Arroyo Center

Diagnosing the Army's Equipment Readiness

The Equipment Downtime Analyzer

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SUMMARY

The new Army Vision,[2] with its emphasis on rapid force deployment followed by immediate employment, demands logistics processes and robust equipment that enable soldiers to keep equipment ready to fight. Forces will have to pick up and go in the "readiness state" they find themselves in at the time they receive a deployment order, must arrive at the area of operation ready to fight, and then must have the ability to sustain a high level of equipment readiness. Achieving this, in turn, calls for dramatic progress in optimizing the Army's ability to keep equipment ready. This requires optimizing the logistics system's equipment sustainment processes as well as enhancing the companion processes—product development and recapitalization—that produce equipment reliability.

To do this, the Army must have metrics that realistically portray how well its equipment readiness capabilities support the Army Vision. These metrics should connect the underlying logistics and equipment reliability processes to equipment readiness and illuminate their interactions. Without the ability to make these connections and to see how the component parts fit together to create the overall picture, the Army could make some individual processes highly efficient yet still fall short of satisfying equipment readiness needs.

This document describes a conceptual framework for providing these capabilities and a new initiative, the Equipment Downtime

[2]General Eric Shinseki, U.S. Army Chief of Staff, and the Honorable Louis Caldera, Secretary of the Army, "The Army Vision Statement," *http://www.army.mil/armyvision/vision.htm,* October 1999.

Analyzer (EDA), which applies the basic principles of this framework to the extent possible solely by leveraging data collected by existing Standard Army Management Information Systems (STAMIS). It promises to facilitate the achievement of the Army Vision by providing an integrated set of metrics that tie the performance of equipment sustainment processes to equipment readiness, directly focusing efforts on not only the critical customer at the end of the Army's logistics chain—the warfighter—but also on what that customer cares about—keeping equipment operational.

THE NEED FOR METRICS

Today it is very difficult, if not impossible, to answer many critical operating questions reliably, consistently, and quickly. This is because the Army does not have a mechanism for "drilling down" into equipment readiness results to understand what drives readiness. This is in contrast to many corporations that have activity-based cost systems that help assess how each process and each organization within a firm contribute to overall operational results. With these systems, managers can see how all their processes and business units affect the bottom line. They know where the problems and opportunities are, which process improvements are paying off, and where additional leverage is possible.

THE EQUIPMENT DOWNTIME ANALYZER: WHAT IS IT, AND HOW DOES IT WORK?

The EDA is designed to give Army logisticians insight into equipment readiness comparable to the insight that activity-based cost systems provide to corporations with regard to their costs. It aims to increase the Army's understanding of how processes influence equipment readiness—and thereby to ensure that today's process improvements work synergistically, achieving the maximum possible impact. It enables managers to look inside equipment readiness results to understand the contribution made by each logistics process, by equipment usage, and by equipment reliability and to see how these factors combine to produce equipment readiness.

The EDA starts from the simple mathematical relationship that underlies the "not mission capable" (NMC) rate. The NMC rate is the product of the average end item repair time and the end item failure rate; a rate of 10 percent means that the equipment was not ready 10 percent of the time. Currently, the Readiness Integrated Database (RIDB) records the amount of time that equipment is down, but neither it nor any other Army STAMIS captures how many times each item failed or how long it was down each time. Thus, it is impossible to know which of these two principal components, much less which of their elements (such as customer wait time), is driving equipment readiness.

This is the heart of the challenge the Army faces when trying to make objective decisions on such issues as the need for recapitalization or when trying to understand the cause of NMC trends; there is little or no information about the relative contributions of failures and repairs to equipment readiness trends. Further, downtime is saved in monthly totals, making it difficult to systematically examine downtime in the field versus the motor pool. So this produces the second fundamental challenge: the lack of a clear, realistic understanding of how equipment readiness fares in demanding environments.

