Logistics Management Institute

Intermediate-Level Repair Cycle Management: Supply and Maintenance Process Improvements

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LOGISTICS MANAGEMENT INSTITUTE

Intermediate-Level Repair Cycle Management: Supply and Maintenance Process Improvements

Executive Summary

Supply organizations that directly support personnel who maintain operational weapon systems rely on Intermediate Level (I-Level) maintenance as the major source of resupply for both line replaceable unit and shop replaceable unit (LRU and SRU) reparable assemblies. The time that it takes to repair these items once they are removed from the weapon system (or next higher assembly) is called the I-Level repair cycle time (RCT).

The length of the I-Level RCT has the greatest influence on the inventory investment at the retail level. The longer the RCT, the more serviceable assets the supply organization must stock in retail inventory so that, when an unserviceable is removed from a weapon system, a serviceable can be immediately issued. This procedure reduces weapon system downtime.

We estimate that the retail inventory investment to support the I-Level RCT pipeline exceeds $1.2 billion. Based upon our observations, we believe that I-Level RCT is longer than it should be. DoD policy does not allow including awaiting parts (AWP) time when measuring RCT because the probability of a similar delay occurring each time is low. When AWP is included, inventory requirements increase. Only the Air Force currently excludes AWP time when measuring I-Level RCT. Also, any waiting time that occurs during the RCT needlessly increases the time and increases inventory requirements. We observed many instances of unnecessary delay.

The Military Services can improve I-Level RCTs through a series of policy and procedural changes. We recommend that the logistics response time process action team adopt an intermediate repair process improvement program to do the following:

- Compute retail reparable item requirements based upon historical average RCTs that exclude AWP time and other delays of a one-time nature.
- Establish I-Level RCT performance standards and measure actual times against those standards.
- Minimize the length of time that reparable items wait to be moved from place to place. A significant contributor to lengthy awaiting maintenance times is the size of induction quantities. Quantities significantly in excess of

capacity should not be inducted because they needlessly lengthen repair cycle times.

- Ensure that parts removed and replaced at I-Level are stocked at the appropriate level in the combined wholesale-retail supply system. Long procurement lead-times for nonstocked or out of stock parts can shut down repair production lines.

- Explore alternative financial models and incentives for I-Level operations. The present model encourages local repair even when the wholesale system has excess serviceable assets and causes unserviceable assets to be held at the I-Level for long periods of time which could adversely impact readiness.

Each day of I-Level RCT results in a DoD inventory investment of more than $180 million. A one day reduction in I-Level RCT would reduce retail requirements by this amount.

The implementation of these recommendations will require the coordinated action of both supply and maintenance managers.

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CHAPTER 1

Introduction

BACKGROUND

Each of the Military Services owns and manages retail reparable item inventories to support its operating forces. Many of these retail inventories depend on Intermediate Level (I-Level) maintenance as their principal source for serviceable items. Ideally, each time an operational unit is issued a serviceable item from one of these inventories, the unit returns the unserviceable item to the I-Level maintenance activity for repair. Once repaired, the item is returned to the supply shelf to meet a future demand. When the unit does not return an unserviceable item, or I-Level cannot or does not have the authority to repair or dispose of the item, the retail level requisitions an asset from the wholesale supply system. Figure 1-1 illustrates the general process for issuing and repairing reparable items.

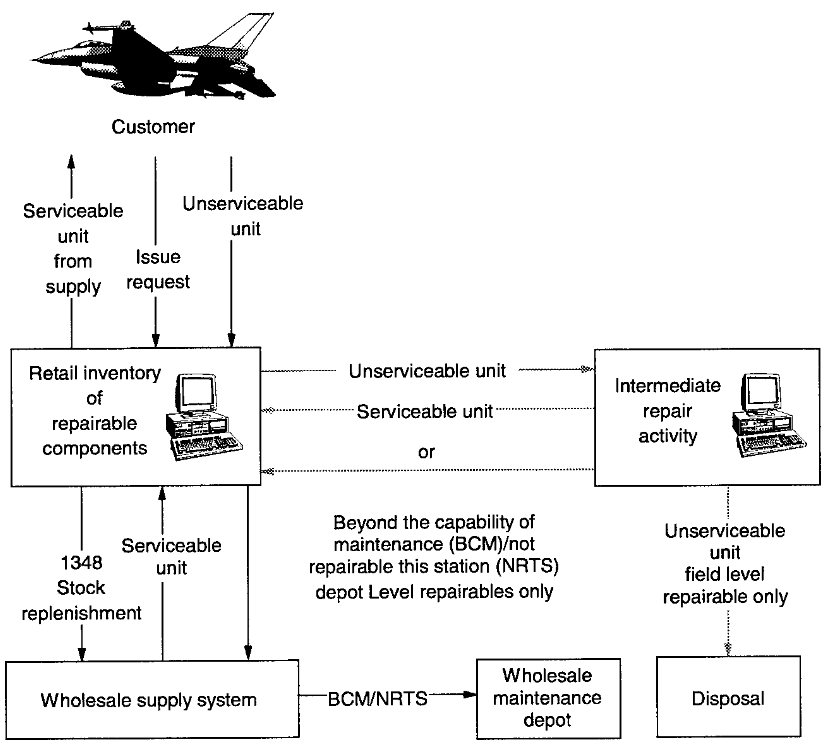

Figure 1-1.
Generalized Reparable Item Flow

Under Department of Defense (DoD) policy,[1] the I-Level repair cycle begins when an organization enters the initial demand for the replacement of an unserviceable into a supply system and ends when the unserviceable asset is restored to serviceable condition and is recorded as such on supply records. The timing of the starting event varies by Service. It always occurs sometime after the failed item has been removed from the weapon system, but no later than when supply receives the unserviceable item. For example, at some Naval aviation facilities, the squadron mechanic orders a replacement unit "on line." The supply department then delivers a serviceable item and picks up the unserviceable item for transport to the maintenance facility.

The Services are authorized to stock a level of assets equal to the demands that are likely to occur during the repair cycle time (RCT). This level of assets is known as the retail repair-cycle requirement. The Services may also include the RCT in formulas used to compute a variable safety level and, therefore, establish confidence that backorders will not occur.

STUDY OBJECTIVES

This study has three objectives — quantify the present retail repair cycle requirement, describe I-Level repair processes and procedures for each service, and explore the following major issues.

MAJOR ISSUES

This study addresses the following issues:

- Can the I-Level repair cycle time be reduced?
- Will reducing RCT result in a smaller inventory investment?
- Will reduced cycle times also establish a more responsive repair operation and better readiness?
- Are the Services correctly measuring and using I-Level RCT?
- Is adequate management information, including performance indicators, available to supply and maintenance activities?
- Are the interfaces between retail supply and intermediate maintenance activities conducive to a responsive and efficient repair process?
- Are awaiting parts (AWP) delays minimal and adequately managed?

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[1] DoD 4140.1-R, DoD *Materiel Management Regulation*, January 1993 (pp. 3–10).

- How does retail-level financing [Defense Business Operations Fund (DBOF) versus operations and maintenance (O&M)] have an impact on operations and investment?

- How does maintenance operations financing (labor and materials) have an impact on incentives to repair at the I-Level or turn-in and requisition from the wholesale system? This issue also addresses carcass turn-in credit policies.

Discussion

Can the I-Level Repair Cycle Time be Reduced?

Essentially, Services calculate RCT with two different methods. The first method uses the actual time that it takes, on the average, to repair an individual reparable item. This RCT includes all elapsed time from the initial demand for a replacement item until the failed item is repaired and placed back on the shelf. One Service uses a second method to compute retail requirements for spare reparable items. This RCT is usually less than the actual RCT because delays of a one-time nature, such as AWP time, are not included in requirements determination computations.[2] This "file" RCT must be reduced in order to reduce retail requirements. Simply reducing AWP time, according to policy, would not reduce file RCT but would improve responsiveness. On the other hand, reducing move and queue times would result in a reduction in file RCT.

According to our observations, I-Level RCT can be reduce (both file and actual). Conforming to policy, using performance indicators, improving supply and maintenance interfaces, and reducing parts problems can contribute to lowering both actual and file RCT.

Table 1-1 shows estimated repair cycle requirement times and pipeline costs by Service.[3] The times for two of the Services are very low while the times for the other two are very high. We estimate that the total dollar value of the DoD retail repair cycle requirement is approximately $1.2 billion, and the average dollar-weighted repair cycle time is 6.6 days. At the DoD level, reducing the I-Level RCT requirement by one day equates to a $187 million reduced retail repair cycle requirement. Details concerning the methodologies used to estimate the RCT values for each service are included in the appendices.

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[2]The policy in DoD 4140.1-R, DoD *Materiel Management Regulation*, January 1993 (pp. 3–10), excludes using AWP time in requirements determination. In reality, only one Service completely excludes AWP time. One Service is using a fixed parameter for computing requirements at a number of installations.

[3]Naval ships are not included because currently they do not have I-Level repair of shipboard unserviceable components for return to retail reparable inventories.

Table 1-1.
Average RCT and Pipeline Costs

	Dollar-weighted average RCT in days	Value of one day of RCT requirements (in millions)	Total RCT requirements (in millions)
Army	25.0	8	200
Navy (Air)	6.4	59	378
Air Force	5.0	119	595
Marines	60.8	1	61
DoD total	6.6	187	1,234

Since requirements determination formulas for both the repair cycle quantity and safety level use RCT as the key factor in the Service models,[4] reducing these times will decrease requirements. The degree to which this reduction can occur varies widely by Service. The RCT times for two of the Services are considerably longer than the other two and have the most potential for reductions. Chapter 3 and the Service appendices provide more detail.

Are the Services Correctly Measuring and Using I-Level RCT?

Only the Air Force measures and uses RCT in accordance with DoD policy. AWP time and other one-time delays should be measured but not included in file RCT times. The Navy includes up to 20 days of AWP time. The Marine Corps includes all elapsed time but uses a 90-day cap. The Army uses a fixed parameter of 25 days for both order and shipping time (OST) and RCT at most installations. By eliminating AWP times, the Navy and Marine Corps can immediately reduce file times (and therefore requirements). For the Navy, we estimate a 45 percent requirements reduction, which would reduce requirements by over $170 million. We could not estimate Marine Corps savings because sufficient data were not available. In the case of the Army, eliminating AWP delays from measured actual times would still produce greater requirements than the 25-day parameter (an estimated 33 days, increasing Army requirements by approximately $64 million); however, this formula would more accurately reflect true requirements. If other initiatives can reduce this duration below 25 days, the Army can achieve savings.

[4] Appendices A through D discuss Service formulas and procedures for computing repair cycle and safety-level requirements.

Is Adequate Management Information, including Performance Indicators, Available to Supply and Maintenance Activities?

In order to minimize investment in reparable item inventories without jeopardizing readiness, the Services must accurately monitor and compute RCT and keep it as low as possible. Figure 1-2 shows the time segments associated with I-Level RCT. By measuring and tracking each individual segment of RCT, using actual historical repair cycle-time data to compute requirements, and excluding extended delays of a one-time nature such as AWP time, the Services can reduce overall repair cycle requirements. The times that should be measured and tracked are

- processing (supply to maintenance and maintenance to supply transit times),
- awaiting maintenance (time between receipt by maintenance and the beginning of actual repair),
- repair time, and
- AWP time and other logistics delays.

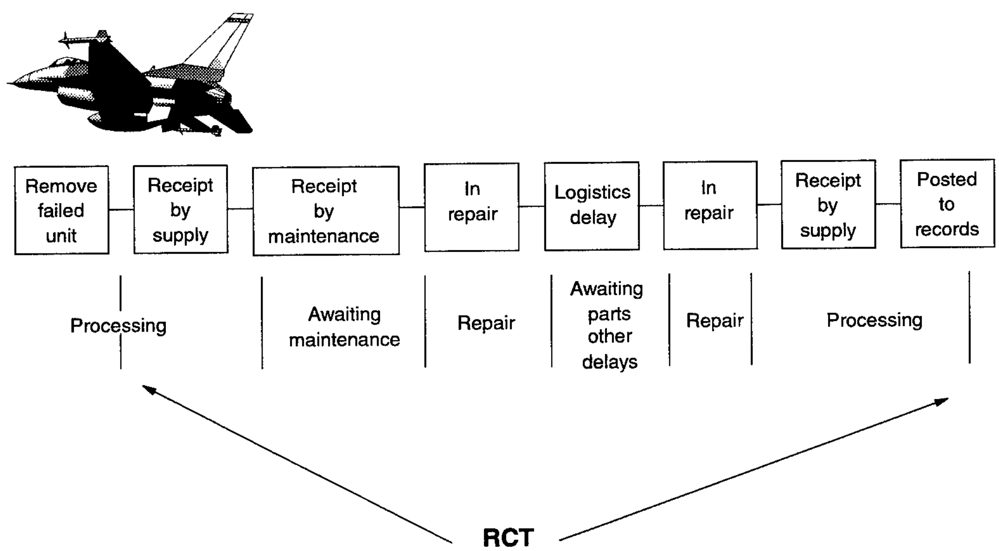

Figure 1-2.
I-Level Repair Cycle Time Segments

In most cases, the data needed to monitor performance are available but not routinely used to monitor overall system performance. In addition, times are not captured for all the segments in some Service systems. Performance should be monitored against some reasonable expectations. By establishing standards for each segment of RCT and measuring performance against these standards, RCTs can be reduced.

Are the Interfaces between Retail Supply and Intermediate Maintenance Activities Conducive to a Responsive and Efficient Repair Process?

To answer this question, we defined a "responsive and efficient repair process" as one that produces low average repair cycle times. We found that the answer to this question is generally yes for Service aviation operations; however, ground force operations need improvement.

Maintenance operations, such as the Service's aviation I-Level maintenance organizations, with tightly integrated supply and maintenance personnel were the most efficient. In such an organization, supply and maintenance personnel work together toward common goals to ensure that readiness at the organizational level remains high while investments in inventory remain low. We did not observe this same level of coordination and integration at ground forces I-Level maintenance organizations.

We observed a tremendous amount of dedication at the facilities that we visited. However, as in any human enterprise, improvements can be made. If local installation supply and maintenance process action teams focus on the processing and scheduling functions, including transit times, improved RCT will result.

Are AWP Delays Minimal and Adequately Managed?

AWP seems to be the largest single problem contributing to long RCTs at the intermediate level. At the I-Level, a significant amount of time is spent expediting parts requirements. Algorithms used for range and depth computations for repair parts stocked locally should be reexamined. Delivery times for items that must be ordered from the wholesale system are generally reasonable if the items are in stock. Based on our sampling, wholesale backorders caused the majority of the extended parts-related delays. Some of these backorders are centrally managed, low demand items that are not stocked. In other cases, the suppliers have had difficulties meeting required delivery dates. Some of the delays were traced to poor initial provisioning of new or modified weapon system components. Parts are not immediately available when required for a variety of other reasons. The retail supply activities and the inventory control points (ICPs) should work together to help reduce AWP problems.

How Does Retail-Level Financing (DBOF versus O&M) Have an Impact on Operations and Investment?

The method used to account for reparable assets in inventory ledgers (an end-use O&M account or a revolving stock fund account) has little impact on the way reparables are managed because

- Under both financial systems, the point of sale between wholesale and retail is essentially the same. No end-use O&M funds are obligated until an unserviceable is declared beyond the capability of maintenance (BCM) to repair or not reparable this station (NRTS), and a replacement is ordered.
- Regardless of how the inventory is funded, the I-Level maintenance operation is O&M funded. Under both funding scenarios, end-use O&M funds are only obligated when the unserviceable cannot be repaired locally.
- The repair process (the physical act of removing, repairing, and returning items to supply) is virtually the same no matter how the inventory is funded.

Central ownership of assets within a single fund does present advantages because the Services can redistribute assets geographically without processing bills and credits.

How Does Maintenance Operations Financing (Labor and Materials) Affect Incentives To Repair at the I-Level or Turn-In and Requisition from the Wholesale System?

The repair parts consumed during a local repair and civilian labor are the only expense to an O&M account because separate appropriations finance the military labor. The labor of the military workforce appears to be "free." For this reason, repairing locally usually appears to be an economic incentive. If, during the logistics support analysis phase of weapon system design, designers conducted a proper level-of-repair analysis, repair at the I-Level was authorized because it was the most economical. If the level of repair analysis (LORA) was not thorough and it is not the most economical, the item should be reclassified as an item that must be repaired at a depot. However, when the wholesale supply system has excess serviceable assets, repairing locally is not economical from a total systems cost perspective. Even though it appears to the local commander to be the least costly, in reality, it is a suboptimal solution. Also, when serviceable assets are readily available from the wholesale system but the I-Level holds unserviceable items for an extremely long time waiting for parts, local repair can cause support problems. If the true costs for holding and repairing locally were considered, the decision to hold the items would probably change.

Under the current financial structure, the decision whether to repair or return is a local decision that balances available funds, readiness, and wholesale stock availability. The DoD should explore alternative wholesale and retail financial policies (including DBOF pricing policy) and resulting incentives. Getting the most readiness for the least dollars from the combined depot and I-Level system should be the goal.

SUMMARY RECOMMENDATIONS

- Use actual historically based repair cycle times for the RCT requirements determination process.
- Exclude AWP.
- Exclude other delays of a one-time nature.
- Establish standards for RCT and measure against actual times.
- Minimize processing and awaiting maintenance times.
- Improve repair parts support.
- Explore alternative financial models and incentives for combined depot and I-Level operations.

REPORT FORMAT

Chapter 2 of this report discusses I-Level RCT policies, average times, and requirements. Chapter 3 includes a concise treatment of the issues addressed, the conclusions reached, and the recommendations made to improve I-Level repair cycle times within DoD. Chapter 4 addresses reparable item financial practices. Appendices A, B, C, and D include a more detailed discussion of the Army, Navy, Air Force, and Marine Corps processes and systems. Appendix E and F describe the Navy and Army regional maintenance concepts and initiatives.

CHAPTER 2

I-Level RCT Policies and Requirements

BACKGROUND

While each of the Services conducts I-Level repair and associated functions (i.e., credit policy, location of repair, and supporting software) differently, the overall process is essentially the same. The customer (ship, air squadron, air wing, or tank battalion) generates the unserviceable and sends it to a supporting logistics organization. The paperwork and, in most cases, the unserviceable item are sent to a supply organization (in one service the item goes to the supporting maintenance unit, and the paperwork goes to supply). The supply organization processes the paperwork, establishes a "due in from maintenance" record in the supporting software, and forwards the unserviceable to maintenance. Upon completion of the repair, the item is returned to the originating supply organization, which closes the tracking document, places the item on the shelf (or issues it if a backorder exists), and updates the stock records. Unserviceable items that maintenance cannot repair or that are not reparable are returned to supply and forwarded to a higher maintenance level or to property disposal.

In this chapter, we discuss DoD and Service RCT policies, describe I-Level repair processes and procedures, and quantify the present retail repair-cycle requirement.

POLICIES

DoD Policies

The DoD policies governing retail reparable inventory and the use of RCT are stated in DoD 4140.1-R, *DoD Materiel Management Regulation*, dated January 1993. As defined by this regulation, both the depot-and intermediate-level repair cycles begin when the customer enters the initial demand for the replacement of an unserviceable item into a supply system and end when the unserviceable asset is restored to serviceable condition and recorded as such on supply records. The time between the beginning and end of the repair cycle, except such avoidable or unpredictable time as AWP delays, is included in computing repair-cycle requirements, equipment failures, and backlogs. Increases to the repair cycle because of AWP time are not included in repair cycle computations.

