production ticket is not always correct. If these tickets are incorrect, as stated by depot officials, this only adds to the inaccuracy of the reporting.

Depot officials agree, however, that it is essential that system discipline be maintained to assure accurate labor reporting. They indicate that an individual from the Directorate for Maintenance will be designated to randomly check the validity of the reporting system.

#### Rework

In order for management to know how effective maintenance operations are in terms of cost and quality, accurate rework information must be captured. We found that some rework was not properly identified and reported at Corpus Christi. As a result, management cannot determine the extent of rework or if corrective action is needed.

Corpus Christi is not identifying and reporting rework properly because

- the current reporting system does not capture all rework costs,
- interpretations of rework differ,
- the labor standards sometimes allow for rework, and
- system discipline for identifying and reporting rework is lacking.

#### Reporting system

The depot uses the Management Information System-Quality (MIS-Q) for reporting rework to its higher level command--DESCOM; however, because of system deficiencies all rework is not being reported. The data for the system are taken from Quality Control Product Deficiency Reports, which are generated by quality inspectors upon actual inspections and not by supervisors or operators upon recognition of defects.

During the first 6 months of fiscal year 1978, the Performance Report for one work center showed 244.5 hours of rework while the MIS-Q report only showed 104.7 hours. Almost all of the 244.5 hours resulted from labor hours expended to rework production units which contained defects and which were rejected by supervisors or operating personnel. Maintenance personnel entered this data into the labor and production reporting system as rework, in accordance with depot regulations. However, it was not captured by the MIS-Q report and reported to DESCOM. Had the deficiency been identified by quality rather than maintenance personnel, the tasks performed would have been identified as rework and reported under the MIS-Q system.

In addition, work measurement has established specific operation codes to cover rework in some work centers. This rework is reported as direct labor because it involves defects which are inherent in the product and beyond the operator's control. For example, depot personnel stated an engine with 2,500 different parts cannot possibly be torn down and reassembled without some rework. However, this rework is not being captured and reported to DESCOM under the MIS-Q system.

### Differing interpretations of rework

The Corpus Christi Army depot is reporting rework to DESCOM in accordance with DESCOM Regulation 750.1 which limits the reporting and measurement of rework to the maintenance resources that are expended on rework as a result of quality inspections. The regulation differs from the DOD Depot Maintenance and Maintenance Support Cost Accounting and Production Reporting Handbook, which identified defective work costs as

- cost of additional material and labor necessary to remedy or "make good" imperfections in work arising from normal productive processes,
- the cost of redoing guaranteed work, and
- the cost of reinspections of defective work.

This handbook also allows defective work to be charged to direct cost when a certain amount of defects are inherent and beyond the operator's control.

### Rework time included in labor standard

According to work measurement personnel, the labor standards do not allow time for rework. Generally, this is true; however, some rework is done as normal repair because the labor standards are obsolete or overstated. For example, the standard time to repair a T-53-L13B engine compressor rotor blade is 6 hours. Maintenance personnel said that 6 hours was sufficient time to repair the rotor blade and perform the required rework. Labor hour standards are discussed below under work measurement.

### Lack of system discipline

When an item is returned to a work center for rework, the shop traveler, which normally accompanies the item, should either have a supplement attached to the original shop traveler or a rework tag attached to the item. In some cases, a new shop traveler is prepared which does not indicate that the item is being returned for rework. When this happens, the receiving shop may be unaware that the item is being returned for rework; therefore, it may be incorrectly reported as direct production.

The reporting of rework is also influenced by the status of the job order/program control number assigned to the item. If a job order/program control number has been closed, the labor hour charges will be reported to another program. Incorrect reporting also occurs when the number of items produced is already equal to the induction quantity. In the above cases, if the labor hours were charged to a closed job order/program control number, the computer would reject it, thus causing more paperwork to transfer the labor hours and material costs.

Also, in some cases, quality inspectors failed to prepare the required deficiency reports on items returned for rework. Furthermore, some work center supervisors assumed that they were limited as to how many rework labor hours they could report.

Corpus Christi Army depot officials agreed that errors have occurred and plan to install checks to assure proper reporting.

#### WORK MEASUREMENT

Because of rising personnel costs and reduced staff levels, DOD has come under increasing pressure to improve productivity.

