US Army Reliability Initiatives — In Concert with Air Force R&M 2000

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Purpose: To present an overview of Army RAM initiatives

Special math needed for explanations: None

Special math needed to use results: None

Results useful to: Contractors competing for Army programs, reliability engineers and managers

Abstract — This paper describes how the US Army is improving readiness through enhanced reliability, availability, and maintainability (RAM). The Army is serious about supplying its personnel with the kind of equipment that stays on line. The US Army Materiel Command is taking aggressive steps to ensure that systems achieve their RAM requirements. Too often the Army has been accused of settling for minimum performance. As is well known, industry is reactive; it responds to pressure to improve what the customer thinks is important.

An important step to getting higher levels of reliability and maintainability is to stand together with the Air Force and Navy customers and demand that RAM design and manufacturing disciplines are carried out and contractual RAM requirements are achieved.

The achievement of requirements must be accomplished during system development and fielding. Improved RAM results in improved productivity, user satisfaction, and lower operating and support (O&S) costs. Linking R&M initiatives with O&S cost is an important step in justifying the up-front design and manufacturing disciplines that improve field performance.

Meeting RAM requirements is the beginning and not the end of Army reliability efforts. Continued efforts to improve RAM are the thrust. For each system, the Army strives for continued improvement. Increased reliability reduces O&S costs while improving fielded mission accomplishment. Contractors will continue their efforts to improve production quality and to eliminate systemic causes of field failures.

1. INTRODUCTION

The Army has been getting tough about R&M. Army weapon systems like the M1 Abram Tank, the Bradley Fighting Vehicle, Blackhawk, Firefinder, Patriot, and the Copperhead Projectile exemplify the type of success that we have had with RAM. For example, the Bradley is now achieving a MTBF of over 2.5 times the original requirement. Successes like this have resulted in a new Army RAM initiative. The Army has established a goal of reducing RAM driven O&S costs by 50 percent. This parallels the Air Force R&M 2000 thrust where any new system

must achieve "reliability of twice its predecessor" and one-half the maintenance burden. The Army recognizes that a dedication to RAM can yield high payoffs.

What happens when adequate RAM is not achieved? It could show up as a maintenance problem such as that encountered with the Lighter Air Cushion Vehicle (LACV-30), where it took 48 hours to inspect a fire suppression unit after each 25 hours of engine operation. The Army has also had helicopter composite blades delaminate unexpectedly; it has experienced the M60 vehicle fuel-tank corrosion problem which shows how material selection in early design affected field RAM and O&S costs.

2. INITIATIVES

To attack the overall RAM problem, the Army has developed some initiatives. To get at the problem as early as possible in the system life-cycle, the Army has upgraded RAM and made it one of the major factors in contractor proposal evaluation. For example (figure 1), in the T800 engine source selection, RAM and ILS (integrated logistic support) were worth 30 percent of the total selection points. This equalled the percentage of points assigned to the *Technical* and *Cost* categories and was triple the percentage assigned to the *Management* category. In the old way of selection, RAM would have been buried in the *Technical* category with a very low percentage of points.

Fig. 1. US Army Source-Selection Practices

To avoid fielding materiel with safety and reliability problems, the Army has instituted a component safety program. This program establishes safe operation requirements and controls for critical items without waiting for catastrophic mishaps or mission failures. Contractors have been asked to identify critical design characteristics and to institute intensified manufacturing and quality controls on these items during R&D and on into production. These

same identification and control requirements are carried through to maintenance and overhaul activities as illustrated by figure 2.

Fig. 2. US Army Component Safety Program

The established requirements on items in actual use are validated and revised if necessary. The program covers the critical items throughout the life cycle, including field-data reporting. There is a closed-loop corrective action system for any problems.

Recent actions mandating weapon-system warranties have a direct impact on the expense of corrective action. The Army insists that contractors are responsible for materiel that does not meet specification. Conformance to specification applies to operational requirements as well as plant acceptance. The Army has structured its warranties to accept an anticipated level of failures. This anticipated-failure concept recognizes that no design is perfect and an anticipated level of failures will occur. Failures which exceed the anticipated level are rightfully the expense of the contractor. The Army will not pay for this warranty coverage because the basic contract price includes the RAM requirement, and excessive failures show that the requirement was not met. RAM data are being used increasingly in defining the contracted anticipated failure warranty threshold.