The policy requires computation of a repair cycle level to replace reparable components found unserviceable during organizational, intermediate, or depot-level maintenance. In other words, if organizations have a local supply of serviceable components (rotatable pool) from which to draw at the same time they turn in a broken one and a local repair organization repairs the unserviceable components for return to the pool, then the pool quantity should roughly equal the number of demands that are expected over the time it takes to repair the item. If, for example, each day there is a demand for an engine and it typically takes five days to repair the engine, then the pool should have about five engines. In this case, a repaired engine arrives from maintenance just in time to meet the next demand. Since the repair time can vary, the policy also requires a safety level that includes RCT as a factor to protect against variability. Actual repair cycle times should be used to compute repair-cycle requirements. If actual RCTs are unavailable, organizations can substitute time from a comparable item or use standard times.

The DoD regulation does not address the individual segments that make up I-Level RCT. Based upon our review of the Services' systems, we suggest defining the segments as follows:

- Processing (supply to maintenance and maintenance to supply transit times),
- Awaiting maintenance (time between receipt by maintenance and the beginning of actual repair),
- Repair time, and
- AWP time and other logistics delays.

With formal segment names and definitions defined, the Services can measure their performance against their own goals.

Recommendation

Incorporate I-Level Repair Cycle Time Segment Names and Definitions into the DoD Materiel Management Regulation (DoD 4140.1R)

Table 2-1 summarizes RCT policies for each of the Services. The following two observations relate to the Services' compliance with present DoD policy:

- Technically, only the Air Force follows the policy that requires using actual times minus avoidable or unpredictable delay time, most importantly AWP time. The Marine Corps includes all times up to 90 days, the Navy uses a 20-day ceiling, and the Army uses a 25-day RCT[1] constant for most of their authorized stockage list (ASL) levels.

[1] For ASLs maintained by the Standard Army Intermediate Level Supply (SAILS) System and direct support unit standard supply (DS4) systems. The new Standard Army Retail Supply System (SARSS) uses actual RCT (including awaiting parts) instead of a 25-day constant.

- Three of the four Services use RCT as a factor in computing safety level. The Army safety level quantity is five days of supply based upon average washouts only.

Table 2-1.
Service Policies

Policy	Army	Navy	Air Force	Marine Corps
Name of inventory using RCT for level setting	ASL	AVCAL	Base supply	RIP
Who computes?	Local	ASO	Local and ALC	Local
Repair cycle time	25-days fixed for most ASLs	Actuals with 20 cap	Actuals with 4-day floor (critical) and 10-day ceiling (noncritical)	Actuals with 90-day cap
Factor in safety level	No	Yes	Yes	Yes
Hold policy	None	60-day review - local decision	None	60 – 120 days

Table 2-2 shows the formulas the Services use to compute retail reparable inventory repair cycle-level and safety-level requirements.

Table 2-2.
Service Repair Cycle Requirement Formulas

Service – Army	
Repair cycle quantity	$RCL = \frac{AQRA}{360} * RCT * 1.25$
Safety level	Not a function of RCT
Legend	RCT = repair cycle level AQRA = Average quantity repaired annually
Constraints (including awaiting parts)	All RCT and OST fixed at 25 days for repairables.
Service – Navy	
Repair cycle quantity	$RPQ = \frac{(RPF)(TAT)(UPA)(NMC90)}{90}$
Safety level	Poison distribution function of RPQ to yield either 85 or 90% protection.
Legend	RPQ = raw pool quantity RPF = I-Level repair over one maintenance cycle TAT = turn-around time UPA = units per application NMC90 = number of maintenance cycles in 90 days
Constraints (including awaiting parts)	Individual observations restricted to: Removal to IMA (processing) - 1 day Scheduling time - 3 days Awaiting parts - 20 days Actual repair time - 8 days Total constrained time - 20 days
Service – Air Force	
Repair cycle quantity	$RCQ=DDR*PBR*RCT$
Safety level	$SLQ=c*\sqrt{3*(RCQ+OSTQ+NCQ)}$
Legends	RCQ = repair cycle quantity DDR = daily demand rate PBR = percent base repair SLQ = safety level quantity OSTQ = order and shipping time quantity NCQ = NRTS/condemned quantity
Constraints (including awaiting parts)	Constrains are placed on the average as follows: For critical items, 4 days or greater used. For noncritical, 10 or less days is used. Awaiting parts time is included but tracked separately.
Service – Marine Corps	
Repair cycle quantity	$RCR = \frac{RR*RCT}{30}$
Safety level	Poison distribution function of both the repair cycle quantity and the OST quantity to yield 90% protection.
Legends	RCR = repair cycle requirement RR = repair rate (per month)
Constraints (including awaiting parts)	The file average is capped at 90 days. Awaiting parts time is included.

As previously stated, the DoD policy does not authorize including AWP time in the repair cycle level for two reasons. First, the odds of having parts-related delays for the same component on a recurring basis are long. If inventory levels are increased to cover an event that is not likely to repeat, then the levels will be too high. Second, it may be cheaper to invest in an inventory of repair parts to support maintenance than in an increased level of serviceable components to support longer repair times. Determining the range, depth, and stocking location of individual repair parts consumed by I-Level repair requires careful analysis of each reparable assembly. Stocking based on historical demand does not ensure consistent RCTs. For example, items that fail infrequently but are critical to the operation of the component should be carried somewhere in the system as insurance if the production leadtime is long. To get an item expedited from a wholesale depot may take one or two days versus one or two years of procurement leadtime. On the other hand, items that are frequently used should be positioned as close to the mechanic as possible. In this case, AWP time can be reduced to minutes. Items with chronic procurement related problems, such as bearings, should be analyzed at the national level to ensure investment in enough safety level to compensate for procurement variabilites.

The Navy sample data collected during this study illustrate the variability of parts-related delays. Based on a central computation that includes insurance items for low frequency failure parts, the Navy stocks repair parts to support maintenance and supplements those levels based upon actual local demand histories. Table 2-3 shows AWP statistics for the sites that we visited. Although the average AWP delay was almost 4 days, the median time was .4 days. That is, half the national stock numbers (NSNs) repaired had an average less than or equal to .4 days. The average is influenced by a small number of NSNs with long AWP times.

Table 2-3.
Navy Sample Awaiting Parts Statistics

Navy Sample Awaiting Parts Analysis	Statistic
Mean	3.9
Median	0.4
Standard deviation	14.0
Range	291.0
Minimum	0.0
Maximum	291.0

Figure 2-1, shows the dollar weighted results of excluding AWP time from the Navy data, constraining the AWP to 20 days, and using actuals that include all AWPs. The no AWP policy yields an average RCT of 3.5 days. Under the existing policy, the current average is 6.4 days. At an estimated $59 million per day RCT pipeline, excluding AWP time would reduce requirements by over $170 million. The cost to enhance repair parts availability in order to lower AWP times is not known; however, if properly approached, it should be significantly less expensive than increasing levels of expensive reparable assets.

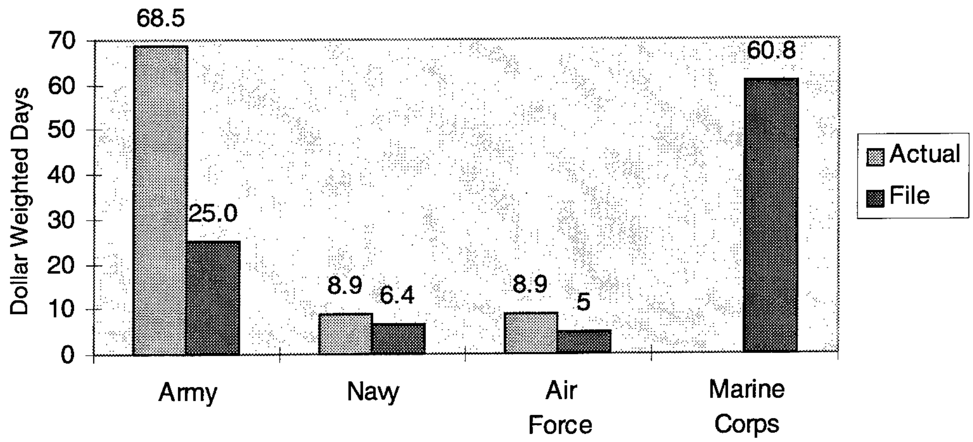

Figure 2-1.
Navy AWP Data

Recommendations

Use Actual Historical Repair Cycle Time Data for the RCT Requirements Determination Process, but Exclude Extended Delays of a One-Time Nature for each Observed Time

Under the DoD policy, services should use actual historical repair cycle-time data but exclude delay time of an avoidable or unpredictable and infrequent nature. For example, wholesale backorder time for centrally stocked items should be excluded because it is random in nature and not likely to repeat. To do this, maintenance data processing systems must track these times such as "awaiting parts" and essentially "stop the clock." Constants or arbitrary floors or ceilings should not be used.

Use RCT as a Factor for Safety-Level Computations

All but one of the Services presently use RCT as a factor for safety-level computations. Since repair cycle times can vary, the variable safety level can help protect against deviations.

Current Repair Cycle Times and Requirements

Quantifying Service-wide I-Level repair cycle times and retail reparable requirements is not a simple task. Wholesale repair cycle requirements for items repaired at DoD depot maintenance activities are included in the Central Secondary Item Stratification (CSIS) budget summaries. Most of these summaries also include average repair cycle times. Except for the Air Force (which includes base levels of reparable requirements in the CSIS), no similar report summarizes retail reparable requirements repaired by I-Level maintenance activities. Therefore, we dedicated much of our effort to gathering data that could be used to estimate I-Level repair cycle times and requirements.

RCTs can be used to compute retail requirements in the following three basic ways:

- Use actual times averaged over some period of time,
- Use constrained times, or
- Use a constant.

Although each uses a completely different approach, the Navy,[2] Air Force, and Marine Corps each use constrained times to set retail requirements. The Navy has individual segment constraints that are applied to each repair observation with a total constraint of 20 days. The Air Force uses a floor of 4 days for critical items and a ceiling of 10 days for noncritical items. The Marine Corps caps the average at 90 days. The Army uses a constant 25 days for RCT independent of actual data. For our analysis, we compared actual times to file times in order to gauge how well the requirements determination system matched the real world.

Table 2-4 shows our estimated RCTs and associated pipeline requirements for each Service. From each installation that we visited, we tried to get NSN data showing a 12-month average of actual RCTs by individual segment, constrained RCTs (those used in the supply system's file for requirements determination purposes), and repair rates. When available, we used these data, along with other information provided by headquarters, to compute actual and file average RCT, dollar weighted RCT, median RCT, total RCT inventory requirements, and a day's worth of RCT pipeline for the Service as a whole.

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[2]Throughout this report, Navy discussions are limited to Naval and Marine Aviation retail reparable requirements. There are no ship related retail supply levels (rotatable pools) repaired by I-Level repair organizations.

Table 2-4.
Repair Cycle Times and Requirements

Service	File days		Actual days		Pipeline ($ million)	
	Average	Dollar weighted	Average	Dollar weighted	Requirement ($ million)	Dollars per day
Army	25.0	25.0	54.2	68.5	200	8
Navy	5.6	6.4	10.7	8.9	378	59
Air Force	4.4	5.0	7.7	8.9	595	119
Marine Corps	47.6	60.8			61	1
DoD total		6.6			1,233.7	187

Since Service systems did not always collect and maintain the data we needed, we could not complete every cell of Table 2-4. For the Army, we used the 25-day constant RCT and applied it to estimated Army wide total ASL requirements provided by the Army Deputy Chief of Staff for Logistics (DCSLOG). We also used some Standard Army Maintenance System (SAMS) RCT reports obtained from the installations to estimate actual times. The Navy's Naval Aviation Logistics Command Management Information System (NALCOMIS) provided all necessary installation specific RCT data. We applied the results to estimated requirements data provided by the ASO. For the Air Force, we used the CSIS budget summary for constrained base RCTs and requirements for depot-level reparables and data provided by the Air Force Logistics Management Agency, Maxwell Air Force Base (AFB), Gunter Annex, for field-level reparable items. The installations visited provided us with actual data extracted from the Standard Base Supply System (SBSS). The detailed methodologies used to estimate these times and values are discussed in detail in the appendices.

Given the method used by the Services to compute and use retail RCT, it is clear that the file times are lower than actual experience. This result should always be the case since DoD policy excludes using AWP time to compute RCT requirements. Although most of the Services measure AWP time in their systems, all the Services include some, if not all, AWP time in their file times. Because of these constraints, the file times are lower than actual times (almost double in the Navy). The greater the difference, the greater the probability of backorders and readiness degradation.

Local excess serviceable assets prevent backorders. During our field visits and review of the various field-level reparable item stratification, we observed that, in general, most areas have excess serviceable stocks. For example, in March 1995, one Service had a retail-level reparable authorized level for demand supported items of $38 million and an on-hand level of $85 million. Much of the excess can be attributed to draw-down in military structure. The procedures followed during a period of high inventory will not hold once the excess stocks are consumed. Much greater emphasis will have to be placed on RCT.

Figure 2-2 shows the actual and file dollar weighted RCTs when they are available. The goal should be to minimize the difference between file times and actual times through improved management practices. Through better management approaches, organizations can reduce these times. In the next chapter, we explore three areas that can be leveraged to improve RCT management — better information systems with performance indicators, improved supply and maintenance interfaces, and improved repair part inventory support for maintenance.

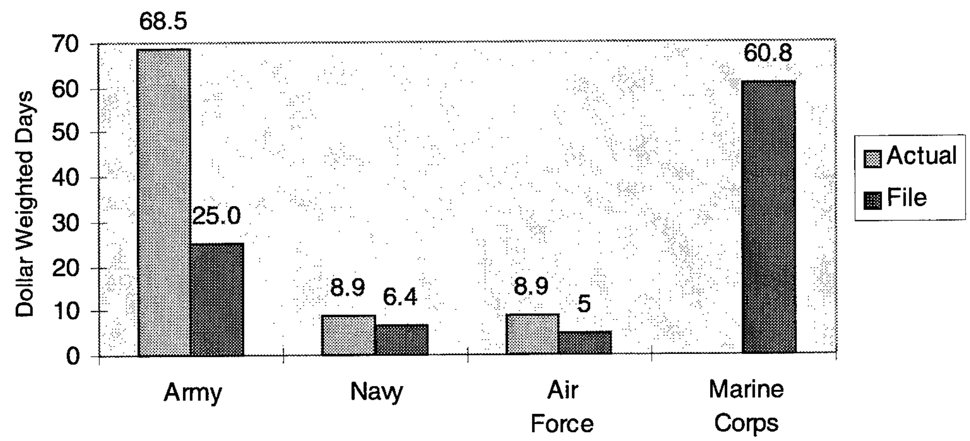


Figure 2-2.
Service I-Level File RCT

CHAPTER 3

I-Level RCT Improvements

INFORMATION SYSTEMS AND PERFORMANCE INDICATORS

Discussion

The key to the I-Level repair process is close coordination and cooperation between retail supply and maintenance operations. Not only must the individuals involved in the operation work closely together, but the information management systems that support the two functions must be integrated so that they can pass data from one to the other.

The RCTs used for requirements determination purposes should be based upon actual historical times and must exclude unanticipated delays such as AWP time. To accomplish this, the system must measure and track actual times for each segment of RCT. The RCT segments are processing (supply to maintenance and maintenance to supply transit times), awaiting maintenance (time between receipt by maintenance and start of actual repair), repair time, and AWP time and other logistics delays. Ideally, the system will compute historical average RCT with and without delays. If computed by the maintenance system, the data (at the NSN level) should be automatically loaded into the supply system.

Table 3-1 shows the supply and maintenance retail systems involved with RCT management. The Army SAMS does track RCT by NSN, including AWP times, once maintenance receives the item. It does not cover the transportation segments on both ends. SAMS produces a report that supply could use to load RCT data into SAILS/DS4; however, they would have to load the times manually.[1] The Marine Corps Integrated Maintenance Management System (MIMMS) transmits monthly RCT data to the supported activities supply system (SASSY) but does not separate AWP time from total time. The Air Force SBSS system maintains constrained RCT data (floors and ceilings) and feeds these data to the appropriate ALC to support their worldwide computation. The Navy NALCOMIS system is an integrated supply and maintenance system that tracks all segments of RCT and transmits the relevant data monthly to a central processing facility.

[1] SARSS will track RCT and update supply records automatically; however, SARSS has not yet been widely implemented.

Table 3-1.
Service ADP Systems

Service	Supply	Maintenance
Army	SAILS/DS4, SARSS	SAMS
Navy		
Ships	Shipboard Uniform Automated Data Processing System-Real Time	NALCOMIS
Shore	Uniform Automated Data Process System-Stock Point	NALCOMIS
Air Force		
Air Combat Command	SBSS	Core Automated Maintenance System
Air Mobility Command	SBSS	G081 Maintenance System
Marine Corps	SASSY	MIMMS

In order to measure performance (the efficiency of the combined supply and maintenance organization) and establish goals for improvement, the system should also measure actual times against a standard. For example, if the "should take" repair time for an avionics black box is one day and the average time over one year is close to that duration, then performance is efficient. If, however, the average starts to creep up to two or more days, then a problem exists. Possibly the skills mix of the shop is changing and more training is required. If the "should take" awaiting maintenance time is one day and the actual times creep up to seven or more days, maybe a capacity shortage is causing the problem. Without standards, management cannot gauge performance. The data processing systems should produce performance indicator reports that measure "should take" times to "did take" times. None of the systems we looked at produced such reports.

During our field visits, we found that some of the supporting supply and maintenance automated systems were primarily stovepipes in their functional area; maintenance systems fed other maintenance systems and supporting supply systems fed other supply systems. While some information automatically passed between the two systems and they are somewhat integrated, more can be done in this area. The Services are aware that they must make improvements, and they are investing time and dollars to improve their systems. The Army, for example, is currently fielding a new automated retail supply system (SARSS-O), which will improve the interchange of supply and maintenance information at the level where it is needed to support I-Level maintenance.

Recommendations

Measure and track the segments of RCT individually.

Establish standards for each segment of RCT and measure against actual times.

These standards can be constants for some segments and variables for others. For example, when the repair will be accomplished locally, the transportation segment could be set at one day. The repair segment might be established as a variable. It could be set as the average repair time (minus unusual delays) over a long historical period or, alternatively, as a constant that varies by commodity group. Each installation should set aggressive standards and monitor performance.