An effective work measurement program is one recognized way of improving personnel productivity. We found, however, that the work measurement program at Corpus Christi could be a more effective tool for management to control productivity if

- methods improvements studies had been performed before standards were established, as required;
- standards had been regularly updated; and
- a significant number of standards had not been altered.

#### Description and implementation

Work measurement is the term generally used to describe the body of knowledge and techniques used to design job activities so they require a minimum amount of resources and, when appropriate, to establish labor standards useful to management in forecasting staff requirements, formulating

budget estimates, measuring and controlling efficiency and performance, and comparing actual accomplishments with expected accomplishments.

In implementing a work measurement system, many factors must be considered, such as the type of activities or personnel to be covered, the type of desired labor standards and their accurate development, the production-reporting and cost-accounting systems, the organizational placement and control of the work measurement staff, and the staffing assigned. Top management, after deciding on these elements, should monitor their implementation and use to determine whether the work measurement system is cohesive, effective, and efficient.

For years, both private industry and the Government have recognized the advantages of using a good work measurement system over historical averages to control job growth and to indicate what a job should take.

#### DOD efforts

In 1965, DOD established the Defense Integrated Management Engineering System (DIMES) to improve its use of manpower resources at its industrial-type activities. In 1970 DIMES was extended to nonindustrial activities and it became the principal work measurement system for all DOD activities. The DIMES objectives are to

--improve labor productivity by applying management-engineering principles and techniques and

--provide a common base of work measurement and productivity data which can be used in developing budget estimates and staffing requirements in work planning and control, in developing productivity performance indexes relating outputs to inputs, and in fulfilling other management purposes.

In a 1976 report 1/ on DOD's efforts to use work measurement, we stated that the full potential of Defense's work measurement efforts was not being realized. We found this to be true also for the Corpus Christi Army depot as discussed in the following sections.

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1/"Improvements Needed in Defense's Efforts to Use Work Measurement" (LCD -76-401, Aug. 31, 1976).

### Lack of methods improvements studies

According to Army regulations, methods studies should be made before engineered standards are established. However, Corpus Christi is not following these regulations.

A methods improvements study is a technique that subjects each work operation to close analysis. The analysis is intended to eliminate unnecessary elements or operations and to determine the quickest and best method of performing the operations. A methods improvements study provides greater efficiency and economy of resources.

Significant savings can result from increased methods improvements efforts. The Air Force's Sacramento depot, for example, through methods improvements studies, reported documented savings of \$5.6 and \$7.1 million in fiscal years 1975 and 1976, respectively. During fiscal year 1977, the Corpus Christi Army depot reported a \$585,000 savings attributable to methods improvements studies. However, documentation to substantiate the reported dollar savings was not available.

Corpus Christi currently has 13 technicians to perform work measurement functions, as compared to 30 people in 1972. Depot officials believe this reduction has affected the staff's ability to perform methods improvements studies and update standards every 2 years as required.

### Standards altered to implement the single standard concept

In 1975, the Army Materiel Command (now DARCOM) established the single standard concept. The concept was intended to meet all depot supply, maintenance, and base operations management needs by using the DIMES as the singular work measurement/standards system. The concept was intended to eliminate the use of multiple standards for depot bidding, workloading, scheduling, manning, budgeting, and performance evaluating.

To implement the single standard concept, Corpus Christi officials believed that the DIMES standards would have to be adjusted because the standards were lower than the figures historically used to bid on depot work. Depot officials believed that if these standards were used as the single standard without adjustments they would be overprogramed and incur program cost overruns because the DIMES standards did not allow for inefficiencies and unskilled labor force.



Ultimately, the depot altered the DIMES standards by adjusting quantity factors (number of items to be worked) and statistical expectancy factors (frequency or occurrence rate at which items are worked) to increase DIMES extended hours to more closely correlate to the planning bid figures. The DIMES extended hours are derived by multiplying the standard time by the quantity factor and then multiplying the product by the statistical expectancy factor.

Although we did not determine the exact extent of the alterations, we noted that 461 standards were altered in 9 work centers. We further found that 67 different standards relating to the UH-1 helicopter were altered--some were increased and some were decreased--which resulted in a net increase of about 200 standard hours to the overhaul of the UH-1 helicopter. Some of these 67 changes are shown below.

