Improving the Army's Management of Reparable Spare Parts

John R. Folkeson, Marygail K. Brauner

Prepared for the United States Army
Approved for public release; distribution unlimited

RAND ARROYO CENTER

The research described in this report was sponsored by the United States Army under Contract No. DASW01-01-C-0003.

ISBN: 0-8330-3743-9

Published 2005 by the RAND Corporation
1776 Main Street, P.O. Box 2138, Santa Monica, CA 90407-2138
1200 South Hayes Street, Arlington, VA 22202-5050
201 North Craig Street, Suite 202, Pittsburgh, PA 15213-1516
RAND URL: http://www.rand.org/
To order RAND documents or to obtain additional information, contact
Distribution Services: Telephone: (310) 451-7002;
Fax: (310) 451-6915; Email: order@rand.org

Summary

High Backorder Rates for Reparable Items

Since its inception in 1995, the Army's Velocity Management (VM) initiative, now known as Army Distribution Management (ADM), has been used to improve the responsiveness, reliability, and efficiency of the Army's logistics system. However, as VM efforts expanded from order fulfillment at the tactical-unit level to national-inventory management, a troubling pattern emerged: a multiyear pattern of high and variable backorder (BO) rates for reparable items managed by the Army Materiel Command (AMC) and all the major subordinate commands (MSCs) within AMC.

A reparable is an item that can be cost-effectively repaired. When a reparable such as a diesel engine or turbine fuel control malfunctions, it can be replaced by a repaired or rebuilt component; it usually does not need to be replaced by a new item.

From the perspective of the ultimate customer—an Army mechanic trying to bring a malfunctioning piece of equipment back to mission-capable status—a BO can mean a lengthy delay and potentially a shortfall in mission support. The pattern of high BO rates suggests that improvements are needed in the process for managing and repairing reparable items. Improved effectiveness and efficiency of AMC's component-repair capabilities and capacity can also contribute directly to other depot programs (e.g., components are also used to repair higher reparable assemblies and even for end-item overhauls), in addition to returning serviceable assets to the shelf, where they will be available for issue to those Army customers directly responsible for repairing mission equipment.

To illustrate the process-improvement approach described in this report, we use a case study of the M88A1 armored recovery vehicle engine. This diesel engine, which has had persistent BO problems, is typical of a large group of unsophisticated, older components needed to keep aging weapon systems in mission-ready condition.

Planning and Execution of the Reparable-Management Process

When an end-item fault or malfunction is discovered, during either equipment operation or routine maintenance, if a serviceable reparable is needed to complete the end-item repair, a mechanic requests the part or component from the supply system. The reparable-management process begins with the identification of the malfunctioning component and ends when a serviceable asset is made available through either repair or vendor replenishment to replace the item issued to the mechanic.

Whether or not there are serviceable reparables in stock at the national level depends on the effectiveness and responsiveness of the AMC process for planning and executing reparable workload, both repair programs and new buys. The planning activity analyzes inventory levels and produces a formal decision package for a reparable repair program or a vendor procurement, both known as a PRON (procurement-request order number) that is submitted for approval. Over the long term, the planning process also provides input to the Army working-capital fund (AWCF) budget process and the program-objective memorandum (POM) budget planning process, which has a rolling six-year planning horizon and ultimately feeds into the congressional appropriations process.

Once a repair PRON receives management approval, it is typically scheduled to begin execution at the start of a new fiscal year 18 months after the start of the planning cycle. Once a repair is completed, the item manager (IM) may immediately ship the item to a customer to satisfy a due out, move it to a centralized distribution depot for future issue, or leave it in storage at the distribution center collocated with the repair facility.

The PRON is usually described as a yearly repair requirement. Unserviceable items are often inducted in monthly batches, and output is also usually processed in batches. However, the formal PRON process also drives the overall planning process for long-term capacity adjustments (e.g., workforce, equipment, facilities). Quarterly replanning meetings provide a venue for adjusting production schedules.

Three Critical Issues in the Reparable-Management Process

Our examination of the reparable-management process identified three key issues that need to be addressed:

- The impact of uncertainty and variability in customer demands on long-term planning forecasts.
- The need for increased emphasis on near-term replanning for execution.
- The inability of repair responsiveness to meet changing requirements.

The Impact of Uncertainty and Variability in Customer Demands on Long-Term Planning Forecasts

The current process for planning reparable workload requires and uses forecasts made over long horizons. It is nearly impossible to accurately make such forecasts 18 to 30 months into the future because of changes in mission scenarios and other sources of demand uncertainty and demand variability. In other words, forecast error is to be expected.