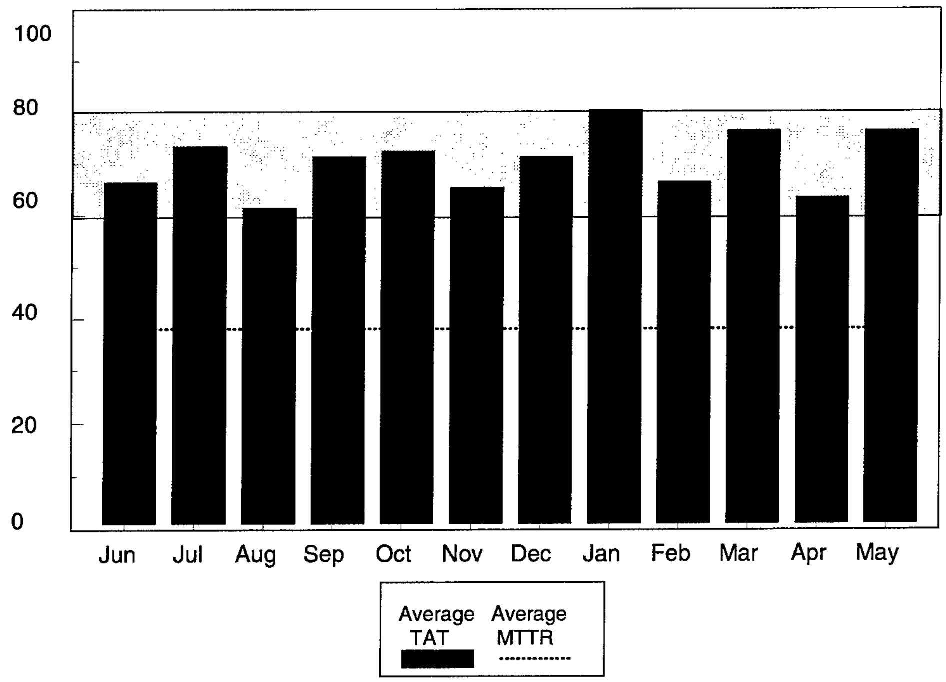
SUPPLY AND MAINTENANCE INTERFACES

Discussion

To be efficient, supply and maintenance organizations must work as a team. The most efficient maintenance operations that we observed were the ones in which supply and maintenance personnel were tightly integrated. At these organizations, the traditional lines between supply and maintenance were almost invisible. This attribute is found in both Navy, Marine Corps, and Air Force aviation intermediate maintenance operations. We were very impressed with the close coordination among the supply and maintenance personnel in the 436th Logistics Group at Dover AFB. Biweekly, the supply and maintenance personnel briefed the leadership of the group on the status of all critical items due-in from maintenance and provided analysis of and reasons for any item that did not meet standards. Furthermore, expediters from both supply and maintenance worked closely together on a daily basis to solve problems that might prevent items from being processed quickly. We also observed this close cooperation at Oceana Naval Air Station with the same positive results.

Ground forces intermediate maintenance operations for both the Army and Marine Corps are not as integrated. The warehouses where the assets are stored tend to be geographically dispersed in relation to the maintenance organizations performing the repair actions. For these activities, processing time (transportation and receiving functions on both ends) becomes an important factor that deserves management attention.

Figure 3-1 is an example of the long transportation times that can result from geographic dispersion. While the average RCT, or TAT in Army terms, is 60 to 80 days, the average repair time (including scheduling and AWP time) averages 38 days. The transportation to and from maintenance (22 to 44 days) accounts for the difference.



Note: MTTR = mean time to repair; TAT = turn around time.

Figure 3-1.
Average Repair Times Versus Total RCT for Army Regional Maintenance

Another noticeable difference between aviation and ground forces is the awaiting maintenance time (time between receipt by maintenance and beginning of actual repair). The aviation operation tends to repair items as they are received with little or no delay because of backlogs. The ground forces operation tends to work more like their depot counterparts, has more formal production planning and scheduling exercises, and builds 15 to 30 day in-shop backlogs as a hedge against production line stoppages. Figure 3-2 compares Navy awaiting maintenance times with Army general support times.[2]

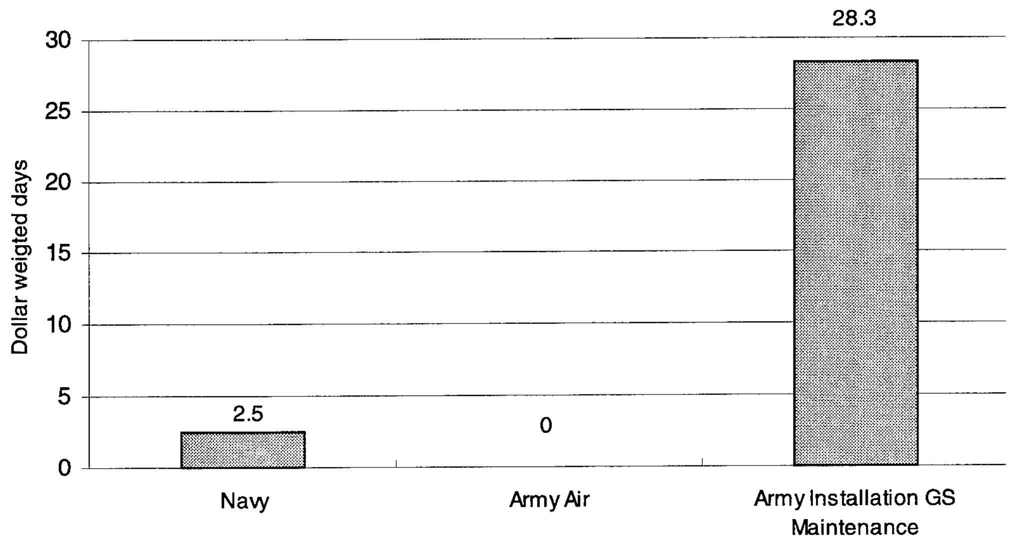
Recommendations

Minimize Processing and Scheduling Times

Management should focus attention on these durations and make an effort to reduce them, especially transit times. One justification for having an I-Level maintenance capability is the speed and flexibility of the repair process. If RCT approaches or surpasses order and shipping time from the wholesaler for the

[2] Awaiting maintenance times were not available for Air Force and Marine Corps units.

same item, then RCT requirements are greater than they would be if the item were not repaired locally.



Note: GS = ground support.

Figure 3-2.
Awaiting Maintenance Delays

Develop Reduction Goals Where Practical

Organizations should use total quality management techniques to develop these goals. If supply and maintenance process improvement teams within each activity look for ways to streamline processing and scheduling, they can realize real reductions.

Repair Parts Support to Maintenance

Discussion

Since AWP time should not be included in RCT, the parts needed by maintenance must be available when they need them. Otherwise, actual times will exceed requirements and backorders will occur. This important area requires management understanding and attention. Processing and scheduling delays can take months if they are not closely monitored and managed, but parts problems can shut down repair activities for years if long lead-time parts are involved.

During our visits to field locations, lack of repair parts and lack of confidence in the supply system were frequently mentioned as a cause of extended RCT. In addition, when repair parts shortages exist, organizations tend to conduct "controlled cannibalization" to keep the maintenance shop in operation. At one of the field sites, we found a situation in which end items worth hundreds of millions of dollars each were rotated through a maintenance status and used as an alternate source of supply to provide serviceable items to keep other aircraft flying. We also found instances where cannibalization took place in shops. In this situation, personnel remove serviceable piece parts from secondary items entering the repair process and use them to repair items already in the process.

Generally, organizations should warehouse parts that support I-Level maintenance as close to maintenance as possible. From the time the technician diagnoses the problem and orders the replacement part to the time he or she receives the part should be measured in hours if not minutes. This duration should hold for most parts that are stocked locally, and most parts that are maintenance coded for removal and replacement at the I-Level should be stocked locally in sufficient quantities to avoid delays. For those repair parts coded for I-Level that have very low mean time between failures, the Service may elect to stock a small number centrally to support multiple I-Level operations. If these parts fail, maintenance is an order and shipping time away from completing the repair; however, if the requirement has a high priority, the part can usually be expedited and received within a few days. If the parts are not on hand or on order anywhere in the supply system, then maintenance is an administrative and production leadtime away from completing the repair, which should never (or rarely) happen.

Problems of this nature most frequently occur when new or modified equipment is introduced into the field with inadequate parts provisioning. Weapons System program managers and ICPs must ensure that enough initial spare parts are procured with the equipment or modification kit to support I-Level maintenance.

Figure 3-3 compares the Army and Navy in-maintenance delay data (mostly AWP) from the sites we visited.[3] AWP times differ because of different stocking policies. The Army's inventory reduction initiatives have affected maintenance operations.

The Services should review the methodology used to determine local range and depth requirements for spare parts. Low failure items should be stocked either locally or centrally as insurance or numerical stock objective (NSO) items. Organizations should use either a historical demand-based model (either days of supply or economic order quantity) or a material requirements planning (MRP) model that multiplies a projected repair rate by a bill of materials (BOM) listing to stock frequently used items. The use of "parts kits" also lends itself to the MRP and BOM approaches. Under any of the methods, the Services should not reduce these inventories for the sake of "inventory reduction" goals at the expense of longer repair cycle times.

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[3] We could not obtain AWP data from the Marine Corps systems. The Air Force system has AWP times but did not separate hands-on time from total time.

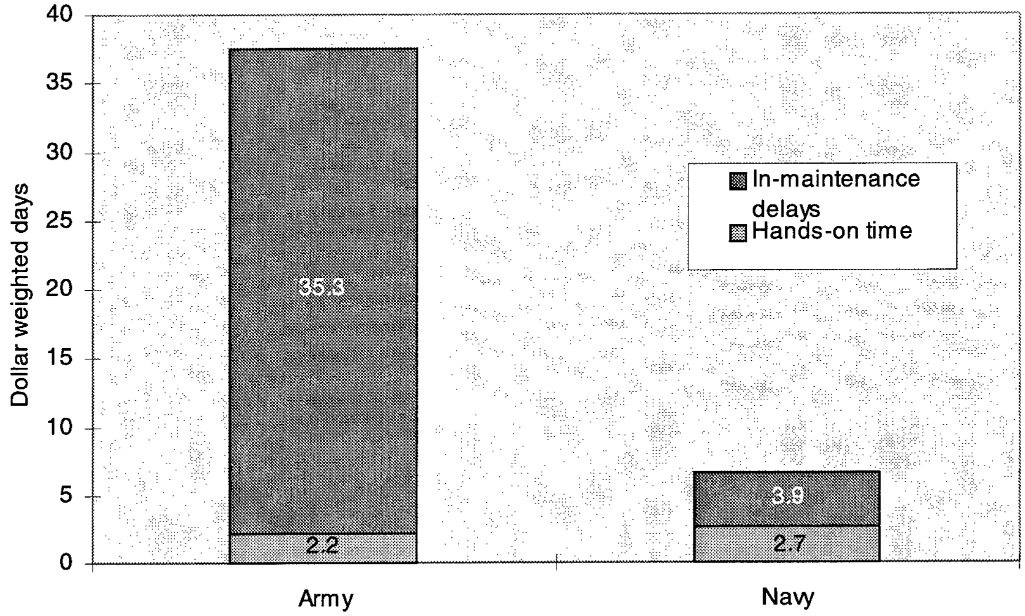


Figure 3-3.
Repair Time Versus Awaiting Parts Time Data

Recommendation

REVIEW RETAIL STOCK RANGE AND DEPTH POLICIES AND PROCEDURES

Most repair parts that are coded for removal and replacement at the I-Level should be stocked as either insurance and NSO items or demand-based items. Organizations should perform multi-indentured tradeoffs to determine range, depth, and stock location.

CHAPTER 4

Reparable Item Financial Practices

FUNDING OF LEVELS

During our field trips, we explored how type of funding affects RCT. According to our observations, the type of money used to fund field-level reparable items has little impact on I-Level RCT. However, having all these assets in a single fund has other advantages. Under decentralized ownership, lateral transfers are difficult to arrange and are accompanied by many inventory and financial transactions in order to maintain accountability. Within a single fund, lateral transfers are merely "location changes."

Among the Services, and in one case within one Service, there are different approaches to funding these items. The various combinations are

- wholesale DBOF (single stock fund),
- wholesale DBOF/intermediate O&M, and
- wholesale DBOF/intermediate DBOF (retail stock fund).

Figure 4-1 illustrates the financial policies used by each of the Services. Presently, only the Air Force uses the wholesale DBOF to fund retail reparable inventories. The Army uses a retail stock fund to fund reparable inventory at the installation level. All other reparable inventories are O&M funded; however, most of the Services have future plans to migrate this inventory to either a wholesale or retail DBOF account.

Only the Navy centrally computes and funds all retail reparable requirements. In the Air Force, each base individually computes its own requirement; however, the total worldwide requirement is centrally computed. Using this method has resulted in imbalances between local requirements and worldwide requirements. The Army and Marine Corps compute requirements locally.

From a repair incentive standpoint there is little difference across these models. If the unserviceable item can be repaired at the I-Level, no customer funds are expended. The physical act of repairing items is virtually the same.

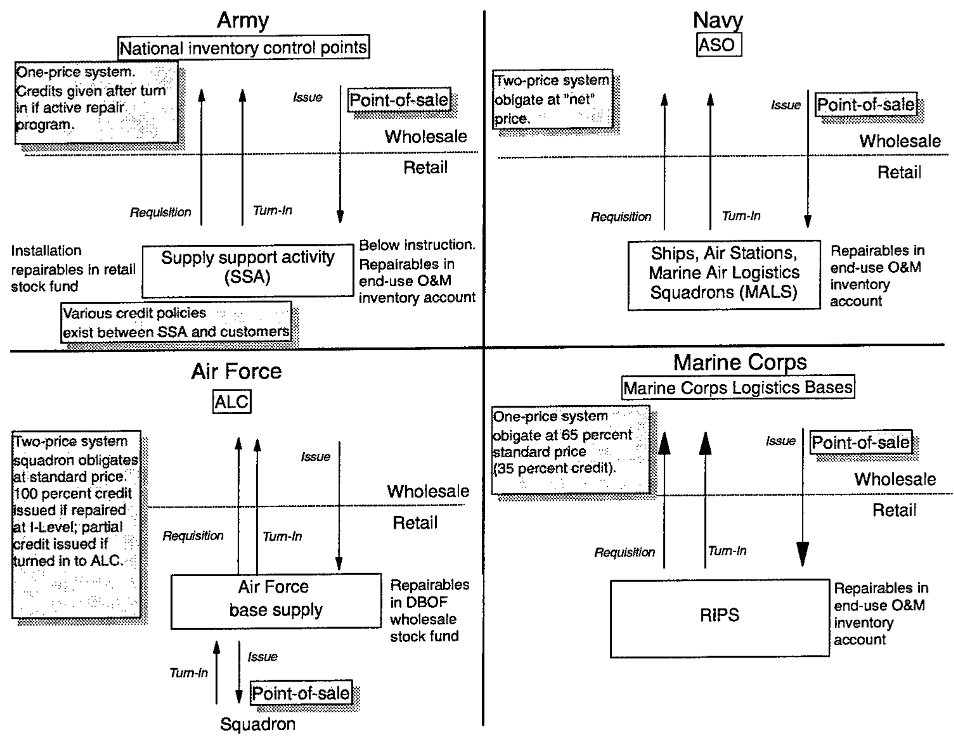


Figure 4-1.
Service Financial Processes

Funding of I-Level Maintenance Operations

Since all direct and indirect labor and overhead costs for intermediate maintenance activity are mission (O&M) funded, I-Level maintenance does not "bill" supply for the repair of unserviceable components as the wholesale system does. When the I-Level cannot immediately effect repairs because of backlogs, AWP, or lack of personnel, the activity can either hold the unserviceable item until such time that repairs can be made or turn it in to the wholesale system with an accompanying requisition. Because of the system, turning items in for credit is very expensive to O&M budgets, so most local activities prefer to hold items until, for readiness reasons, they must initiate a turn-in or requisition. The practice of holding can result in carcass shortages at the depot and wholesale backorders, some of which may be critical. It also greatly increases RCT for those Services that include some or all of this time in their retail requirements computations.

Figure 4-2 illustrates how financial incentives in the Marine Corps[1] can influence decision-makers to build up retail levels of inventories while holding unserviceable items for long periods of time. The line graph plots total costs (inventory investment and recurring order charges) to backorder rates under

[1] Reparable levels are locally computed for Marine Corps Fleet Marine Force activities based upon actual repair cycle times. Awaiting parts times are included up to 90 days.

four different hold policies — never holding, waiting 75 days before turn-in, waiting 97 days, and waiting 102.5 days. A computer simulation that varied demands and repair over time for a sample item generated the cost curves. At the core of the model is the assumption that I-Level repair costs are only a fraction of the requisition costs because it appears as such to the supply department. Of course, the fallacy of this economic model is that real costs are associated with repairing locally. As the graph shows, using this flawed economic model, the solution that yields the least amount of backorders for the least total cost is the policy that holds unserviceable items the longest period of time.

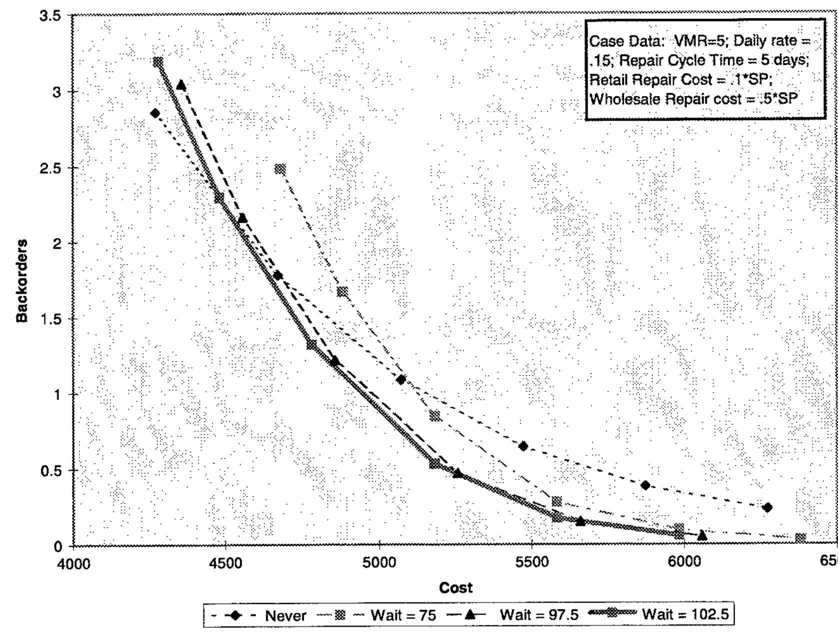


Figure 4-2.
Comparison of Repair Strategies

This model does not consider the true costs of I-Level maintenance or wholesale asset balances and is, therefore, suboptimized. The incentives will change if the costs to repair at the I-Level are similar to those at the depot level. The incentives will also change if the cost to turn-in and order a replacement item were significantly lower. Under the Navy's new regional maintenance approach (combining depot and intermediate maintenance organizations into a single geographic region), depending upon how the financial policies are ultimately implemented, the local incentives may change. The ideal financial model would produce incentives that yield the most readiness for the least investment. Exploring new and innovative models in detail is beyond the scope of this study; however, these and other financial models should be explored.

RECOMMENDATIONS

Explore Alternative Financial Models and Incentives for Combined Depot and I-Level Operations

Some alternative financial models and incentives are:

- Separate appropriations for infrastructure costs. Users pay the actual repair costs for both I-Level and depot-level.
- Different depot-level reparable pricing options.
- Regional maintenance operations with the same shops doing both depot and I-Level repair.

APPENDIX A

Army

SYSTEM OVERVIEW

The Army stocks secondary depot reparables (SDR) and field-level reparables (FLR) at two inventory levels — wholesale and intermediate. Wholesale reparables for which the Army is the inventory manager are stocked in Defense Logistics Agency (DLA) supply depots, and, in some cases, SDRs are stocked at the maintenance depots that repair the item. Intermediate reparable inventories are stocked at direct support (DS) and general support (GS) supply activities on an authorized stockage list (ASL). Commanders are authorized to consolidate stock of all or part of their reparable inventory at central locations for ease of management and operational conditions. Depending on location and organization, the inventories of SDRs and FLRs may either be operations and maintenance (O&M) or stock funded (SF).

