



How to Improve the Army's Management of Repairable Spare Parts

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Repairable items—spare parts that are cost effective to repair when they break—are critically important to the Army's fighting capability. Many deadlining equipment faults require at least one repairable spare part to correct the problem.¹ Repairables can also be quite expensive—an engine for an M1 tank costs about \$500,000. However, analysis done by RAND Arroyo Center shows that repairable spares are backordered (not available for immediate issue from worldwide inventory when requested) more often than other parts, and the delays that result are longer and more variable. Backorders impede the prompt repair of equipment, lowering unit readiness. The variation in the time it takes to get a part (some backorders get filled relatively soon; some take a long time) also makes it difficult to plan work or schedule specific repairs, thus reducing maintenance efficiency.

To determine how the repairable spares management process could be made more effective, Arroyo researchers conducted a case study centered on improving the availability of the engine of an armored recovery vehicle. This is an expensive part (about \$100,000 based on the last acquisition cost) that has had a high incidence of backorders (up to 100 percent) for several years. They report the results of that analysis in *Improving the Army's Management of Repairable Spare Parts*.

Problems with the Repairable Process

The Army's management of repairables involves two major activities that are not well integrated: (1) long-range planning and (2) execution (i.e., near-term planning and repair). The planning activity has a long time horizon. Because of the requirements of the DoD budgeting process, AMC inventory planners must develop fiscal year plans

¹ A deadlining fault is one that precludes a vehicle from performing one of its primary functions, e.g., moving, firing its main weapon.

Key Findings

- Repairable spare parts managed by the Army Materiel Command (AMC) were backordered on average about 20 percent of the time (FY98 to FY02).
- The planning and execution activities for managing repairable spares are not integrated.
- Planning (both long-term and near-term) is not updated frequently enough to enable responsive support.
- The repair providers have difficulty responding to changes in production schedules.
- The Army should test improvements through a pilot implementation.

about 18 months in advance of the start of the year in question. These plans consist of repair and procurement quantities for each repairable. When the year of execution starts 18 months later, planners then release the annual repair program to the maintenance depots, with monthly quantity requirements. Often the approved program is not updated from the 18-month-old plan. The actual customer demands that have emerged over that time can be very different from the program in both timing and quantity. Therefore, the execution activities must modify the programmed actions so that they best meet the current demand. Planning and execution are currently sequential activities with no integration in the form of continuous feedback and adjustment. Instead, execution should be based upon frequent replanning to get a better match between actual demands and the repair (or the procurement, as necessary) of the items.

Arroyo researchers identified two fundamental problems with management of these two activities

that contribute to the unavailability of needed reparable spare parts. One is that the long-term plan is not updated with current information to produce an updated program as execution commences. This is critical in light of the uncertain demand from uncertain operational needs (change in demand from a change in use) and the variability of demand that is characteristic of most reparable spare parts (most parts do not fail at predictable intervals but rather fail with significant variability around an average). Both the planning for future-year demands and the current-year execution plans need systemic revisions to improve the availability of needed parts. The second problem is that the repair activity is not able to change production flexibly in response to changes in customer demand.

Improving the Planning Activity

Because long-term planning looks more than a year into the future, uncertainty will always cloud demand. Arroyo researchers identified four potential ways that the Army could better deal with uncertain demand. The first, which applies to the planning itself, is to update forecasts frequently. The forecasting model the Army uses performs adequately. However, its forecasts need to be updated periodically to take into account events that affect the demand for reparables, e.g., unforeseen contingency operations or natural disasters, as well as the inherent variability in demand for these items. Although the major commands of Army Materiel Command meet quarterly to review parts that are in short supply, typically only the most critical issues get attention. An initial goal might be to transition to a policy that allows monthly repair schedule adjustments with the authority to adjust the schedule delegated to item managers for more responsive implementation.

Second, the Army could work to shrink replenishment lead-times. The time it takes to deliver materiel to a customer is known as lead-time. If a part is on the customer's shelf, lead-time is short. If not, it could take many days or weeks to receive it from an inventory source. Reducing lead-time requires a close look at overall replenishment processes to identify segments that could be shortened, perhaps by policy changes such as inventory levels.

Third, even with more frequent replanning, the Army should consider increasing the targeted level of customer service provided via safety stock levels. These stocks buffer against uncertainty, some level of which will remain even with more frequent replanning, and increasing them will improve customer service. As repair lead-time improves, less stock will be needed to provide a given level of safety or customer service.