We use the M88A1 diesel engine to illustrate a case in which increasing demand over the extended planning horizon led to underproduction. In this example, forecast error was caused by demand uncertainty, rather than variability. The current planning process can also create the opposite situation by overproducing items with declining demand. In either case, the reparable-management process must be capable of adapting to changing demand. Fundamentally, successful planning requires frequent replanning to incorporate emerging information so that the execution will meet valid needs.

Increased Emphasis on Near-Term Replanning for Execution

The reparable-management process tends to focus primarily on long-term budget planning, and thus it is less responsive to changing customer needs that emerge during near-term execution. Although the MSCs and their repair depots hold quarterly meetings to revise schedules and address problem areas, these meetings typically focus on only the most critical issues.

Improved Repair Responsiveness to Meet Changing Requirements

To the extent that an IM can change a production plan or program to meet changing demands, the question arises as to whether the depot can adjust its repair program to meet those changing demands. We found, for example, that the procedures used for inventory management and control at Anniston Army Depot (ANAD) did not provide sufficient visibility to identify repair-part problems before they became critical in the production process.[2]

Alternatives for Improving the Reparable-Planning Process

Strategies for Dealing with Uncertain Demand

A review of the literature on commercial business practices identified the following four promising approaches for meeting customer needs under conditions of uncertain demand:

---

[2] The case study provided an in-depth view of ANAD, but similar systems and policies would have similar results at other Army depots with similar workloads.

- Frequently update forecasts.
- Increase safety stock.
- Improve replenishment lead times.
- Improve communication about customer needs and requirements.

Frequently update forecasts. The literature suggests that the fundamental problem in forecasting reparable demand is not the type of model used but the length of the planning horizon. Some decisions must be made with the best information available at the time, whereas other decisions can be revisited as new information emerges. The forecasting model used in the reparable-management process is capable of making adjustments. In planning a repair program, an IM uses several tools, including the Requirements Determination and Execution System (RD&ES), which analyzes data on demands and other transactions in order to make recommendations for repair and/or buy quantities. RD&ES generates a monthly repair plan that starts with an updated forecast (using an exponential moving average model) supplemented by known factors that have changed or are expected to change, such as fielded equipment density, operating tempo, etc. This approach can rapidly adjust to changing conditions, helping accommodate highly variable demand. Forecasting for PRON execution and production control could be improved through frequent recalculations to update predictions with current data. The near-term predictions we reviewed during the case study demonstrated improved output.

Increase safety stock. Safety stock refers to inventory that is held to buffer a process against uncertainty. The RD&ES module has the capability to determine safety-stock needs within the planning calculation. Safety stock should not be considered merely an added cost to the logistics system.

Improve replenishment lead times. The time to process and deliver a customer order for a component or part is known as the lead time. If a request for an item can be filled immediately from tactical- or national-level inventory, the lead time can be very short, but when the request cannot be satisfied until the next repair is completed, the lead time can be quite long. In the case of the M88A1 engine, the lead time necessary to fill a customer request might be many days or weeks if the reparable is not in stock, mostly due to lengthy queuing or waiting times within the various depot repair activities.

Approaches to reducing lead time must examine the chain of events necessary to meet a need to determine where it is more efficient and effective to insert buffers or to reduce constraints so that the desired response time can be achieved at lower total cost. It is possible, for example, that some work-in-process (WIP) engines could be used to shorten the achievable repair time. All the activities in the chain of lead-time events should be addressed to improve responsiveness.

Improve communication about customer needs and requirements. The pattern of changing customer demands for reparables is not likely to change. In light of such

realities, it is important to adjust expectations and to increase communication about how the process must change to better meet customer needs and requirements. Customers and providers across the system supported by the Army's reparable-management process must understand both the nature of the issues involved and actions that could contribute to an improved outcome. Unless the process changes, the outcome is not likely to change.

Frequent Replanning and Near-Term Repair Execution

When the results of the planning process are shown to be inadequate to meet emerging customer demand, the plans should be adjusted promptly under appropriate management controls. An initial goal might be to transition as quickly as possible to monthly repair-schedule changes (i.e., replanning) using the available monthly RD&ES outputs. In the future, the management decision process might be informed weekly or even daily about customer demand, and production-schedule changes could be implemented when warranted.

Improving Repair Responsiveness

Several alternatives for improving repair responsiveness emerged from interactions with managers and technicians within the system and from lessons learned from commercial practice.

Reduce lead time for the next repair and overall repair flow time. Reducing flow time in the repair activities of the reparable-management process will involve looking very closely at all the process activities required to return a broken asset to serviceable status and to deliver it to the Defense Logistics Agency (DLA) distribution center packaged and ready for issue. The intent of such analysis would be to establish a mechanism that could respond to customer needs by increasing production when demand increases, thus reducing the potential for BOs, and decreasing production when demand is low, thus reducing unnecessary inventory investment.