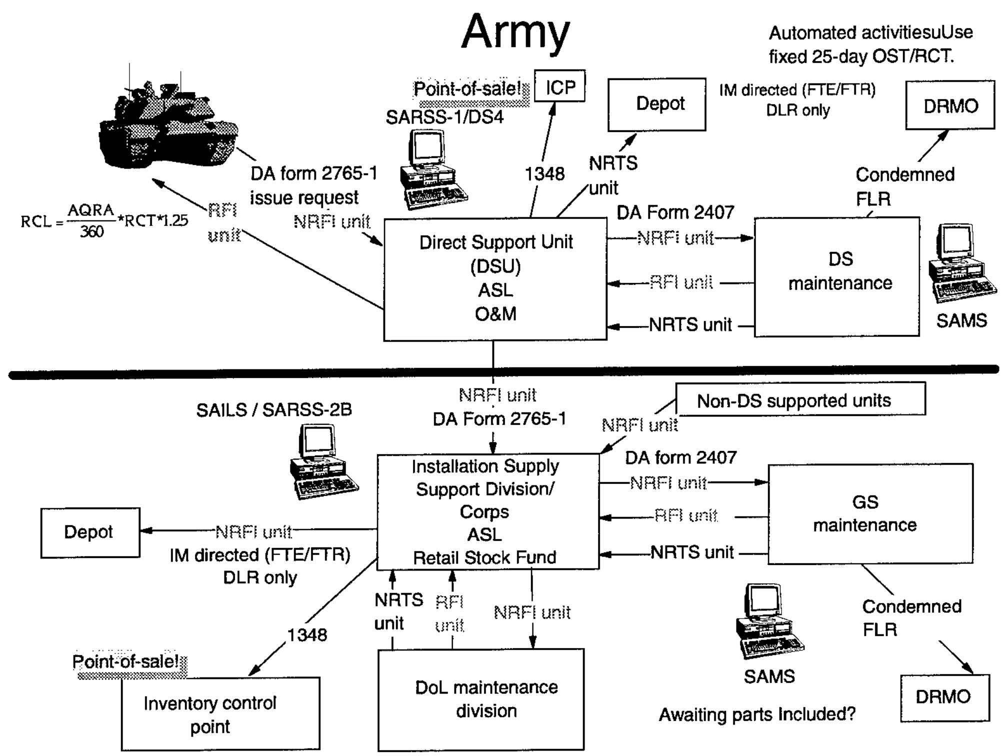
The Standard Army Retail Supply System (SARSS—1,—2,—2B) and the Standard Army Intermediate Level Supply System (SAILS) manage the ASLs. The actual software package used by a supply activity depends on its location and mission. The Standard Army Maintenance System (SAMS—1,—2) manages the I-Level maintenance system, and the location and mission of the maintenance unit dictates which software package is used. An all encompassing SARSS—O system is replacing the SARSS—1,—2,—2B software systems.

ARMY PROCESS

When a reparable item needs replacing, the customer sends the unserviceable to the supporting supply support activity (SSA) and submits a requisition for a replacement item. The repair cycle time (RCT) begins at this point and ends when the unserviceable is processed through maintenance and back to supply and the appropriate supply action is initiated.

The Army uses military units (DS and GS), base-level table of distribution and allowance (TDA) organizations and contractors to perform I-Level maintenance. Figure A-1 shows the process that is generally followed. Within a division, separate brigade, or similar organization, the unit turns in an unserviceable to the supporting SSA. If the item can be repaired at the DS level, the SSA sends the unserviceable to the supporting DS maintenance company for repair and, after it is repaired, returns it to supply to be placed in stock. The SSA sends unserviceables that cannot be repaired at the DS level to an exchange point established by the Corps Support Command (where there is one) or the

Installation Supply Support Division (ISSD), DoL, exchange point for turn-in and submits a request for a replacement. If the item is GS reparable or the supporting maintenance activity has special repair authority (SRA) for the item, the unserviceable is sent to maintenance (GS maintenance unit, DoL maintenance division, or contractor) for repair and return to stock. The depot-level reparable (DLRs) and not reparable this station (NRTS) items are evacuated, by either predetermined routing or item manager (IM) direction, to a depot or contractor facility. The authorized repair activity also has the authority to condemn an item, and, when this occurs, the maintenance organization returns the item to the SSA. It is sent to the Defense Reutilization and Marketing Office (DRMO) for disposal.



Note: IM = item manager; FTE = report of excess; FTR = report of excess response ; DLR = depot-level reparable; FLR = field-level reparable; NRFI = not ready for issue; RFI = ready for issue; DoL = director of logistics; DA = Department of the Army ; NRTS = not reparable this station; RCL = repair cycle level; QRA = average quantity repaired annually; RCT = repair cycle time.

Figure A-1.
Army I-Level Repair Process

The Army is implementing a Regional Intermediate Maintenance Management program in which a regional maintenance management manager will review the intermediate repair programs of the maintenance activities in the region and will set priorities and redirect workload among the maintenance activities in coordination with the activities involved and their commanders. GS maintenance activities are repair programs developed by the regional managers and tailored to meet maintenance activity training and proficiency requirements, weapons system availability requirements, and cost. The regional manager also develops maintenance programs that support regional requirements not identified by the individual maintenance activities. These regional programs enhance readiness of low-density equipment, which, when requirements are consolidated at the regional level, support a repair program. The regional manager can also address any short fall or excess capacity problem by cross-leveling assets, reassigning workload, or elevating the issue to the wholesale level. The regional manager also has the authority to designate, for cost, capacity, or other considerations, maintenance activities as Centers of Technical Excellence (CTE) where all or most of the intermediate maintenance on a particular item will be performed. The current regional efforts are being performed on a repair and return to the initiating installation supply source. Once financial problems are solved, the Army can achieve the ultimate goal of this initiative — a system that repairs and returns to stock at the installation that conducted the repair. Appendix F further discusses the Army regional maintenance approach.

Repair Cycle Times and Requirements

How Allowances are Determined

The four types of reparable allowances are

- requisitioning objective (RO) (demand based),
- provisioning (nondemand based),
- local Commander's designated for (nondemand based),
- critical low-density equipment,
- seasonal, and
- operational readiness float (non-demand based).

Each ASL item must have an RO that is recorded in the stock accounting record. The Army uses either days of supply (DOS) or economic order quantity (EOQ) formulas to compute RO. Stockage-level computations for reparable items, at the level where repair is accomplished, differ from the computations for material not repaired at that level. The two computations are the following:

- *Not repaired at stockage level.* RO consists of an operating level (OL), order ship time (OST), and a safety level (SL).
- *Repaired at stockage level.* RO consists of a repair cycle Level (RCL), OL and OST for washouts only, and an SL.

Table A-1 and A-2 show how allowances for reparable items are computed.

Table A-1.
Not Repaired at Stockage Level

Factor	Period
OL	15 days CONUS 30 days CONUS
OST	Average number of actual days over a minimum of 1 year
SL	5 days CONUS 5 days ALOC 15 days OCONUS

Table A-2.
Required at Stockage Level

Factor	Period	Source
RCL	Average annual repairs accomplished	SAMS
OL	Average annual washouts	SAMS
SL	5 days based on average washouts	
OST	Average number of actual days over a minimum of 1 year (washouts only)	SARSS

Tables A-3 and A-4 show the allowance formulas for each computation.

Table A-3.
Not Repaired at Stockage Level

Factor	Formula	
OL	Average daily demand	X 15 days ALOC X 15 days CONUS X 30 days OCONUS
OST	Average daily demand	X Average OST days
SL	Average daily demand	X 5 days ALOC X 5 days CONUS X 15 days OCONUS

Table A-4.
Repaired at Stockage Level

Factor	Formula
RCL	Average daily repaired X RCT X 1.25 - RCT (25 days is a standard, SARSS-0 uses actual times)
OL	EOQ formula using *average daily washout quantity*
SL	*Average daily washout quantity* X 5 days
OST	*Average washout quantity* X average OST days

The ROs are recomputed semiannually or when the balance on hand equals zero, whichever occurs first.

I-Level Repair Cycle Times

In order to estimate Army I-Level RCTs, we visited both Fort Hood and Fort Bragg. Fort Hood gave us two sets of data. The first set consisted of 12 months of actual RCT data for all items repaired at the regional maintenance operation. The second set of data consisted of 12 months of RCT data for all items repaired at I-Level organizations located at Fort Hood. Fort Bragg could not give us similar files, so our Army-wide estimates are only based on the Fort Hood data.

Figure A-2 shows the Army regional maintenance RCT statistics in both averages and dollar-weighted averages. With the data, we were able to separate repair time from transportation time. The repair time clock starts when the maintenance organization receives the unserviceable item and ends when the serviceable item is picked up for return. This time includes not only the actual hands-on repair time but all time spent in maintenance [awaiting parts (AWP) time, queue time, and setup time]. As the data show, the dollar-weighted average repair time is 80 days with a dollar weighted average transportation time of 27.1 days. The total dollar-weighted average exceeds 107 days.

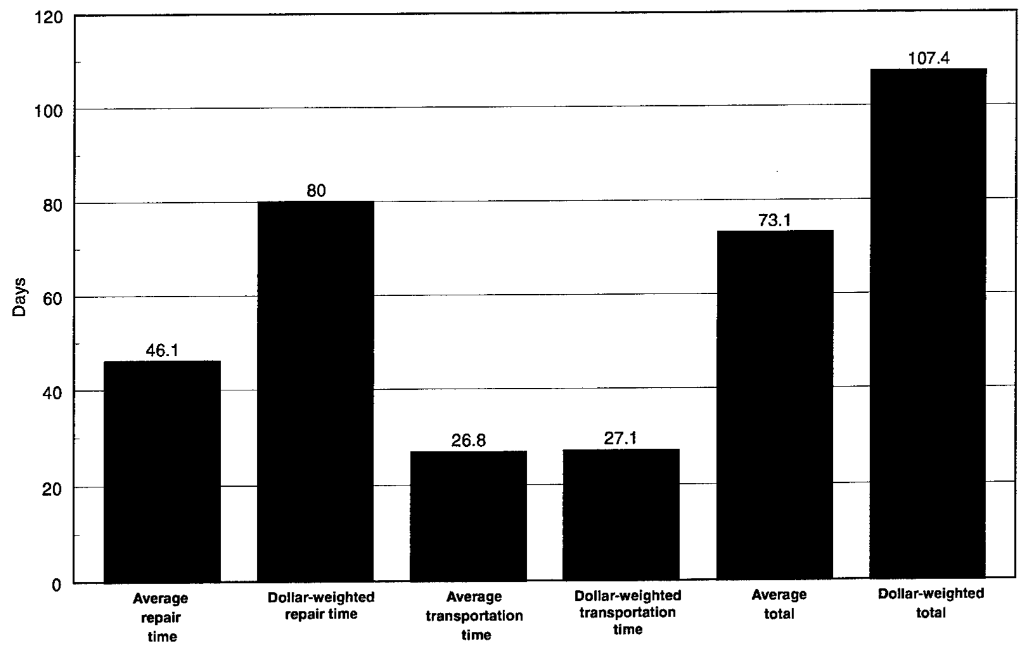


Figure A-2.
Fort Hood Regional Maintenance RCT Data

Figure A-3 and Table A-5 both show I-Level RCT statistics for Fort Hood. The overall average dollar weighted RCT is 68.5 days. Of that, only 4.6 days represent actual hands-on repair time. AWP and other in-maintenance delays account for more than 53.2 days or more than 77 percent of the total. The installation GS maintenance has an average 36.3-day scheduling delay (starts after maintenance receives the item and ends after the first repair action begins) in part because of large induction batch sizes (inducting more carcasses than can be worked during the normal RCT.

Pipeline Costs

From the Fort Hood data, we determined the mix of repair activity between depot-level and field-level items as well as the repair rates, NRTS rates, and washout rates. Table A-6 shows the results of this analysis. By applying these rates to Army-wide retail stock fund requirements and assets data,[1] we estimated the repair cycle requirement (RCR) Army-wide for Army stock-funded activities. As shown in Table A-7, we used the Army standard 25-day RCT used for requirements determination (rather than actual RCT times) to estimate RCR at approximately 116 million.

[1] The Army retail stock-fund report shows a single OST reparable requirement of $126 million that we had to split into separate OST and RCT portions using Fort Hood statistics.

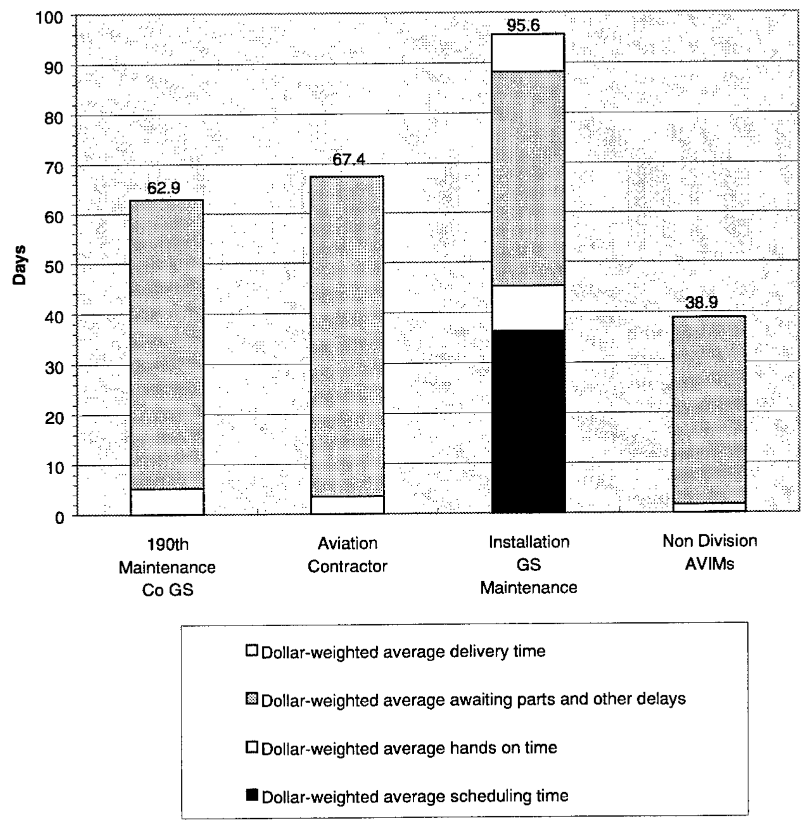


Figure A-3.
Average RTAT Segment

Table A-5.
Fort Hood I-Level RCT Statistics

Type of maintenance activity	Dollar weighted average scheduling time	Dollar weighted average hands-on time	Dollar weighted average AWP and other delays	Dollar weighted average delivery time	Dollar weighted average RCT
190th maintenance Co GS	0.0	5.2	57.6	0.0	62.9
Aviation contractor	0.0	3.6	63.9	0.0	67.4
Installation GS maintenance	36.3	8.9	43.0	7.4	95.6
Nondivision AVIMs	0.0	1.7	37.2	0.0	38.9
Total	8.8	4.6	53.2	1.8	68.5

Table A-6.
Fort Hood Repair Rates

Condemnation level		% Mix of items	
Depot level		53.2	
Field level		46.8	
Condemnation level	**% Repair rate**	**% NRTS rate**	**% Washout rate**
Depot	85.0	14.6	0.4
Field level	95.1	4.6	0.3
Total	92.3	7.3	0.3

Table A-7.
Army Retail Stock-Fund Level Analysis
($ 000)

	Days	$ Level	Total assets	Days demand	Report OST	Percent
RCL	25	116,637	—	4,665	—	9
OST	25	9,677	—	—	126,314	1
SL	5	25,263	—	—	—	2
OL	35	176,840	—	—	—	14
War reserve		60,638	—	—	—	5
NSO		902,441	—	—	—	70
Total RO	65	1,291,495	449,081	5,053		100

Using the percentages of each level to the total for the stock-funded inventory shown in Table A-7, we applied those same percentages to an estimated $900 million O&M ASL requirement in order to derive the RCT portion of the total O&M requirement. Table A-8 shows the results of this analysis. The RCT requirement is estimated at approximately $81 million.

Table A-8.
Army O&M-Level Analysis
($ 000)

	Days	$ Level
RCT	25	81,280
OST	25	6,744
SL	5	17,605
OL	35	123,234
War reserve	—	42,257
NSO	—	628,881
Total RO	65	900,000

Table A-9 shows the total Army-wide estimated RCT requirement.

Table A-9.
Army-Wide-Level Analysis
($ 000)

	Days	Requirements	$ per day
RCL	25	197,917	7,917
OST	25	16,421	657
SL	5	42,868	—
OL	35	300,073	—
War reserve	—	102,895	—
NSO	—	1,531,322	—
Total RO	65	2,191,495	—

APPENDIX B

Navy

SYSTEM OVERVIEW

Inventories of reparable items (depot and field level) in the Navy exist at the wholesale level and retail consumer level. Wholesale reparable assets are stocked at the Fleet Industrial Support Centers (FISCs). Retail consumer reparable assets are also stocked at the FISCs and at the following activities:

- Ships support (nonaviation)
- Ships (nonaviation) as authorized by the coordinated shipboard allowance list (COSAL)
- Tender and repair ships as authorized by tender and repair ship load lists (TARSLLs)
- Supply ships as authorized by fleet issue load lists (FILLs)
- Ship related shore activities as authorized by the coordinated shore based allowance list (COSBAL)
- Ship related depot and intermediate maintenance activities as authorized by the ships operational support inventory (OSI) stock lists
- Aviation support
- Ships (aviation) as authorized by the aviation coordinated allowance list (AVCAL)
- Naval air stations as authorized by the shore coordinated allowance list (SHORCAL)
- Marine Aviation Logistics Squadron (MALS) (AVCAL).

Presently, the consumer-level reparable inventories are operations and maintenance (O&M) funded. In the future, the Navy plans to capitalize these assets into the Defense Business Operations Fund (DBOF). The intermediate maintenance activities are all O&M funded for materials and other expenses.

Intermediate-Level (I-Level) maintenance repairs aviation reparable retail inventories when they have the capability and then returns them to supply stock. For this reason, only the aviation AVCALs and SHORCALS use I-Level repair cycle time (RCT), referred to by the Navy as repair turn-around time (RTAT), as a factor for setting retail levels. The wholesale depot or an I-Level organization (on a repair and return basis with no supply involvement) repairs shipboard reparable retail inventories. Therefore, this appendix focuses on retail inventories of aviation reparables.

Both I-Level maintenance and supply use the Naval Aviation Logistics Command Management Information System (NALCOMIS) to manage the aviation I-Level repair process. NALCOMIS also links to Shipboard Uniform Automated Data Processing System-Run Time (SUADPS-RT) and Uniform Automated Data Processing System-Stock Point (UADPS-SP) for shore activities.

Navy Aviation Process

The Flow of Unserviceable Assets Through I-Level Maintenance

Figures B-1 and B-2 show the general I-Level repair processes for both Navy and Marine activities. These processes are generally the same; the names of the activities performing the supply and maintenance functions are the main difference. When a reparable item fails on an aircraft or at the squadron or operation level, maintenance personnel remove the failed item. If the squadron has NALCOMIS terminals, the mechanic uses the terminal to requisition a replacement component and prepare a maintenance action form. For other squadrons, the process is manual. If a serviceable item is in stock, the item is issued, and the unserviceable is sent to maintenance. If maintenance cannot issue a serviceable item, they process the carcass as an expedited repair (EXREP) and then return it to the squadron. EXREP is the highest priority. If a serviceable is issued and the on-hand balance is zero or below a certain level for critical items, they process the repair as a priority two. All others are processed as a priority three.

If an item is inducted and cannot be repaired, it is condemned and disposed of if it is a field-level reparable or turned in to the wholesale system if it is a depot-level reparable. The latter actions are referred to as BCM. Some items are automatically labeled BCM because the I-Level is not authorized to repair the item. Some other reasons for labeling a reparable a BCM include lack of parts, shop backlogs, and lack of skills. Once an item is labeled a BCM, maintenance prepares a stock replenishment requisition and submits it and obligates end-use O&M funds. At this point, NALCOMIS interfaces with SUADPS-RT for shipboard and MALS sites and UADPS-SP for major shore installations to keep the physical and financial inventory records up to date. SUADPS-RT and UADPS-SP do the financial accounting. For this reason, dual stock balances are maintained between these two systems.