The EDA works by capturing a history, by day, of every reported deadlining event[3] across all supply and maintenance activities at all echelons that directly played a part in returning the deadlined system to fully mission capable status. From these histories, the EDA produces end item repair time and equipment failure rate metrics as well as several others not currently available, such as organizational-level repair time. Through the use of metrics that span all equipment readiness processes, the EDA provides a systems view that can detect whether changes in root-level processes, such as the wholesale order fulfillment process, "bubble up" to affect equipment readiness or whether reactions in other processes consume the improvement. The systems approach allows one to see reactions resulting from process interactions.

The systems approach provides a better understanding of how single actions affect the overall process. For example, the EDA highlights maintenance "workarounds" such as the controlled exchanges that

[3]A deadlining event is defined as an end item failure that causes the end item to be NMC.

occur when a requisition has been outstanding for an excessive length of time and maintenance personnel bypass the supply system to get the needed part. Without the detailed information supplied by the EDA, such efforts by maintenance personnel can hide underlying supply problems. In other cases, maintenance problems can be disguised as supply problems. For example, a misdiagnosis can trigger additional parts ordering late in a repair process. Without visibility of this event, an awaiting-parts problem may appear to be one of supply or requisitioning, when, in reality, the problem was one of misdiagnosis.

Figure S.1 illustrates an actual history recorded by the EDA for a deadlined tank. The tank was deadlined for 19 days, during which time there were three major repair segments: diagnosis and parts ordering, awaiting parts (AWP), and the actual "fix" process (often there is an additional delay—actually a fourth process segment—for part pickup and receipt by the maintenance organization). After the initial diagnosis, parts were ordered on day 2, and the tank was then AWP until day 18. The tank was then "fixed" and returned to fully mission capable (FMC) status one day later. The figure also shows the day on which maintenance ordered each part, when the part was issued, and the source of supply. For example, a wiring harness was ordered on day 2 and was supplied via an on-post referral, which was issued on day 5. Each day on which parts were ordered represents what we term an "order cycle." The second wiring harness was ordered because the wrong one was received the first time; the late extinguisher order resulted from delayed identification of a part need; and the tank's fire control computer was given to another tank. The causes of these order cycles are typical of the reasons we have documented thus far: controlled exchange, diagnostic problems, and requisitioning or part-delivery problems. Of further note, the second time the wiring harness was ordered, maintenance decided to stop waiting for an issue from supply and satisfied the need through a workaround on day 18, which allowed completion of the repair. By combining these detailed histories, the EDA can produce both repair process and reliability metrics at any level of aggregation from an individual tank, or even a tank part, through the entire Army fleet.

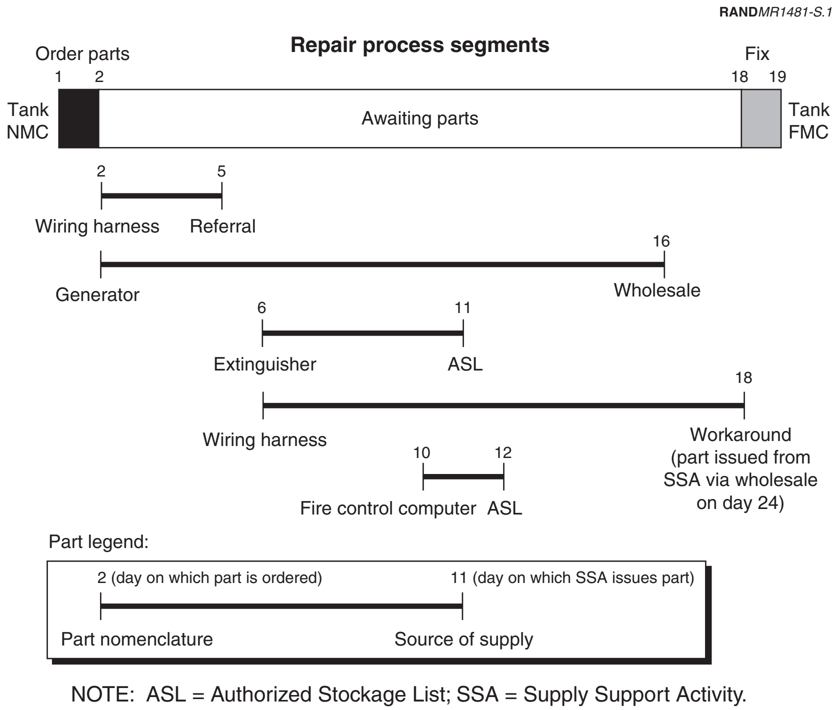

Figure S.1—Linked Maintenance Snapshots and Supply Data Create Cross-Functional Repair Records Across Echelons