Replan frequently to synchronize repairs with demand. Updated information could be used monthly by the current RD&ES module to revise production schedules that cover the currently approved PRONs. In addition, the proposed lead-time reduction efforts could provide the kinds of operating practices necessary to enable depot production to respond to forecast changes. A mechanism or signal should be established that communicates to depot managers and workers the need to perform a given task and the quantity of items to be produced. This replanning works two ways: It *increases* production when demand increases, thus reducing the potential for BOs, and it *decreases* production when demands are not as great as forecasted, thus reducing unnecessary inventory investment.

Assure the availability of unserviceable assets. Repair actions cannot begin until unserviceable assets that have been removed from end-items are available for induction. Currently, unserviceables (unless they are specially identified) are treated as

the lowest-priority items within both the supply and the transportation activities. The supply and transportation communities need to review the priorities assigned to dealing with unserviceable assets to allow them to be used more effectively in meeting the needs of individual customers and the Army as a whole.

Improve the process for managing depot repair parts. Under the current process, technicians must leave their work locations and go to the shop supply room to get parts that are needed, wasting time and manpower. A more effective approach would be to provide repair parts, both new and reclaimed (i.e., recycled), at the workstations. For example, routing reclaimed parts to the Automated Storage and Retrieval System (ASRS) facility would improve visibility of assets and would allow parts to be brought forward to mechanics in an orderly manner.

The inventory policy for repair parts at AMC maintenance depots would also benefit from greater flexibility in setting inventory levels for different items. Current policy sets inventory levels at 60 days of supply (DOS) for all items other than bench stock and special-project assets. A more flexible policy would allow for addressing the different characteristics of individual repair parts, thus reducing the risk of stock-outs. Such a policy might distinguish among at least three kinds of items:

- **Items used for nearly all repairs.** As long as there is recurring monthly production or availability of these items, replenishment with the current 60-DOS policy should ensure that assets are on hand and that there is a continuing vendor relationship to meet future needs. Over time, the 60-DOS level might actually be reduced. For these types of items, replenishment time and variability, as well as cost, should determine the final inventory depth.
- **Less frequently used items.** The programmed logic for inventory decisions in DLA's automated inventory-replenishment system is based on the frequency with which items are ordered. Low-demand items replenished by large orders are typically replenished only infrequently and thus may not be stocked at DLA if the repair depot orders them too infrequently to qualify them for stockage. Infrequent orders also complicate vendor relationships. Smaller, more-frequent replacement orders have the benefit of both limiting inventory investment and communicating to IMs and vendors the continuing need for such items to support repair programs. The relevant IMs must understand that these less frequently used items are still necessary.
- **Infrequently used items with long lead times for replenishment.** These items require and justify intensive management. They typically represent a small percentage of the total number of items but a majority of the total inventory investment.

Adopt policies that make repair programs responsive to customer demands. The Army maintenance depots' component-repair programs are financed via the

AWCF, which does not require that revolving-fund activities spend all their funds by the end of the fiscal year to avoid losing the money. Thus, a depot can carry over workload beyond its intended fiscal year to provide approved cash flow for labor and materiel while awaiting the approval of a new PRON. Workload carryover and the pattern of delayed production, along with changes in demand, contribute to the due-out volume, or the BO rate. The Army needs a policy that is more responsive to customer demands.

Adopt financial policies that encourage appropriate use of repair capacity. Prices of Army-managed items include a supply-management surcharge to recover the costs of operating the national supply system. This surcharge, which includes both fixed costs (costs that do not vary by supply-management activity) and variable costs (costs generated by specific items), can result in comparatively high prices and can lead to lost sales—even for items with low acquisition costs. For example, the surcharge acts as a "tax" on purchases from the supply system, whereas locally purchased or repaired equivalents avoid such a charge. One approach for addressing this problem would be to fund fixed costs (e.g., costs for Department of Defense (DoD) agencies, depreciation, and adjustments for prior-year losses or gains) through direct funding and to allocate variable costs more specifically to the items generating them.

A Pilot Effort to Implement Improvements

The implementation of improvement initiatives can be made more tractable by starting with a pilot effort that allows the development and testing of alternative approaches. The results obtained in a pilot implementation could be measured, rules could be adjusted, and confidence would be developed in the selected improvement approaches.

We recommend that senior management at an MSC appoint a small pilot implementation team. The team's effort should focus initially upon a few reparable NIINs (national item identification numbers) related to a single weapon system or end-item that is repaired at the same facility. This approach could create a vertical slice of the overall reparable-management process and thus would facilitate actions across activities to achieve recognized results.

It is possible to dramatically improve the availability of reparables to customers. This report discusses approaches that can efficiently improve each activity in the process. Many of these approaches are drawn from successful commercial practice, and others derive from successes within military practice that deserve expansion.