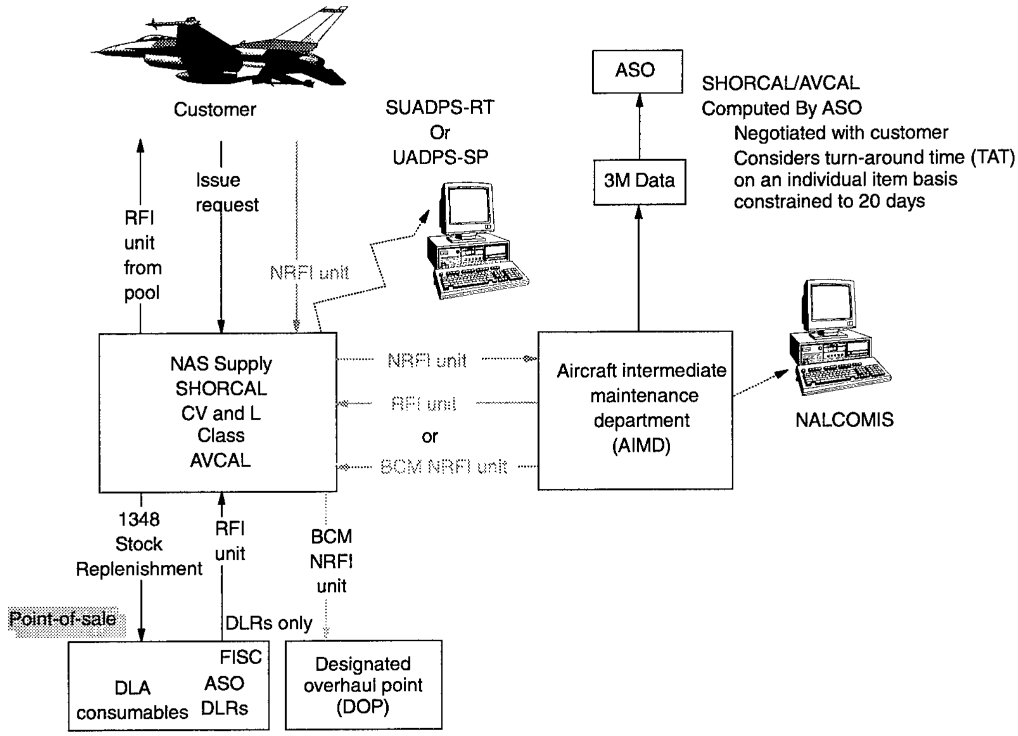


Figure B-1.
Navy Aviation I-Level Repair Process

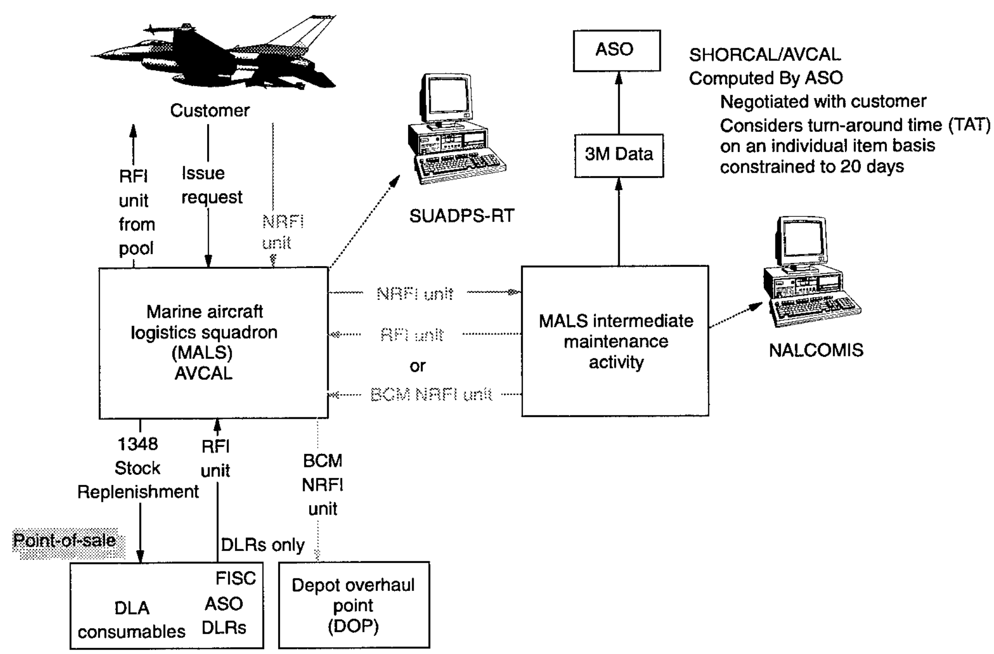


Figure B-2.
Marine Aviation I-Level Repair Process

NALCOMIS keeps track of the four separate segments of RTAT — supply processing time, maintenance scheduling time, awaiting parts (AWP) time, and actual repair time. AWP time starts one hour after the parts requests are processed in NALCOMIS and passed to SUADPS-RT or UADPS-SP. NALCOMIS also tracks failure rates, repair rates, and BCM rates. These data are reported by tape to the Navy's 3M system; the ASO uses them to set AVCAL and SHORCAL allowances.

Credit Policies

The Navy uses a two-price system for depot-level reparables. If they have a carcass to return, the activity obligates stock replenishment requisitions at the net, or repair price, published in the Management List-Navy. This event triggers the Navy's carcass tracking system. The retrograde material must be turned in under the same document number as the requisition in order to close the loop. If a carcass is not received within 90 days, a bill is processed for the difference between the standard price and the net price.

Repair Cycle Times and Requirements

How Allowances Are Determined

ASO computes allowance levels for retail aviation inventories serviced by an AIMD, or MALS. Attrition, repair rates and RCT are derived from maintenance data reported by NALCOMIS to the Naval Aviation Maintenance Office. Allowances are computed as the sum of the rotatable pool and attrition support. The rotatable pool represents the AIMD repair pipeline plus a safety level. TAT is constrained to 20 days and includes the segments and segment constraints shown in Table B-1.

Table B-1.
Turn-Around Time Constraints

Element	Maximum time allowed
Removal to IMA (processing)	1
Scheduling time	3
AWPs	20
Actual repair time	8
Total constrained time	20

The methodology for computing allowances for afloat AVCALS, SHORCALS, and MALS is generally the same; however, there are several differences. The basic formulas for computing the repair cycle quantity is as follows:

- Attrition quantity = monthly BCM quantity * endurance period in months[1]
- Pool quantity = daily repair quantity * average RTAT
- Safety level computed by raw pool quantity poison distribution table
- Repair cycle quantity = raw pool quantity + safety level
- Allowance quantity = attrition quantity + repair cycle quantity

Afloat AVCALS

- Collective BCM rates, repair rates, and average RTATs are used.
- AVCALS are recomputed before deployment.
- Raw pool quantities are adjusted by past and future flying-hour programs.
- Safety level uses 85 percent of the protection table.

SHORCALS

- Site specific BCM rates, repair rates, and average RTATs are used.
- SHORCALS are recomputed on an as-required basis.
- Safety level uses 90 percent of the protection table.

MALS

- Site-specific BCM rates, repair rates, and average RTATs are used.
- MALS AVCALs are reviewed and revised every 36 months.
- Safety level uses 85 percent of the protection table.

[1] One month CONUS shore, two months OCONUS shore, three months afloat and MALS.

I-Level Repair Cycle Times

In order to estimate Navy aviation I-Level RCTs, we visited MALS-29 at New River, North Carolina, and (NAS) Oceana in Norfolk, Virginia. At these two sites, we collected a 12-month history of every national stock number (NSN) repaired locally. For each NSN, these histories included the actual and constrained RTATs, repair rates, BCM rates, and the total number of failures for the period.

Figure B-3 shows the distribution of actual average RTATs across the 1,470 NSNs examined. The average RTAT across the 1,470 NSNs was 10.7 days; however, the median RTAT was only 4 days. The dollar weighted average was 8.9 days. As shown in Figure B-3, the low frequency, long RTAT items drive up the average.

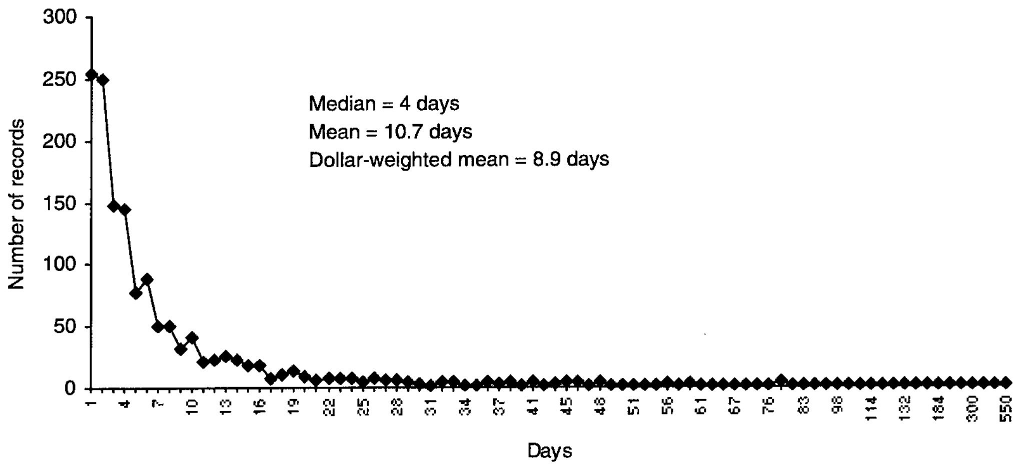


Figure B-3.
Actual RTAT Distribution

Figure B-4 further breaks down the average RTAT into its component segments. Also shown is the influence of the numeric constraints placed in the file when the actual times exceed the maximum authorized. The largest segment of the RTAT is AWP, averaging 3.9 days. Once the maintenance technician places an order for parts through the NALCOMIS system, the job is placed in AWP status if the parts are not received within one hour. Parts that are in stock are normally received the same day. This demand for parts that are either not stocked or backordered drives this average.

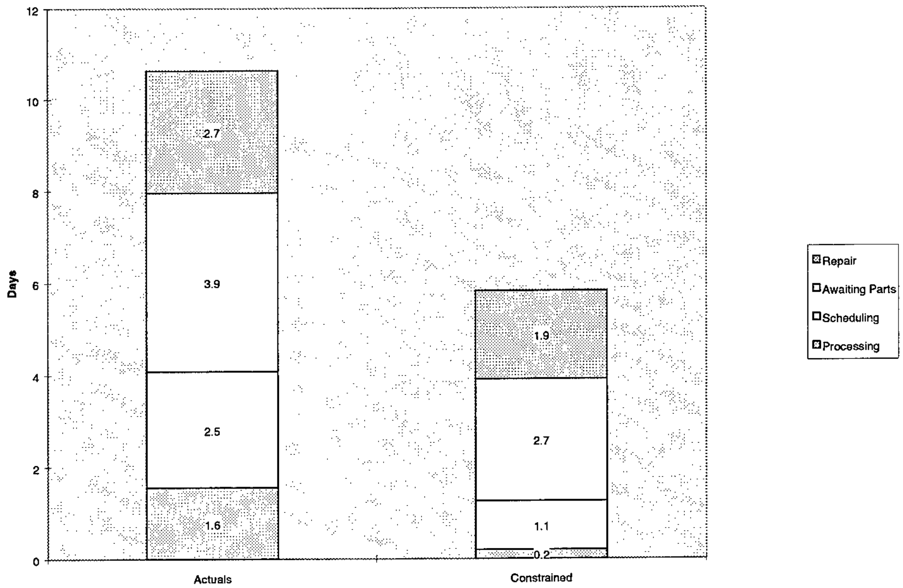


Figure B-4.
Average RTAT Segment

Figure B-5 shows the distribution of actual AWP times across the items analyzed. As shown in Figure B-5, the average AWP time is 3.9 days; however, the distribution reveals the influence of the low frequency, long AWP occurrences. The median AWP time is .4 days.

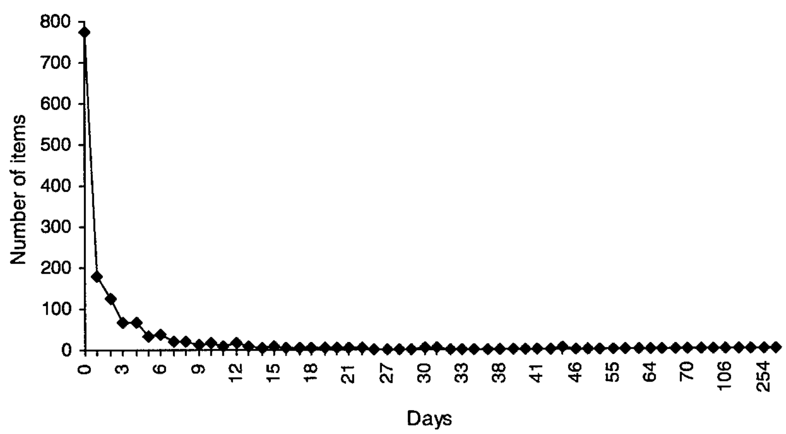


Figure B-5.
Actual AWP Distribution

The same pattern of low frequency, long-time also applies to processing, scheduling, and repair times. The average processing time is 1.6 days; the median is 0 days. The average scheduling time is 2.5 days; the median is .5 days. The average repair time is 2.7 days; the median is 1 day.

Figure B-6 shows the distribution of constrained RTAT data. When we apply maximum time constraints to the actual times, the average drops from 10.7 days to 5.6 days. The dollar weighted average was 6.4 days. The repair rate for the two sites over the 12-month period was 75 percent; that is, 3 out of every 4 items were repaired locally. The remaining 25 percent were either washed out (field level) or labeled BCM (depot level).

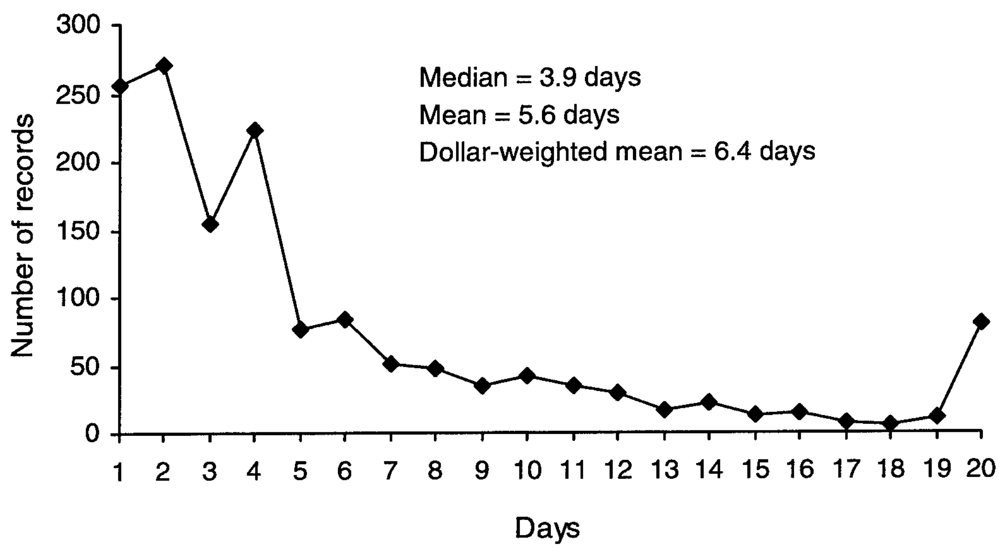


Figure B-6.
Constrained RTAT Distribution Data

Pipeline Costs

Table B-2 shows the estimated dollar value of the ASO provided AVCAL and SHORCAL allowances. Of the total, we estimate that approximately 7.564 billion is inventory served by a co-located intermediate maintenance organization.

Table B-2.
Estimated Value of Aviation Retail Requirements

$ Millions			
	DLR	FLR	Total
MALS	1,610	190	1,800
Yokosuka	447	52	499
Other	1,360	160	1,520
Lamps	729	86	815
ISAL	233	27	260
Bases	1,715	202	1,917
L class	364	43	407
CVs	2,631	310	2,941
FISC	121	14	135
AIMD supported	6,767	797	7,564

Based on the sample data, we applied a 75 percent local repair factor and a 15 percent demand based versus insurance factor against the total requirement and a 6.4-day dollar weighted RTAT. Table B-3 shows the results. We estimate that a day's worth of pipeline for Navy aviation is approximately $133 million.

Table B-3.
Estimated Value of RTAT Pipeline

$ Millions			
	Dollars	Days	Per day
AVCAL/SHORCAL	7,564		
RCT requirement	852	6.4	133

Piece Part Support to Maintenance

Local inventories of consumable material in support of maintenance are stocked based upon demand. If a reparable is in maintenance and the parts required are more than an hour delayed, the item is considered AWP. The statistics for our sample, shown in Table B-4 show that the parts for nearly 85 percent of the repairs arrive in 5 or less days, and over 96 percent arrive within 20 days. The majority of parts requirements are satisfied the same day.

Table B-4.
Awaiting Parts Data

AWP	Count	Running balance	Total (percentage)
0	776	776	52.8
1	179	955	65.0
2	123	1,078	73.3
3	67	1,145	77.9
4	65	1,210	82.3
5	32	1,242	84.5
6	38	1,280	87.1
7	22	1,302	88.6
8	22	1,324	90.1
9	14	1,338	91.0
10	16	1,354	92.1
11	7	1,361	92.6
12	15	1,376	93.6
13	8	1,384	94.1
14	5	1,389	94.5
15	8	1,397	95.0
16	4	1,401	95.3
17	4	1,405	95.6
18	3	1,408	95.8
19	5	1,413	96.1
20	3	1,416	96.3
21	5	1,421	96.7
22	3	1,424	96.9
23	1	1,425	96.9
27	1	1,426	97.0
28	2	1,428	97.1
29	1	1,429	97.2
30	5	1,434	97.6
31	3	1,437	97.8
32	1	1,438	97.8
33	1	1,439	97.9
34	2	1,441	98.0
36	1	1,442	98.1
38	1	1,443	98.2
39	1	1,444	98.2
40	1	1,445	98.3
41	1	1,446	98.4

Table B-4.
Awaiting Parts Data (Continued)

AWP	Count	Running balance	Total (percentage)
42	1	1,447	98.4
45	4	1,451	98.7
46	1	1,452	98.8
47	2	1,454	98.9
52	1	1,455	99.0
55	1	1,456	99.0
57	1	1,457	99.1
62	1	1,458	99.2
64	1	1,459	99.3
66	2	1,461	99.4
67	1	1,462	99.5
70	1	1,463	99.5
77	1	1,464	99.6
88	1	1,465	99.7
106	1	1,466	99.7
112	1	1,467	99.8
146	1	1,468	99.9
254	1	1,469	99.9
291	1	1,470	100.0

Other Considerations

Financial Incentives

If maintenance cannot repair a DLR locally, they turn the unserviceable item in and requisition a serviceable item. Under the Navy two-price system, the activity obligates O&M funds at the net price, which is basically the repair price plus the cost recovery rate. If the item can be fixed locally, the activity expends O&M funds only for the parts consumed. Since O&M budgets are constrained, the incentive is to repair locally whenever possible.