With this detail, the EDA can also provide a much richer picture of equipment readiness than the one available today. The straight horizontal lines in Figure S.2 depict the monthly NMC tank rates for one Armor battalion. The jagged line shows the tank NMC rate by day. This line reveals highly volatile daily NMC rates that paint a much different picture of equipment readiness than the "smoothed" monthly rates, which combine periods of motor pool inactivity and training. As an example, in late July 1999, an exercise caused the NMC rate to increase from 5 percent to almost 30 percent in just four days. Once the battalion completed the exercise, it experienced just two tank failures during the remainder of the monthly reporting

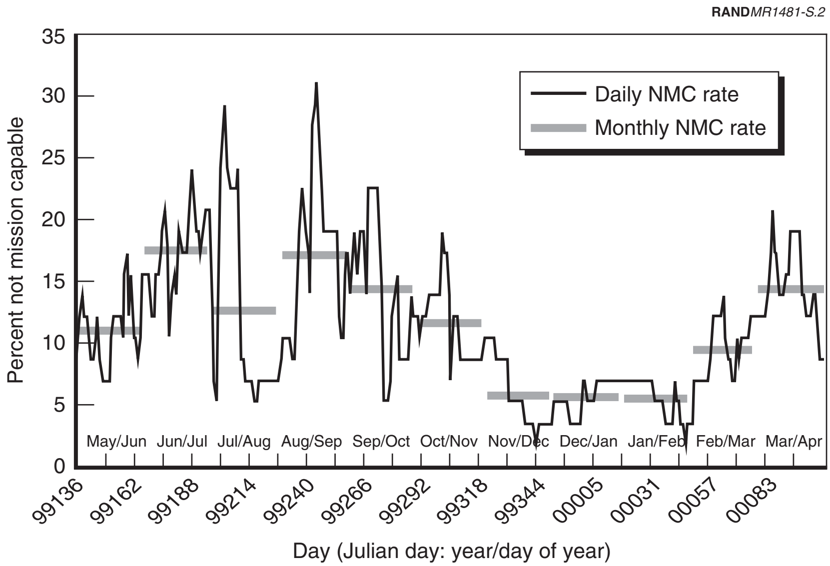

Figure S.2—Daily NMC Rates Produce a Much Richer Portrayal of Equipment Readiness Than Monthly Averages

period, recovering to 94 percent readiness in early August. As a result, the monthly NMC rate was only 13 percent, reflecting neither the battalion's sustainment capability when equipment was actively used in a mission profile (which was worse) nor the condition of the tanks after recovery (which was better).

Once we understand sustainment capability and determine a need for improvement, EDA metrics shine the spotlight on the need to either improve failure rates or reduce "broke-to-fix" time, or both. From a total repair process perspective, decomposing the broke-to-fix process into maintenance levels and process segments to produce diagnostic metrics, as depicted in Figure S.3, can help illuminate improvement opportunities and identify where to focus efforts. The relative heights of the bars in Figure S.3 roughly represent the proportion of deadlining repairs that are executed at each echelon of maintenance, and the lengths of the process segments roughly represent their relative proportions of total repair time. By further decomposing awaiting parts time into its components—order cycles