<u>Operation code</u>	<u>Standard hours</u>	<u>Quantity factor</u>	<u>Statistical expectancy factor</u>	<u>Extended hours</u>	<u>Standard hours</u>	<u>Quantity factor</u>	<u>Statistical expectancy factor</u>	<u>Extended hours</u>	<u>Difference</u>
BCBR	425.0	1	.06	25.5	425.0	1	0.72	306.0	+289.5
HFAF	3.5	1	.69	2.4	3.5	1	1.00	3.5	+1.1
CBA2	9.0	1	.52	4.7	9.0	1	1.00	9.0	+4.3
HBTP	0.3	64	.08	1.5	0.3	64	1.00	19.2	+17.7
BCBH	275.0	1	.05	13.8	275.0	1	.01	2.8	-11.0

Corpus Christi expected to overhaul 275 UH-1H helicopters in 1978. Thus, Corpus Christi increased the standard hours per helicopter by about 200 hours which resulted in a net program increase of about 55,000 hours.

The approach used by the depot to establish a single standard, in our opinion, obscures depot maintenance capability. Personnel responsible for workloading and scheduling at the depot recognize the inaccuracy of the quantity and statistical expectancy factors; therefore, they generally do not rely on the DIMES standards for workloading and scheduling purposes. Thus, the usefulness of the DIMES standards as a management tool has been greatly reduced.

#### COST TRANSFERS

Cost transfers, intended to correct only errors in original entries, are sometimes used to revise incurred program costs so that they will be more in line with planned program costs. In addition to distorting actual operating costs, such transfers may obscure processing problems which should be surfaced and dealt with by management.

Army regulations define a cost transfer as the transferring of recorded costs from one job order to another because of a supportable error in original entries of labor or material costs. All cost transfers over \$200 are to be justified and documented by the maintenance manager and approved by the depot comptroller.

Some cost transfers were being made by work center personnel. Through informal communication, production control personnel would advise work center personnel to stop charging costs to a particular job order/program control number when that job was nearing its planned cost or was in an overrun condition.

For example, informal notices transmitted to the supervisor of the engine repair work center informing him not to charge labor hours to seven programs appeared as follows:

As of February 8, 1978

Program control number	Job code	Production		Unit funding	
		Auth.	Actual	Auth.	Actual
PO2JRV	X05JRV	2	1	\$ 26,362	a/\$ 32,325
PO6JLL	X86JLL	17	16	124,270	a/127,316
PO6JLL	X87JLL	21	20	139,377	a/155,438
PO6JLL	X90JLL	16	15	116,960	a/155,838
P18JLL	X89JLL	2	1	39,322	a/42,070
PO5JLL	X82JLL	42	41	687,246	677,628
PO5JLL	X93JLL	36	35	589,068	541,309

a/Actual funding exceeded authorized funding.

In another example, the reason for the cost transfer indicated that 40 hours were transferred from one program to another because the item worked on one job was assembled on a like end item of another job. However, further investigation revealed that the two jobs involved were not alike and included incompatible parts.

In addition, depot personnel responsible for preparing cost transfers agreed that, while not documented in cost transfer records, cost transfers have been made primarily to

- allocate costs that were incurred and accumulated prior to establishing a program,
- adjust programs to improve cost overrun and underrun conditions, and
- redirect costs charged to closed programs.

#### CONCLUSIONS

The Corpus Christi Army depot's information system has some deficiencies that result in inaccurate information and, thus, limits management's ability to effectively and efficiently manage its resources. We found that

- labor and production information was not being properly recorded and reported,

--the work measurement program was not meeting its objectives and thereby failed to provide optimal benefits, and

--program costs were sometimes misstated due to cost transfers.

#### RECOMMENDATIONS

To overcome existing inadequacies and errors in the Corpus Christi Army depot's management information system especially in the areas of labor and production reporting, work measurement, and cost transfers, we recommend that the Secretary of the Army require system discipline and integrity.

#### AGENCY COMMENTS

Army officials believed that the labor and production reporting problems cited in the report were taken from processing shops, and, therefore not representative of the accuracy of labor and production reporting at the depot. The depot commander said it is difficult for workers in the processing shops to maintain accurate data because of the working environment. Some of the examples cited in the report occurred in non-processing shops.

Army officials believe that the changes made to the DIMES standards have not affected their operations because the DIMES standards are not being used for workloading and scheduling purposes. They said that they have not been using the DIMES standards because they believe that the standards are not realistic since they do not account for inefficiencies and unskilled labor force. In this regard, we were told that DESCOM was developing a management factor to be used in computing standards which would account for these inefficiencies.

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