Since the Persian Gulf war, the Navy has decided to transfer the stocks of reparable retail inventories from O&M end-use accounts to the DBOF. Once this process is complete, these assets will be wholesale assets that ASO will manage centrally. However, this change will not have an impact on the financial incentive to repair locally. Customer O&M funds will still be obligated at the net price whenever there is a BCM, and, since the I-Level maintenance shop labor is not within the DBOF, local repairs are considered to be "free" to O&M paying customers.

The decision to repair or BCM does not consider the stock position assets at the wholesale level or the workload requirements at the Navy Aviation Depots (NADEPs). For this reason, the I-Level could be repairing items that have a long supply of serviceable assets at the wholesale level. Also, the situation could exist where there are carcass shortages at a NADEP for a funded program that results in increased indirect labor costs at the same time the I-Level is repairing those same assets. In this case, the Navy is essentially paying twice for the same repair.

Regional Maintenance

The Navy's move to regional maintenance has the potential to decrease recurring costs dramatically. Because of the possible longer transit times involved with moving items from the Air Station to a regional shop, the RTATs may increase slightly. Appendix E discusses the Navy regional maintenance program in greater detail.

APPENDIX C

Air Force

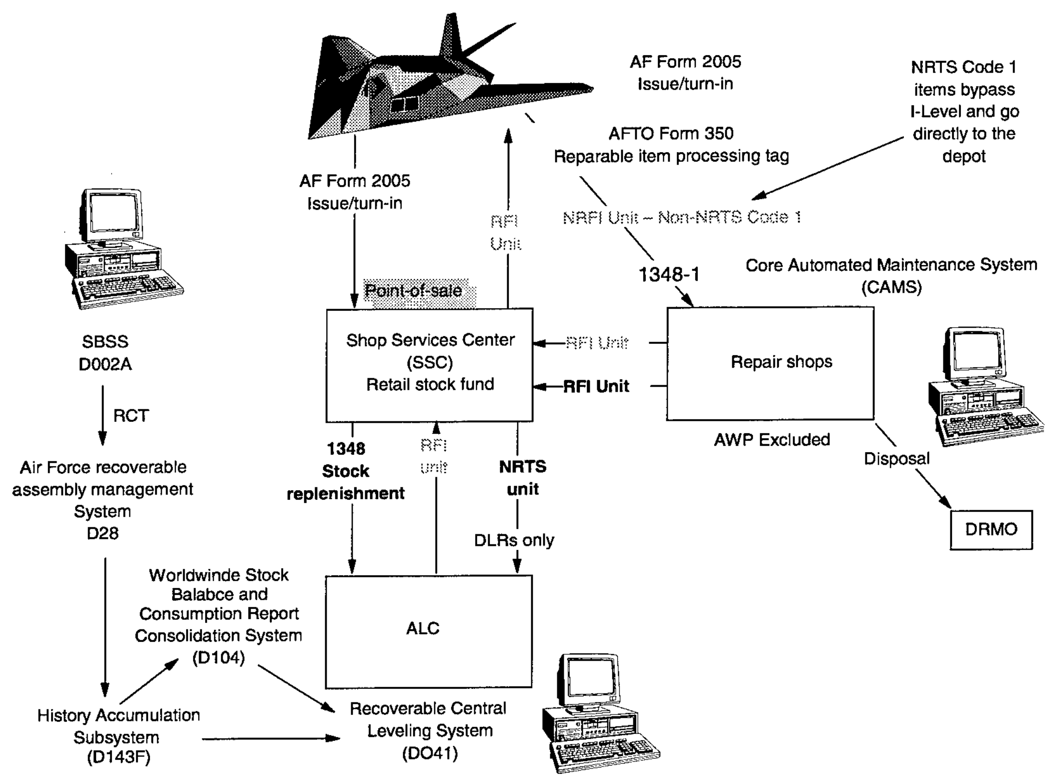
INTRODUCTION

This Appendix describes the Air Force field-level reparable (FLR) process and is based on interviews and research conducted at Headquarters (HQ) U.S. Air Force (USAF), Washington, D.C.; Standard Systems Group and Air Force Logistics Management Agency, Maxwell Air Force Base (AFB), Gunter Annex, Alabama; Warner Robins Air Logistics Center (ALC), Robins AFB, Georgia; 23rd Logistics Group, Pope AFB, North Carolina; and the 436th Logistics Group, Dover AFB, Delaware.

SYSTEM OVERVIEW

The Air Force stocks depot-level reparable (DLR) and FLR items at two inventory levels — wholesale and retail (base level). Wholesale reparable items are stocked at both the wholesale level (DLA distribution depots and Air Force maintenance depots that repair that particular item) and in base supply stocks for operational use [demand supported quantity, pipeline order and shipping time (OST), safety level, and commanders direction] and for the Mobile Readiness Spares Package (MRSP). The MRSP normally contains enough stock to satisfy an initial wartime requirement — essentially the time it would take to establish resupply lines. FLR items are stocked at base supply and consist of quantities that equate to repair cycle time (RCT), safety level and OST quantities to cover those items that cannot be repaired at the base and are either condemned or are sent to another location (maintenance depot or contractor) for repair. The RCT is the amount of time from identification of the need to repair an item until the item is repaired and returned to stock and picked up on the Standard Base Supply System (SBSS) or is determined to be beyond repair and condemned or declared not reparable this station (NRTS) and returned to supply. The inventories of DLRs and FLRs are funded under the stock fund.

Figure C-1 shows the general I-Level repair process. When flight line personnel determine that an item is nonoperative, they take it to base maintenance where it is given a hold status (delayed maintenance) and placed on the repair shop schedule. Time spent in a delayed maintenance status — either waiting to enter a shop or awaiting parts — is not computed in RCT. Once the item is turned into maintenance, personnel submit a request to supply for a serviceable replacement. Supply either issues a serviceable item or gives a due-out to the customer and then, using the SBSS, opens a record on the item referred to as a due-in-from-maintenance (DIFM). This record shows that maintenance owes supply an item in exchange for the one issued or owed to the customer. Both supply and maintenance use the DIFM record to keep track of the repair cycle process. Daily communication between supply and maintenance enables both parties to update the DIFM record with the latest status and location of the items in maintenance. The repair cycle process has three basic categories: (1) items undergoing repair, (2) items awaiting parts, and (3) items that are intentionally not being repaired. When personnel enter one of these codes into the DIFM record, maintenance personnel can update the item status and indicate to SBSS — the system that calculates RCT — whether the time spent in a certain status is in the repair cycle or delayed maintenance. The Air Force uses only the RCT to compute stock levels. Therefore, the RCT recorded in the DIFM record is one of the key factors used to calculate the quantity of an item that must be on the shelf or in the pipeline to support customer requirements. Once the maintenance technicians finish work on an item, they turn it in to supply in either a repaired (serviceable), condemned, or NRTS condition, and the RCT clock stops. The item is then put on the shelf or issued to a customer to fill a due-out, sent to a depot or contractor based on the Reparable Item Movement Control System (RIMCS) code for repair, or, if in a condemned condition, sent to the Defense Reutilization and Marketing Office (DRMO) for disposal.



Note: AFTO = Air Force Technical Order; AWP = awaiting parts; DRMO = Defense Reutilization and Marketing Office; NRFI = not ready for issue; RFI = ready for issue.

Figure C-1.
Air Force I-Level Repair Process

When the wholesale stock of an item falls below requirements, that item is designated critical, and it will not accumulate RCT in the same manner as non-critical assets. Critical items are expedited through the repair shops, and they have a minimum computed repair time of four days and a maximum of ten days. Items remain in a critical status until supply equals or exceeds requirements.

Normally, when a unit turns in an unserviceable FLR and orders a serviceable replacement, the price paid for the serviceable item is the acquisition price plus a surcharge. When the unserviceable is repaired, a review of the Air Force stock status is made, and, if the item is in a buy status or not excess (less than three years of supply), full credit is given to the unit. If the item is in an excess position or the item is NRTS or condemned, the unit does not receive credit.

Repair Cycle Times and Requirements

How Allowances are Determined

The consolidated base supply activity is responsible for the overall management, technical supervision, and maintenance of accountable records for most of the supplies, including FLRs, consumed by the operating units. The system is fully automated and standardized throughout the Air Force. The SBSS is the information management system that runs the process. Operating on a Sperry U2200 computer, SBSS is an automated inventory accounting and control system that is the main line of communication between base units and the wholesale supply system. With the financial programs built into SBSS, the unit and supply personnel can maintain a real-time status of their funds. SBSS also captures maintenance management data pertinent to component repair including repair rates, reasons for nonrepair, repair times, and DIFM status.

SBSS also calculates repair cycle stock levels for all reparable items,[1] and the key criteria are based on the unit price and the percentage of the unserviceables of that particular item that are repaired at the base. The repair cycle demand level (RCDL) for reparables is the sum of the repair cycle quantity (RCQ), order and ship time quantity (OSTQ), NRTS/condemned quantity (NCQ), safety level quantity (SLQ), and a half adjustment factor of 0.5 if the item unit price (IUP) is $750.01 or greater or 0.9 if the IUP is $750.00 or less.

[1] The wholesale system (D041) computes worldwide requirements for DLRs. The sum of the individual base SBSS requirements may be greater than the total wholesale computed requirement.

The Air Force computes the subelements of the RCDL formula as follows:

- RCQ = daily demand rate (DDR) * percent of base repair (PBR) * RCT
- OSTQ = DDR * (1-PBR) * O&ST [2](note 1)
- NCQ = DDR * (1-PBR) * NCT (average # of days it took to determine the item was in an NCT)
- SLQ = C (standard deviation: 1 CONUS/2 OCONUS) * the square root of 3(RCQ+OSTQ+NCQ)
- DDR = cumulative recurring demands divided by current day of the calendar year
- PBR = (repaired units * 100) divided by (units repaired + NRTS + condemned)

I-Level Repair Cycle Times

Since the Air Force computes worldwide base-level requirements for DLRs at the wholesale level based upon actual base RCT data, the central secondary item stratification report includes both the dollar value of the RCT requirement and the average and dollar weighted days. As of 30 July 1995, the average base RCT was 4.4 days; 5.0 days dollar weighted. The Air Force is the only Service that excludes all AWP time in their RCT measurements used for requirements determination. This methodology complies with DoD policy.

As we did with the other Services, we collected data from the two bases visited. Figure C-2 shows the total RCT and AWP times for the two bases. One base was below the Air Force-wide average, and one was significantly above.

Pipeline Costs

As of 15 July 1995, the base RCT requirement for DLRs was $481.4 million. Based on reports prepared by the Air Force Logistics Management Agency, the Air Force had, in March 1995, an additional FLR requirement of $113.3 million. Together, the total RCT requirement for the Air Force is $594.7 million. Using the 5-day average RCT, a day of Air Force I-Level pipeline is estimated at nearly $119 million.

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[2]SBSS excludes from OST computations for any shipment that exceeds a fixed number of days based on the Uniform Materiel Movement and Issue Priority System (UMMIPS) standard for that region. For most items, the SBSS uses 175 percent of the UMMIPS standard. If the receipt is equal to or less than the 175 percent of the UMMIPS standard for that geographical location and for that priority group, the computer will update the calculation for OST days.

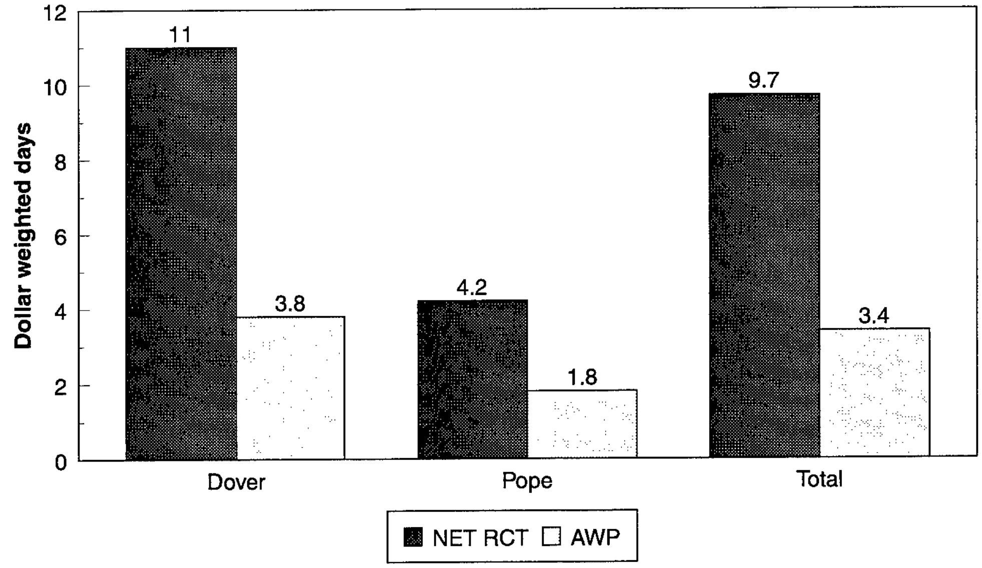


Figure C-2.
Pope and Dover AFB RCT Data

OTHER

During our visits to both Pope and Dover AFBs, we found a very close working relationship between supply and maintenance personnel. Processing and tracking of unserviceable assets was a major effort for all concerned. The logistics groups used daily status reports and held weekly meetings to review DFIM status and determine what needed to be done to move unserviceable items through the process in a more effective manner. They reviewed each DFIM item that was held up for whatever reason and developed initiatives to solve the problem.

The Air Force has developed certain initiatives to reduce RCT. These initiatives include splitting base stocks and placing as many high demand and critical items in forward warehouses located as close to the maintenance shops as possible and using spare part expediters and assigned personnel to manage items that show lengthy delayed maintenance or AWP. They have also set new and challenging RCT standards. In a message to the field, the Air Mobility Command established 4 days as the maximum time it should take to move base repair assets through the repair cycle and only 24 hours for those items designated as critical.

The Air Force has also initiated a program called *Lean Logistics* to improve support and reduce costs. One aspect of this initiative eliminates or reduces FLRs and moves to a two-level maintenance concept. The first level is the flight line, and the second is wholesale (depot or contractor). This initiative started with avionics and engines and will expand to most, if not all, reparables. The

Air Force stated that they have realized considerable savings in dollars and people and are forecasting that, as the program expands, additional savings should be realized.

One area that does need to be addressed is maintenance down time associated with the AWP problem. Personnel at each of the bases commented that this problem of lack of repair parts has been a long-standing issue that continues to be a major obstacle to an efficient operation.

APPENDIX D

Marine Corps

SYSTEM OVERVIEW

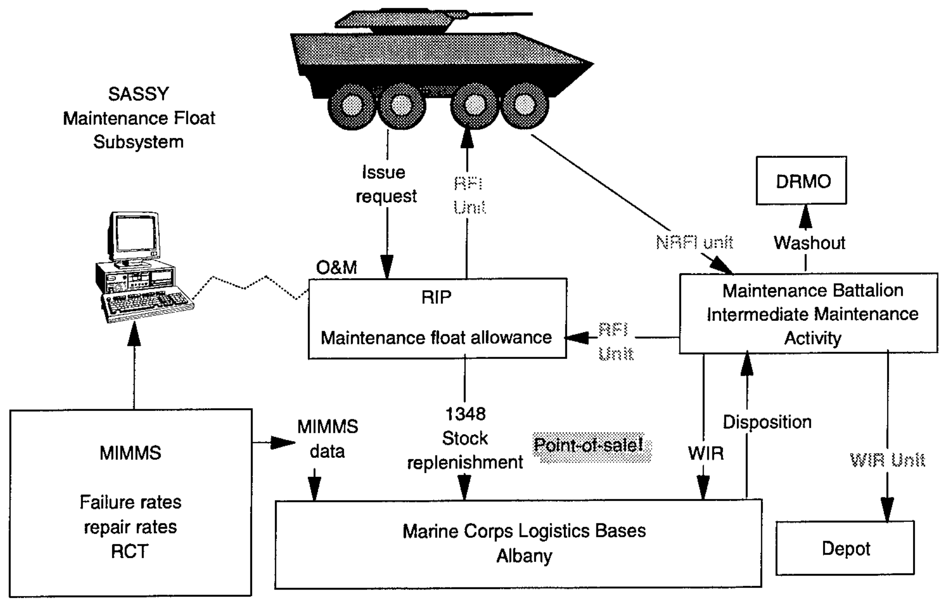
The Marine Corps (nonaviation) secondary depot reparables (SDR) and field-level reparables (FLR) are stocked in two inventory levels — wholesale and intermediate. Wholesale reparables for which Marine Corps Logistics Base (MCLB), Albany, is the inventory manager at the national level are stocked at Albany and Barstow. Reparable issue points (RIPs) stock I-Level reparable inventories. The RIPs are the sole source for the direct exchange of SDRs and FLRs in support of second, third, and fourth echelon maintenance. The RIP inventory is operations and maintenance (O&M) funded.

The RIPs are located at the three FMF Garrisons — the First Force Service Support Group (FSSG) at Camp Pendleton, the second FSSG at Camp Lejeune, and the third FSSG at Camp Butler. MCLB, Albany and Barstow, support other bases, recruit depots, and schools. The Supported Activities Supply System (SASSY) management unit (SMU) manages RIP items. RIP inventories are O&M funded. The Marine Corps Integrated Maintenance Management System (MIMMS) manages the I-Level maintenance of RIP unserviceable assets. A new system, called Asset Tracking for Logistics and Supply System (ATLASS), will replace both SASSY and MIMMS in the future.

MARINE CORPS PROCESS

The Flow of Unserviceables Through I-Level Maintenance

Figure D-1 shows the Marine Corps I-Level repair process. When a reparable item needs replacing, the customer brings the unserviceable directly to the Intermediate Maintenance Activity (IMA). At that time, IMA opens an equipment repair order (ERO) and enters it into the MIMMS system. The customer then goes to the RIP for a replacement item. Once the item is repaired, the IMA closes out the ERO and returns the serviceable item to the RIP inventory. FLRs that are condemned are sent to disposal, and a corresponding wash-through receipt and issue are entered into SASSY. DLRs that cannot be repaired at the IMA are reported to MCLB Albany on a WIR. MCLB Albany then provides disposition instructions that include ship to a depot, continue holding, or send to disposal. This WIR process also applies to SDRs that cannot be repaired within 60 days because of awaiting parts (AWP) problems.



Note: DRMO = Defense Reutilization and Marketing Office; NRFI = not ready for issue; RFI = ready for issue; WIR = reportable item report.

Figure D-1.
Marine Corps I-Level Repair Process

Credit Policies

When a DLR cannot be repaired at the I-Level, the SMU must requisition a serviceable item from the wholesale supply system. If MCLB Albany is the item manager, the item is requisitioned at the repair price. If another Service manages the item, it is requisitioned at the standard price. For these items, the managing Service may or may not issue a credit for the unserviceable. Under the current fiscal year 1995 policy, the Services can issue credits if the carcass is turned in; however, Camp Lejeune is experiencing problems getting credits from some of the Services.

Repair Cycle Times and Requirements

How Allowances Are Determined

The five kinds of RIP allowances are

- requisitioning objective (RO) (demand based),
- mount-out allowance (MOAL),
- local commander-designated insurance items for critical low-density (CLD) equipment,

- provisioning allowance (PAL), and
- special insurance.

The RO includes a repair cycle requirement (RCR), an order and shipping time requirement (OSR) for the items that wash out or are beyond the capability of maintenance to repair, a safety level (SL), and an operating level (OL). Special allowances may also be included in addition to the RO. The following three tables show how the Marine Corps computes RIP allowances (D-1 through D-3).