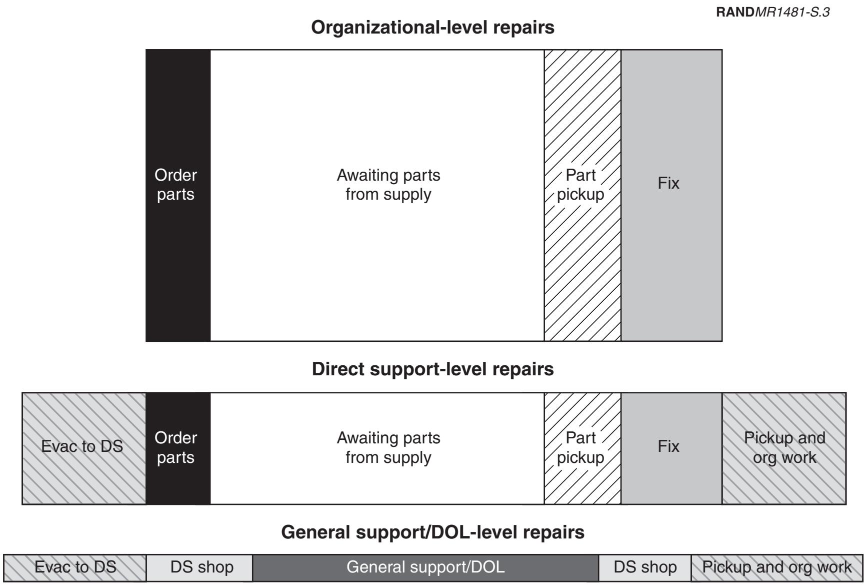

Figure S.3—Decomposing the "Broke-to-Fix" Process Is Useful for Downtime Diagnosis

(the number of unique days on which parts are ordered for a job) and last part customer wait time (LP CWT) (how long it takes to get all of the parts that are ordered on the same day for one repair)—and then the components of CWT,[4] we can drill down to find out how each process is affecting repair time.

IMPLEMENTATION OF THE EDA

The Army's G-4 has developed a plan to implement the EDA as a user-friendly, flexible tool with the design based upon feedback from users of the prototype system. In conjunction with the Combined Arms Support Command (CASCOM) and the Ordnance Center and

[4]Overall CWT can be decomposed into the percentage of requisitions filled by each source of supply as well as the CWT for each source of supply. Sources of supply include Department of Defense wholesale distribution centers, direct vendor delivery, local maintenance, referrals, lateral transactions, and local inventory.

School (OC&S), the Army's G-4 created an EDA operational requirements document (ORD) and gained funding approval from HQDA for the integration of the EDA into ILAP as part of its migration into the GCSS-A management module. The needed data are being archived within the Integrated Logistics Analysis Program (ILAP) and the Logistics Integrated Database (LIDB).

The ultimate promise of this effort is an enhanced capability to focus constrained resources where they will have the greatest effect on keeping equipment ready to fight, whether by improving equipment reliability or by reducing repair time. By enabling logisticians and those engaged in the acquisition and recapitalization processes to examine which improvements will most likely lead to higher equipment readiness, the EDA should improve the Army's ability to sustain equipment readiness while reducing total support costs and enhancing mobility.

Several organizations are already making use of prototype data and metrics. A division has used the data to justify improved stockage through the estimated equipment readiness benefits, and to help identify end items for turn-in. A corps staff is using it to identify repair process improvement opportunities, and to help justify changes in stockage. A major subordinate command of the Army Materiel Command has used it for recapitalization plan analyses. The VM Repair Process Improvement Team is using it to identify opportunities for improvement in unit maintenance operations. At RAND, we are using the EDA to support other research efforts for the Army such as evaluating the effects of age and other factors on failure rates.

In the future, enhanced data capture at the operational level as GCSS-A is fielded will improve the power of the EDA to help the Army identify more efficient methods of achieving better equipment readiness. This should be complemented by seamless integration of the logistics and failure metrics produced by the EDA with other types of data such as personnel readiness, equipment usage, training schedules, customer wait time, repair quality, and scheduled service execution to enable more complete diagnosis of equipment readiness. Together, improved data and seamless database integration will enable the Army to build a comprehensive equipment readiness diagnostic system.

In all of its applications, the EDA and future derivatives will provide new, valuable information intended to help people in the Army conduct better analyses and make well-informed decisions about equipment sustainment.