Fourth, managers of the reparable process need adaptive tools to meet changing customer needs. Management policies and practices must match the dynamic nature of the operating environment to respond promptly to adjustments to successfully meet actual customer needs.

Improving the Execution Activities

Even with updated long-range planning, it will be important to have the capability to change the execution activities quickly in response to changes in customer demand. Thus, the Army should work to shrink repair lead-times. Typically, the repairs occur in

batches, e.g., a certain number of engines get fixed each month, which tends to produce long repair lead-times. Transitioning to a "pull system" (producing at the rate of demand) would reduce lead-times. Further reductions in lead-time require a close look at the process to identify process steps that could be shortened or even eliminated. Shorter lead-times enable production closer to the time of demand, shortening the forecast horizon and thus the forecast error, leading to fewer backorders and less excess production. They also enable better response to changes in demand as forecasts are updated. The goal would be to develop a more flexible system that could increase output in response to increased customer demand and scale it back when demand wanes, shifting resources to other activities.

Even with a pull system, the depot needs a production execution schedule to ensure that adequate capacity is ready. The Army should adjust the depot repair execution schedule frequently to synchronize near-term repairs with current demand. Updated information is available at least monthly that could be used to adjust the repair schedule, increasing or decreasing repairs depending on need. At the same time, the Army should ensure that unserviceable items are available to repair by working to improve the reverse logistics process—the process by which the broken reparable spare parts are brought back to the repair facilities to be fixed and made available for issue.

The depot repair parts management and delivery activities also require improvement. One problem revealed in the case study was work interruptions because of a lack of inventory. The current process has technicians leaving their workstations to get repair parts from supply rooms. A skilled repairperson's time is valuable, and a more efficient process would deliver the parts to the workstation to meet production schedules. A second step would be to modify inventory policy for repair parts, which now states that the depots should stock enough parts for 60 days of production. Such a blanket policy ignores the very substantial differences among parts used to fix reparable components. Some are far too expensive to stock in depth, and others are not used very often. A better policy would take individual part demands and costs into account when setting inventory levels. For example, items used for all repairs are demanded more frequently, and the 60-days-of-supply policy ensures both that there are enough parts on hand to complete repairs and that there is a continuing relationship with a vendor to meet future needs. Infrequently used items with long lead-times call for careful tracking to ensure that they are on hand when needed and that planning for future needs has occurred.

Improving Army Incentives to Use Depot Repair Appropriately

Finally, the Army should adopt financial policies that enable repair programs to meet customer demands and that promote the flexible use of available repair capacity. The Army Working Capital Fund pays for depot component repair programs. Current financial policies encourage depots to carry a backlog of work from one year to the next. This helps the depot fund labor and materiel, but it contributes to backorders and makes the system less responsive to its

customers. A second issue is that when customers buy a reparable from the Army Working Capital Fund, they pay a surcharge that the depots use to recover not only their variable costs related to production but also their fixed overhead costs as well. The fixed-cost recovery portion of the surcharge is in essence a tax that raises the price of the reparable, sometimes to the point where it makes the depot appear uncompetitive with other sources of supply. Customers sometimes turn to these other sources of repair, depriving the depots of business and driving up per-item costs. Instead, the Army could fund the fixed costs directly for the repair capabilities that they need and allocate their variable costs only to the items that generate them.

Test Improvements with a Pilot Effort

Arroyo researchers recommend that the Army implement a pilot effort that would allow the testing of alternative approaches. This would have the twin advantages of helping people adapt to the changing system while identifying which approaches work best.

Item management teams and their supporting repair activities always have initiatives under way aimed at providing their customers better service. The improvements suggested here are intended to focus those efforts on a more systematic view that encompasses the overall reparable management process. The goal is to integrate policies and decisions to improve the effectiveness and efficiency of meeting those customer needs. ■

This research brief describes work done for RAND Arroyo Center documented in *Improving the Army's Management of Repairable Spare Parts*, by John R. Folkeson and Marygail K. Brauner, MG-205-A (available at <http://www.rand.org/publications/MG/MG205/>), 2005, 110 pp., \$20, ISBN: 0-8330-3743-9. MG-205 is also available from RAND Distribution Services (phone: 310.451.7002; toll free: 877.584.8642; or email: order@rand.org). The RAND Corporation is a nonprofit research organization providing objective analysis and effective solutions that address the challenges facing the public and private sectors around the world. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors. **RAND®** is a registered trademark.

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