Table D-1.
RIP Allowance Factors

Factor	Period	Source
Maintenance failure rate (MFR)	Average per month	MIMMS
Repair rate (RR)	Average per month	MIMMS
Repair cycle time (RCT)	Average number of days over 12 months	MIMMS
Operating level time (OLT)	30-days CONUS, 60-days OCONUS	——
Order and shipping time (OST)	Average number of days over 12 months	SASSY
MOAL	Fixed quantity	——
Special allowance (SPL)	Fixed quantity	——
CLD/PAL	Fixed quantity	——

Table D-2.
RIP Allowance Formulas

Factor	Formula	Comment
RCR	(RR x RCT)/22, capped at 90, includes AWP	Work days in month
Resupply rate (RSR)	MFR − RR	
OL	(RSR x OLT)/30	
OSR	(RSR x OST)/30	
SL	RCR + OSR table	Poison distribution – 90 percent confidence level
RO	RCR + OSR + SL + OL	
Mount-out storage level (MOSL)	RO + MOAL	
Total allowances	Larger of MOSL and CLD/PAL + SPL	

Table D-3.
RIP Safety Levels

RCR + OSR	SL	RCR + OSR	SL
1	1	144 to 162	16
2 to 3	2	163 to 183	17
4 to 7	3	184 to 205	18
8 to 11	4	206 to 228	19
12 to 17	5	229 to 253	20
18 to 24	6	254 to 279	21
25 to 33	7	280 to 306	22
34 to 42	8	307 to 335	23
43 to 53	9	336 to 365	24
54 to 65	10	366 to 396	25
66 to 79	11	397 to 429	26
89 to 93	12	430 to 463	27
94 to 108	13	464 to 498	28
109 to 125	14	499 to 535	29
126 to 143	15	536 to 573	30

Once each year, the SASSY management unit recomputes allowances and forwards allowance data to MCLB Albany for approval. MCLB Albany ensures that the allowances are properly computed and that total allowances do not exceed available assets.

I-Level Repair Cycle Times

In order to examine Marine Corps nonaviation RCTs, we visited Marine Corps Headquarters; the second FSSG SMU and Maintenance Battalion at Camp Lejeune, North Carolina; and MCLB, Albany, Georgia. Headquarters gave us summary requirements and asset data for each of the three FSSGs. At Camp Lejeune, they gave us a file that contained factors used for the last annual recomputation of RIP allowances. At MCLB Albany, we received copies of the formulas used to compute allowances.

Table D-4 shows the results of our analysis of the RIP recomputation file. Because unit prices were not listed, we added unit prices from the March 1995 Federal Logistics Data on CDROM (FEDLOG) application in order to compute requirements by dollar value. The total dollar value of the allowance was more than $77.6 million. The RCR was more than $19 million, or nearly 25 percent of the total and represented an average RCT of over 47 days.

Table D-4.
Analysis of RIP Data

	DLR			FLR			Total		
	Dollars	Days	Items	Dollars	Days	Items	Dollars	Days	Items
RCT	17,803,358	47.65	341	1,304,823	46.92	293	19,108,182	47.31	634
OST	17,054,696	29.88	527	1,863,202	29.01	370	18,917,899	29.51	897
SL	17,062,251		584	1,641,089		442	18,703,340		1,026
OL	14,507,970	30	559	1,861,514	30	399	16,369,483	30	958
Other	3,981,417		123	573,176		114	4,554,593		237
Total	70,409,692		706	7,243,804		482	77,653,496		1,188

Figure D-2 shows the distribution of RCTs across the national stock numbers (NSNs) managed. The figure reveals that over half of the NSNs have repair times greater than 41 days.

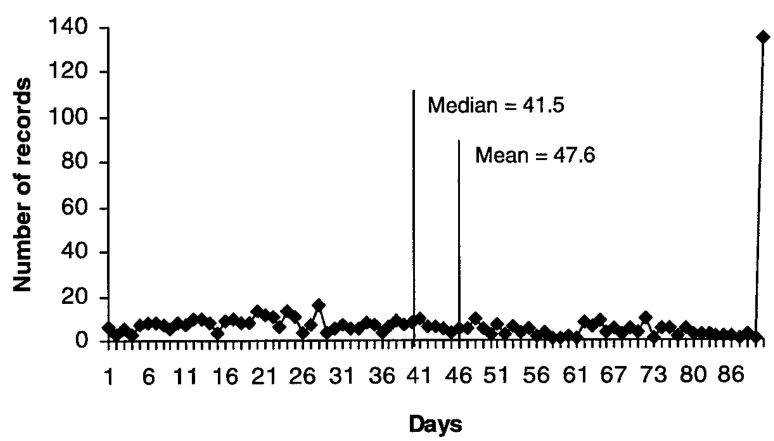


Figure D-2.
RCT Distribution

Table D-5 shows the results of applying the average RCT and RCR percent of total from table D-4 to the total allowance and asset data provided by Headquarters.[1]

Table D-5.
Marine Corps Totals By FSSG

$ in millions					
Activity	RO	On-hand condition	In maintenance /on order	Above RO	Excess dues
First FSSG					
Repair cycle	18.41				
OST	18.22				
SL	18.02				
Operating level	15.77				
Other	4.39				
Total	74.80	46.60	28.20	5.10	4.80
Second FSSG					
Repair cycle	14.00				
Order and shipping time	13.86				
Safety level	13.70				
Operating level	11.99				
Other	3.34				
Total	56.90	39.30	17.30	7.30	3.20
Third FSSG					
Repair cycle	23.38				
Order and shipping time	23.14				
Safety level	22.88				
Operating level	20.03				
Other	5.57				
Total	95.00	49.90	45.10	4.30	3.30
Grand Total	226.70	135.80	90.90	16.70	11.30

The Marine Corps RCT is long because of a combination of AWP time and maintenance backlog (included in the Marine Corps RCT measurement). The Second Maintenance Battalion is operating at below the authorized level, and, since Battalion personnel are nearly all active duty Marines, they have other

[1] The total requirement in the second FSSG recomputation file extended at the standard price obtained from FEDLOG was $77.7 million; the total RO for the Second FSSG provided by Headquarters was $56.9 million. For this reason, we used the lower value provided by Headquarters for a total and applied the factors from the recomputation file to compute the various levels.

military duties to perform in addition to I-Level maintenance. The new ATLASS computer system will relieve some of the administrative time associated with ERO processing and repair part ordering.

By policy, the Marine Corps caps RCT at 90 days. In I-Level RCT terms, this number is high. In fact, 135 of the 634 items having an RCT requirement had 90 days.

The Army generally uses a fixed 25 day RCT; the Navy caps their RCT at 20 days, and the average I-Level RCT in the Air Force is 5 days. If the Marine Corps capped their RCT at 25 days, the average RCT would drop to 22 days. If they capped at 50 days, the average RCT would drop to 36 days. To accomplish this change without having an impact on readiness and without increasing the WIR rates (and thus increasing O&M stock replenishment requirements), the Marine Corps must greatly reduce maintenance backlogs and AWP delays. This change may mean investing more in repair part inventories, especially low demand, insurance type items, and eliminating some of the nondirect labor demands on the I-Level workforce.

Pipeline Costs

Table D-6, a summary of the data above, shows that the estimate of the total Marine Corps I-Level RCR is $55.78 million. This figure represents an average RCT of 47.65 days and a dollar weighted average of 60.8 days. Therefore, each day of RCT equals approximately $.92 million.

Table D-6.
Pipeline Costs

$ in millions			
	RO	Days	Days pipeline
Marine Corps Total			
Repair cycle	55.78	60.80	0.92
Order and shipping time	55.23	29.88	1.85
Safety level	54.60		
Operating level	47.79	30.00	
Other	13.30		
Total	226.70		

Piece Part Support to Maintenance

The SMU also stocks consumable repair parts to support the I-Level maintenance effort. They use a days of supply model and build a requisitioning objective roughly equal to four months of demand based on the average monthly demand. The MIMMS system closely monitors parts requirements for each open ERO and produces management reports that are used for expediting shortages. The significant AWP problems they encounter are the ones in which the wholesale system has backorders with long contract delivery dates. The Marine Corps expressed concern at the number of DLA managed items that are migrating to nonstocked status. For these items, they are always a contracting and production lead-time away from having an order filled. Both DLA and the Marine Corps should work closer together to help alleviate this problem.

Funding Considerations

Financial Incentives

The RIP inventory is O&M funded. When an unserviceable allowance item is successfully repaired at the I-Level, the local commander only spends O&M dollars for the repair parts needed to effect repair. Since the great majority of I-Level maintenance personnel are Marines, Military Personnel appropriations cover their direct and indirect labor. Therefore, the total costs associated with repair at the I-Level are not visible to the local commander.

However, if the SMU must requisition a serviceable, the local commander's O&M account is charged either the repair price (for MCLB Albany managed items) or the standard price with the possibility of receiving a credit. In either case, the price includes both the labor and the materials as well as a surcharge to cover wholesale operations. Clearly, the financial incentive is to effect repairs locally.

O&M Versus Stock Funding

During our visits with Marine Corps Headquarters, MCLB Albany and Camp Lejeune, we explored the pros and cons associated with O&M funding versus stock funding of the I-Level reparable inventory. Headquarters personnel felt that stock funding might have a slight advantage because it would probably result in lower I-Level inventories through a lower obligation authority to sales ratio. Both MCLB Albany and Camp Lejeune were opposed to stock funding because they felt it would increase the complexity and administrative requirement of operating the SMU.

All three commands felt that the financial incentives to repair at the I-Level versus requisition from the wholesaler would remain unchanged under either funding scenario. If the SMU were retail stock funded, the O-level could buy serviceable items from the SMU at a repair price if they turned in a carcass. The SMU could then spend that income on the direct material needed to accomplish the repair. If the item could not be fixed, the SMU could requisition a serviceable and the retail stock fund would be billed by the wholesale stock fund at a higher price than if the repair had been accomplished locally.

Appendix E

Navy Regional Maintenance

Background

The Navy has traditionally operated separate facilities for intermediate and depot-level maintenance support of ships and aircraft. For ships, repair ships (i.e. tenders) and shore-based Ship Intermediate Maintenance Activities (SIMAs) provide I-Level support, and public and private shipyards provide depot-level support. For aircraft, aircraft intermediate maintenance departments located on aircraft carriers afloat and naval air stations ashore provide I-Level support, and Naval Aviation Depots (NADEPs) provide depot-level support. Although many of the Navy's intermediate and depot-level maintenance capabilities are similar, there are significant differences in the types of work required by aircraft, surface ships, and submarines. Accordingly, the Navy has historically used separate maintenance facilities for aviation, surface, and subsurface systems. In addition, separate facilities frequently support different subgroups of ships and aircraft. For instance, a recent study of equipment calibration services in the Tidewater area revealed that several different activities provided similar services within close proximity to each other and that most of these activities were operating at a fraction of their maximum capacity.[1]

Overview

In the current era of dramatically reduced force structures and increasingly austere budgets, the Navy cannot afford to retain excess or duplicate maintenance capabilities and infrastructure. Consequently, the Chief of Naval Operations (CNO) has decided to consolidate most of the Navy's shore-based intermediate and depot maintenance facilities into eight Regional Maintenance Centers (RMCs) as shown in Figures E-1 and E-2.[2] The Atlantic Fleet will operate RMCs in the Northeast, Mid-Atlantic, Southeast, and Gulf Coast (Ingleside, Texas). The Pacific Fleet RMCs will be located in the Pacific Northwest, San Diego, Hawaii, and Japan. The industrial hub of each RMC will be a Naval Shipyard (NSY), Ship Repair Facility (SRF), or NADEP. Each RMC will also encompass several Regional Repair Centers (RRCs) that will focus on specific repair processes (e.g., propulsion, electrical, and structural). The number of RRCs in each RMC will vary, depending on the specific repair requirements and

[1] *Regional Maintenance Working Group Tidewater Calibration Consolidation Study Team Report*, May 1994.

[2] Graphics adopted from the Brief to the BRAC Commission Staff presented by RADM Jim Taylor, Chairman, Maintenance Support Quality Management Board, 21 December 1994.

capabilities in that region. The Naval Capabilities (NAVCAP) model and product-focused database provide the means to identify common products, processes, skills, equipment, and capacities throughout the Navy. The NAVCAP database, which includes both intermediate and depot-level information, contains detailed maintenance capability and capacity data on a product-by-product basis. These data are used in business case analyses to determine the efficacy of establishing RRCs for specific workload categories. Based on the results of these analyses, RRCs may be established in stand-alone facilities or co-located with an industrial hub. For example, the Calibration RRC and Material Engineering RRC for the Mid-Atlantic region are located in stand-alone facilities that were formerly occupied by the NADEP, and the Motor Rewind RRC is co-located with the NSY.

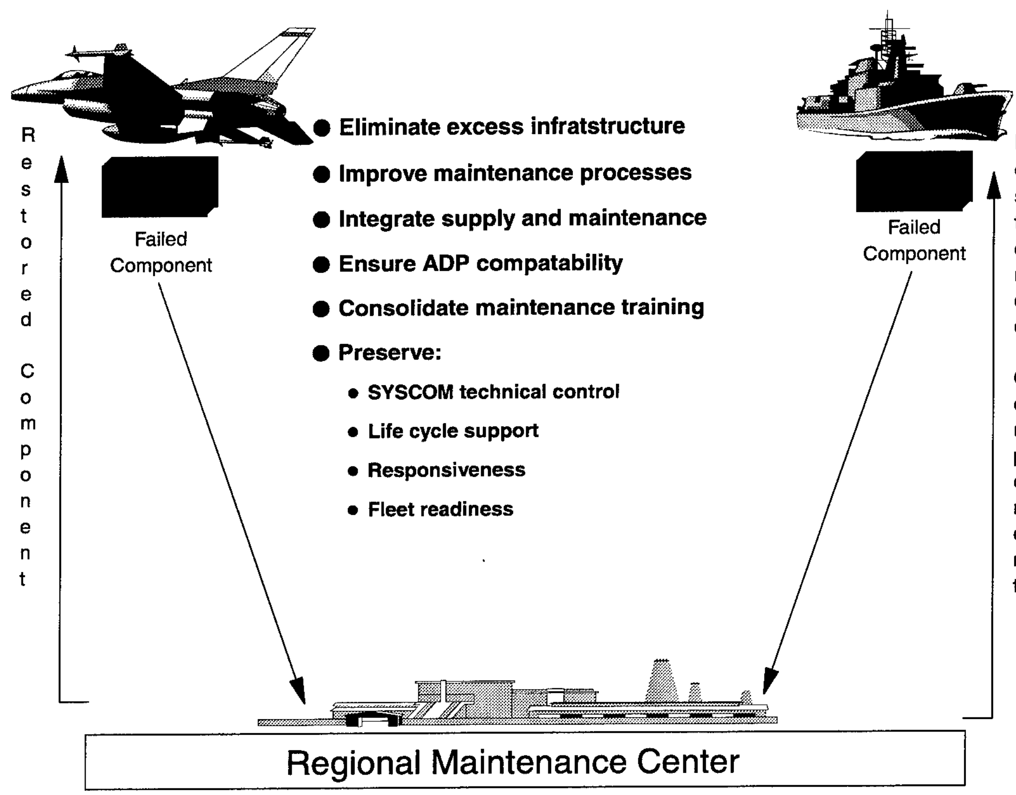
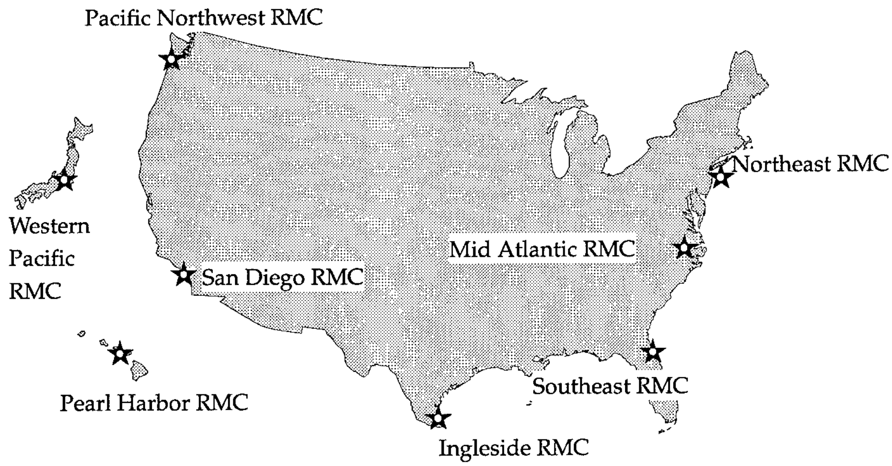


Figure E-1.
RMC Objectives



Pacific Fleet

Pearl Harbor
San Diego
Pacific Northwest
Western Pacific

Atlantic Fleet

Northeast
Mid Atlantic
Southeast
Ingleside

Figure E-2.
RMC Locations

Implementation Plan

The CNO has approved the following RMC implementation plan.[3]

- Phase One (FY95 to FY96)
  - identify/establish RMC and RRC prototypes
  - consolidate/integrate intermediate maintenance functions
  - right-size engineering technical support
  - regionalize integrated supply operations
- Phase Two (FY96 to FY99)
  - consolidate/integrate intermediate and depot maintenance functions
  - establish remaining RMCs and RRCs
- Phase Three (FY97 to FY99)

[3] This plan is addressed in NAVOP June 1994 (CNO 282136Z March 1994).

- develop unified maintenance policies/processes
- adopt common business practices
- integrate management information systems

Organizational Precepts

The following RMC organizational precepts have been approved by the Atlantic and Pacific Fleet Commanders in Chief (CINCs).[4]

- single regional maintenance point of contact
- regional industrial consolidation
- integrated civilian and military workforce
- common management information systems
- dual reporting by maintenance commanders
  - Fleet Commanders exercise operational/fiscal control
  - Systems Commanders retain technical authority

Prototype Activities

RMC prototypes were established in the Mid-Atlantic and Pacific Northwest regions on 1 October 1995.

- Mid Atlantic RMC
  - Norfolk Naval Shipyard will be the industrial hub
  - RRCs will initially be established for the following processes:
    - electric motor repair
    - calibration services
    - materials testing
    - pump repair and test
    - machining

[4] These precepts were approved at the 15 August 1994 CINCs' Conference.

- avionics/electronics
- gas turbine engines
- diving/underwater welding
- foundry/forging

- Pacific Northwest RMC
  - Puget Sound Naval Shipyard will be the industrial hub
  - RRCs will initially be established for the following processes:
    - pump repair and test
    - circuit breaker repair
    - periscope repair
    - pump prime mover
    - calibration services
    - valve repair
    - automatic test equipment repair

Implementation Planning and Oversight

A Regional Maintenance Implementation Board (RMIB) has been established to oversee RMC implementation. The RMIB is chaired jointly by the Atlantic and Pacific Fleet Maintenance Officers (FMOs) and includes representatives of the major Navy commands involved with regional maintenance. It has overall responsibility for reengineering Navy and Marine maintenance processes, defining and developing RMC business policies and standard operating procedures, and ensuring uniform RMC implementation in both Fleets.

Management Structure

The Navy has developed an Integrated Fleet Maintenance Model (IFMM) to describe how maintenance work is planned and executed at all levels.[5] The IFMM is currently being used to evaluate alternative RMC management structures in order to ensure that all applicable maintenance processes and interfaces

[5] Integrated Fleet Maintenance Working Group, *Integrated Fleet Maintenance Model,* February 1994.

are addressed. Although the evaluation process has not yet been completed, current plans call for establishing the Mid-Atlantic and Pacific Northwest RMC prototypes as direct and mission-funded activities that report directly to their respective FMOs.[6]

Automated Information System Support

The Navy has historically used a variety of stand-alone automated information systems (AIS) to support specific elements of its intermediate and depot maintenance programs, but currently none of these systems can support an RMC environment. Consequently, the Navy has initiated an intensive effort to integrate existing AIS capabilities in order to achieve adequate functionality to encompass all applicable maintenance processes in the IFMM.

Projected RMC Benefits

By streamlining shore-based maintenance operations and eliminating excess maintenance capabilities, establishing the RMCs will result in significant cost savings even though it may incrementally lengthen some I-Level RCTs and, thereby, slightly increase associated inventory requirements. Although it would be premature to project the overall magnitude of savings at this time, the initial results of prototype consolidations are very encouraging. For example, establishing the Mid-Atlantic Calibration RRC consolidated 32 separate calibration laboratories into one main laboratory with three satellites and reduced the associated staffing level from 333 to 191.[7] Similarly, establishing the Mid Atlantic Motor Rewind RRC consolidated nine repair activities into one and reduced the associated staffing level from 167 to 62.[8] In addition, integration of supply and maintenance in the Mid-Atlantic RMC has already reduced inventory and expedited repair cycles.

Potential Problem Areas

While the general consensus is that the Navy must streamline its maintenance infrastructure, there is a broad diversity of opinions on specifically what changes are required and how fast those changes should be implemented. In particular, serious concerns have been raised about RMC ownership and funding. These concerns focus primarily on whether fleet readiness will be enhanced or degraded by dramatic changes in existing maintenance management policies and procedures. For obvious reasons, the ownership issue is highly contentious, but the funding issue may involve more significant readiness implications.

[6] Memorandum for Budget Submitting Offices, *Guidance for the Preparation and Submission of FY 1997 Budget Estimates for the Department of the Navy (DON) Budget and Apportionment Review*, Navy Comptroller, FMB-3/BG 95-6, July 1995.

[7] Mid-Atlantic Regional Maintenance Center Development and Operations Plan, January 1995.

[8] Ibid.

Although it might initially seem most appropriate to operate RMCs as mission-funded activities, the Defense Business Operating Fund (DBOF) provides financial flexibility and continuity that are virtually essential for efficient industrial operations. Consequently, some combination of mission funding and DBOF funding for RMCs will probably be required.

Summary

Establishing RMCs provides an extraordinary opportunity to make Navy maintenance support more cost-effective by breaking down some of the barriers that have historically separated the aviation, surface warfare, and submarine communities. However, fundamental reengineering of existing maintenance management processes is necessary so that such a radical change can be successful. This reengineering effort is currently underway and making rapid progress, but several major issues (e.g., integrated AIS support, ownership, and funding) still must be resolved.

APPENDIX F

Army Regional Maintenance

The Army has developed a regional maintenance concept for sustainment maintenance (see Figures F-1 and F-2) (all maintenance conducted on Army equipment above the direct support level). A proof of principle (PoP) of the general support (GS) piece (with some wholesale involvement) of the concept was conducted at Forts Carson, Hood, and Riley; the regional maintenance manager is located at Fort Hood in the 13th Corps Support Command. The Army believes the PoP was successful and has now expanded the original region to include Forts Bliss and Sill and the National Training Center. An additional region is being established in the 18th Airborne Corps; the regional maintenance manager will be located in the 1st Corps Support Command at Fort Bragg.

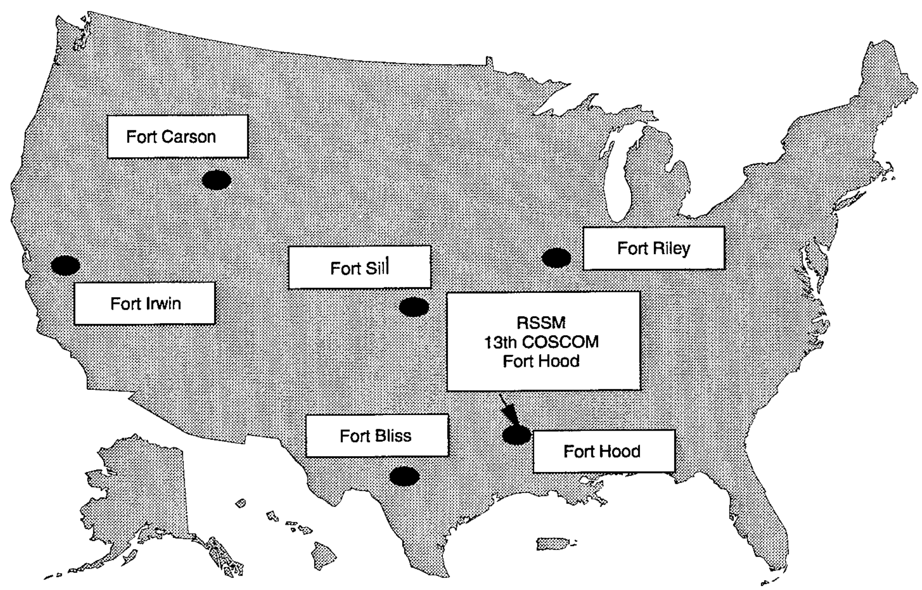


Figure F-1.
III Corps Region

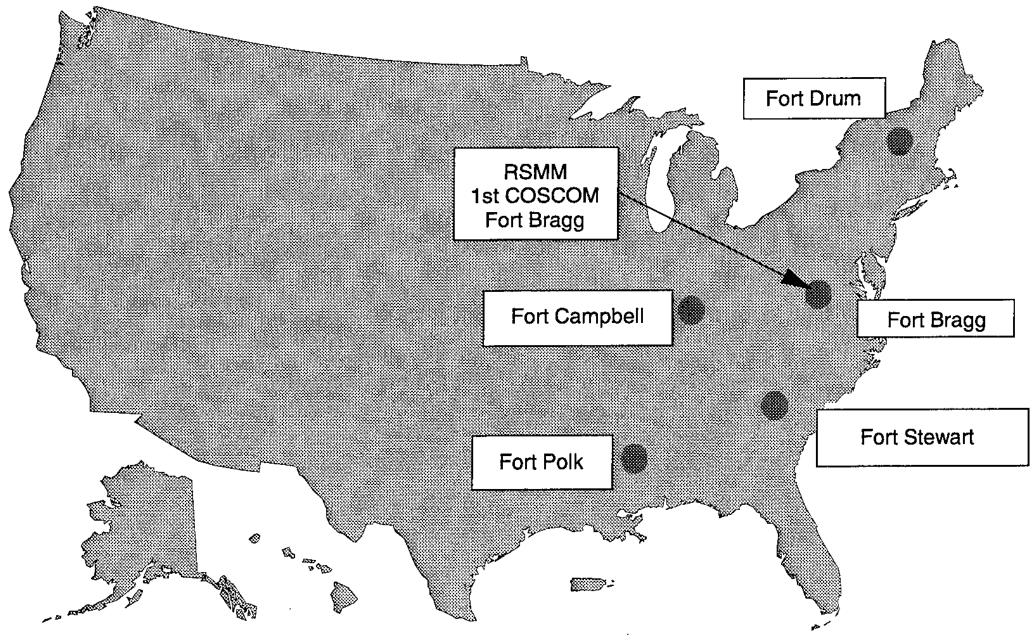


Figure F-2.
XVIIIth ABN Corps Region

The Army's regional maintenance concept focuses on centralized management and decentralized execution. The goal of regional maintenance is to maximize repair capability while providing the same or improved readiness at reduced costs. Through resource allocation, workload distribution, and decentralized execution of maintenance work, the concept seeks to maximize repair capabilities and optimize use of available resources.

A wide variety of Active and Reserve Component GS maintenance units, nondivisional aviation intermediate maintenance units, Installation Directorate of Logistics (DOLs) maintenance activities, and contractors perform this level of maintenance and, in varying degrees, were involved in the PoP. Local sustainment maintenance managers (LSMMs) drawn from each installation's DOL operated the local repair programs and managed workloads assigned to the GS activities in their geographic areas. The Regional Sustainment Maintenance Manager (RSMM) located in the Materiel Management Center, managed and set priorities for workload in the region.

The Army uses the Production, Planning, and Control (PP&C) process at the local and regional levels as a major tool to plan and control sustainment maintenance requirements and performance. At the local level they use the PP&C process to review and adjust current year production programs and to identify the requirements for the following fiscal year. The LSMM develops the following year program, based on requirements from supply managers, for all the sustainment maintenance activities in the assigned geographical area. They consider all of their requirements against their capacity and capability and forwards the program to the region. The LSMM indicates what work he can execute and highlights those areas in which he cannot execute his program for lack of capability or capacity and, conversely, those areas which have excess capacity that can be used for regional programs. The RSMM, and representatives from each of the LSSMs use the PP&C process to review each Installation's program, makes adjustments, and then issues a workload directive to each LSSM to execute the approved program.

Within a region, many of the field-level reparables on the installation reparable exchange list are common to more than one installation. Multiple installations repair the same item; a single installation repairs the common item because the others either lack the capacity or capability or do not generate enough assets to justify establishing a repair program, or none of the installations repair the item for lack of capacity or capability or lack of volume to justify establishing a repair program.

Under the regional maintenance concept and for those common or potential common items, each installation will bid (repair parts and labor only) on performing all or most of the regions work for that item. The work may be split among installations for many reasons, but the prime reason is a training requirement. These bids are reviewed during a regional PP&C for readiness impacts, cost avoidance, and annual demands. Based on the review process, they develop a prioritized list of items that will be repaired on a regional basis, designate installations to be Centers of Technical Excellence (CTE), and assign them all or most of the regions workload for a particular item.

Under the regional maintenance concept, installations in the region can use an almost full cost methodology (parts, labor, general and administrative (G&A), and overhead but not deprecation) to set rates and submit bids for selected repair tasks. These tasks involve items that the wholesale (National) item managers must have repaired, but, for many reasons, they cannot satisfy their requirements through any other means.

The Army believes that the efficiencies gained through managing reparables on a centralized and integrated basis have clearly been demonstrated. The following are the key indicators:

- With only one or two isolated anomalies, weapons system readiness rates have been sustained at a level equal or higher than rates before regionalization.
- Initially, the regional manager approved 65 prime national stock numbers (NSNs) for repair by the CTE. Based on the success of this concept and with all participants agreeing, the number of reparables worked by the CTE grew to 150 by the end of the 9 months PoP and now includes 343 items.
- The final PoP evaluation report states that the actual net production savings (actual labor and parts costs versus preregionalization labor and parts cost)

for repair of 1,553 items totaled $723,870. Furthermore, the Army analysis of the original 65 CTE prime NSNs, which factored in additional criteria such as maximizing repairs and minimizing procurement, projected a potential cost avoidance of $4,440,000. The report also states that the extrapolation of those data to the entire regional repair program identified a potential annual cost avoidance of $11,400,000.

- Many of the wholesale item managers who have participated in the regional program have been very impressed with the concept, and, currently, wholesale directed items are being worked at the regional CTE.

Because of a color of money problem (some installations reparables are funded under a retail stock fund and others are funded with O&M), the CTE process has developed into a CTE repair and return to the originating installation process. Under this procedure, the unit turns in the unserviceable to the exchange point at its installation where it is processed to the DOL, and the DOL documents it and forwards it to the transportation office. The transportation office packages it and makes the shipping arrangements. The item is then shipped to the CTE installation. At the CTE installation, it is repaired and shipped back to the originating installation for processing to supply, where it is put on the shelf.

Even using premium transportation, the transportation turn-around time is long. Among the installations involved in the region at the end of May 1995 (Forts Carson, Hood, and Riley), the transportation turn-around times have averaged a low of 16 days from Fort Carson to Fort Riley and return to Carson to a high of 39 days from Fort Carson to Fort Hood and return to Carson. The transportation times added to the average 37 days it takes to process and repair an item at the CTE result in a long repair cycle time. This situation is partially negated by the fact that the region uses a standard 25 days — in some cases 30 days — RCT in calculating order and shipping time (OST). To help solve the transportation problem, the region was directed, in June 1995, to ship all items under 150 pounds by Federal Express. Since approximately 75 percent of all CTE items meet this criterion, there should be a major reduction in the turn-around times. An independent evaluator will conduct a cost-effectiveness analysis on this initiative. The regional and local managers are working on ways to further reduce the overall RCT.

With the actual RCT averaging between 53 to 76 days, and the region using a standard of 25 to 30 days to compute OST driven stock levels, at some point stocks will be depleted, and the procedure will have an impact on readiness. Once the excess stocks are consumed, the only alternatives available will be to use actual RCT in the OST computation and drive up the requirements objective, or drive down the actual RCT to match the 25 – 30 day standard. Reducing the actual RCT seems to be the least costly.

The ultimate goal of the regional maintenance program is to fund all the stocks under the retail stock fund. When this goal is reached, the items will not be returned to the originating installation but will be repaired and put on the shelf at the CTE installation.

While the Army is currently operating one expanded region (Forts Carson, Bliss, Hood, Riley, Sill, and the National Training Center, Reserve Components, and contractors) and establishing a region in 18th Airborne Corps, the overall direction is to expand the regional maintenance concept over the entire Army.

Appendix G

Glossary

AFB	=	Air Force Base
AFTO	=	Air Force Technical Order
AIMD	=	aircraft intermediate maintenance departments
AIS	=	Automated Information System
ALC	=	Air Logistics Center
ALOC	=	Air Lines of Communication
AQRA	=	average quantity repaired annually
ASL	=	Authorized Stockage List
ASO	=	Aviation Support Office
ATLASS	=	Asset Tracking for Logistics and Supply System
AVCAL	=	aviation coordinated allowance list
AWP	=	awaiting parts
BCM	=	beyond the capability of maintenance
BOM	=	bill of materials
BRAC	=	base realignment and closure
CAMS	=	Core Automated Maintenance System
CINC	=	Commander in Chief
CLD	=	critical low density
CNO	=	Chief of Naval Operations
CONUS	=	Continental United States
COSAL	=	coordinated shipboard allowance list

COSBAL = coordinated shore-based allowance list

COSCOM = core support command

CSIS = Central Secondary Item Stratification

CTE = Center of Technical Excellence

DA = Department of the Army

DBOF = Defense Business Operations Fund

DCSLOG = Deputy Chief of Staff for Logistics

DDR = daily demand rate

DIFM = due-in-from-maintenance

DLA = Defense Logistics Agency

DLR = depot-level reparable

DoD = Department of Defense

DoL = Director of Logistics

DOP = designated overhaul point

DOS = days of supply

DRMO = Defense Reutilization and Marketing Office

DS = direct support

DS4 = direct support unit standard supply system

EOQ = economic order quantity

ERO = equipment repair order

EXREP = expedited repair

FEDLOG = Federal Logistics Data on CDROM

FILL = Fleet Issue Load List

FISC = Fleet Industrial Support Center

FLR	=	field-level reparables
FMF	=	Fleet Marine Force
FMO	=	Fleet Maintenance Officers
FSSG	=	Force Service Support Group
FTE	=	report of excess
FTR	=	report of excess response
F4	=	fiscal year
GS	=	general support
HQ	=	Headquarters
I-Level	=	intermediate level
ICP	=	inventory control point
IFMM	=	Integrated Fleet Maintenance Model
IM	=	item manger
IMA	=	intermediate maintenance activity
ISSD	=	Installation Supply Support Division
IUP	=	item unit price
LORA	=	level of repair analysis
LRU	=	line replaceable unit
LSMM	=	local sustainment maintenance manager
MA-RMC	=	Mid-Atlantic Regional Maintenance Center
MALS	=	Marine Aviation Logistics
MCLB	=	Marine Corps Logistics Base
MFR	=	maintenance failure rate
MIMMS	=	Marine Corps Integrated Maintenance Management System

MMC	=	Materiel Management Center
MOAL	=	mount-out allowance
MRP	=	material requirement planning
MRSP	=	Mobile Readiness Spares Package
MTTR	=	mean time to repair
NADEPS	=	Navy Aviation Depot
NALCOMIS	=	Naval Aviation Logistics Command Management Information System
NAVCAP	=	Naval Capabilities
NCQ	=	NRTS/condemned quantity
NCT	=	condemned time
NMC90	=	number of maintenance cycles in 90 days
NRFI	=	not ready for issue
NRTS	=	not reparable this station
NSN	=	national stock number
NSO	=	numerical stock objective
NYS	=	Naval Shipyard
O&M	=	Operations and Management
OCONUS	=	outside CONUS
OL	=	operating level
OLT	=	operating level time
OSI		operational support inventory
OSR	=	order and shipping time requirement
OST	=	order and shipping time
OSTQ	=	order and shipping time quantity

PBR	=	percent base repair
PM	=	program manager
PoP	=	proof of principle
PP&C	=	Production, Planning, and Control
RCDL	=	repair cycle demand level
RCL	=	repair cycle level
RCQ	=	repair cycle quantity
RCR	=	repair cycle requirement
RCT	=	repair cycle time
RFI	=	ready for issue
RIMCS	=	Reparable Item Movement Control System
RIP	=	reparable issue point
RMC	=	Regional Maintenance Center
RMIB	=	Regional Maintenance Implementation Board
RO	=	requisitioning objective
RPF	=	I-Level Repair over one maintenance cycle
RPQ	=	raw pool quantity
RR	=	repair rate
RRC	=	regional repair center
RSMM	=	regional sustainment maintenance manager
RTAT	=	repair turn-around time
SAILS	=	Standard Army Intermediate Level Supply
SAMS	=	Standard Army Maintenance System
SARSS	=	Standard Army Retail Supply System

SARSS-0	=	Automated retail supply system
SASSY	=	Supported Activities Supply System
SBSS	=	Standard Base Supply System
SDR	=	secondary depot reparables
SF	=	stock funded
SHORCAL	=	shore coordinated allowance list
SIMA	=	Ship Intermediate Maintenance Activity
SL	=	safety level
SLQ	=	safety level quantity
SMU	=	SASSY management unit
SRA	=	special repair authority
SRF	=	Ship Repair Facility
SRU	=	shop replaceable unit
SSA	=	supply support activity
SSC	=	supply support center
SUAPS-RT	=	Shipboard Uniform Automated Data Processing System-Real Run Time
TARSLL	=	Tender and Repair Ship Load List
TAT	=	turn-around time
TDA	=	table of distribution and allowance
UADPS-SP	=	Uniform Automated Data Processing System-Stock Point
UMMIPS	=	Uniform Materiel Movement and Issue Priority System
UPA	=	units per application
USAF	=	United States Air Force
WIR	=	Reportable Item Report

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13. ABSTRACT *(Maximum 200 words)*

Supply organizations that directly support personnel who maintain operational weapon systems rely on Intermediate Level (I-Level) maintenance as the major source of resupply for both line replaceable and shop replaceable (LRU and SRU) reparable assemblies. The time that it takes to repair these items once they are removed from the weapon system (or next higher assembly) is called the I-Level repair cycle time (RCT).

The length of the RCT has the greatest influence on the inventory investment at the retail level. The longer the RCT, the more serviceable assets the services must stock locally so that, when an unserviceable is removed from a weapon system, a serviceable can be immediately issued. This procedure reduces weapon system downtime.

We estimate that the retail inventory investment to support the I-Level RCT pipeline exceeds $1.2 billion. Based upon our observations, we believe that I-Level RCT is longer than it should be. DoD policy forbids including awaiting parts (AWP) time when measuring RCT because the probability of a similar delay occurring each time is low. When AWP is included, inventory requirements increase. Then, when the parts problem is solved and RCT returns to normal, excess inventory exists. Only the Air Force currently excludes AWP time when measuring and using I-Level RCT. Also, any wasted time that exists from the time an item fails to the time it is restored to working condition and placed back on supply shelves adds to RCT and, therefore, needlessly increases inventory requirements.

The Military Services can significantly improve I-Level maintenance RCTs through a series of policy and procedural changes.

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