Another Army program that has a variety of factory and field considerations is the corrosion prevention and control (CPC) program. The environments in which the Army must use its equipment require that both designers and maintenance personnel be attentive to the effects of corrosion. The Army supports their efforts with CPC training and a center of excellence at the Materials Technology Laboratory. This center provides technical expertise in the subject and is available to assist program managers, designers, and product assurance engineers. In the commodity commands, the Army has established corrosion prevention advisory boards to help program managers.

A new regulation is being written to institutionalize Army programs and to ensure that the materiel received is properly designed for corrosion prevention.

Environmental Stress Screening (ESS) accompanied by failure analysis and corrective action, is becoming another business norm. For years, the Army has recognized the benefits of ESS as a means of eliminating parts and workmanship defects before it accepts delivery. The Army is requiring that ESS be performed on more and more of its equipment. To document this, it has issued a new regulation, Army Materiel Command Regulation (AMCR) 702-25, which contains ESS technical and management guidance. The US Army Communications and Electronics Command (CECOM), Ft. Monmouth has been established as the Army center of excellence for ESS. CECOM serves as a technical consultant, a distributor of current ESS information and an ESS training activity. To date, it has trained approximately 900 employees. The use of ESS on programs like the Bradley Fighting Vehicle and the M1 Abram tank has been widely publicized and the lessons learned will apply to the Tactical Missile System (TACMS) weapon system. To use the TACMS with the Multiple Launch Rocket System (MLRS) launcher system requires adding electronics which could degrade overall performance. Inserting ESS into the program will help eliminate any new failure modes or defects and hence retain the overall system reliability at a satisfactory level.

Another initiative is the Continuous Evaluation Process. This process provides the members of the acquisition team with a continuous flow of information pertinent to the system status, from the development of the operational and organizational (O&O) plan, through deployment and assessment of field performance. The main objective of this process is to identify, early in the program, critical items that may have an impact in important decisions. Essentially, this process ensures that:

- test and evaluation requirements are realistic
- the test program is stabilized
- a common test-and-design database is readily accessible and is used in the evaluation process
- duplication in testing is avoided
- current system data are available for use in future system developments.

This continuous evaluation process reduces development costs and improves RAM through timely corrective actions. For example, in the HELLFIRE Program, the Army validates the manufacturing process initially through first article tests and revalidates it through production reliability verification tests, periodic environmental tests, and fly-before-deployment & fly-before-buy tests. In each of the tests, the failures are analyzed and corrective actions taken. Reliability growth tracking is used to monitor flight test progress.

The Army monitors the implementation of these initiatives through the program manager system assessment

review process. This is a comprehensive look at a program manager's achievements with respect to cost, schedule, and Army RAM initiatives. Reliability growth, corrosion prevention implementation, critical component issues, and warranties are tracked throughout development. Figure 3 shows how the Army tracks specific design problems and the associated corrective actions. During functional process assessments, the Army reviews how its commodity commands implement the RAM initiatives. Finally, in-depth, on-site reviews cover the full range of design, manufacturing, and test issues with the contractor. This provides the means to head-off potential problems before they can emerge at major decision points.

Another area of importance is computer-aided design and computer-aided manufacturing (CAD/CAM). The Army recognizes the benefits of CAD/CAM and applies them whenever possible. For example, the Trailblazer AN/TSQ-114 had a problem with a design defect causing trailers to turn over. CAD/CAM eliminated the problem in six months. Conventional engineering methods would have taken much longer and would have necessitated replacing a number of trailers. CAD/CAM also helped to trim the time for improving the design of the SOUTHCOM radio mast. It took one week to design the improvements which, again, was a substantial reduction in the time to obtain the desired result. The Army encourages and supports CAD/CAM use.

3. ARMY COMPARISON TO AF R&M 2000

Recently, General Richard Thompson, Commanding General, Headquarters, US Army Materiel Command, Alexandria, asked that the Army take a look at the Air Force R&M 2000 program and develop an Army program along similar lines. Because up to 75 percent of life-cycle costs are operating and support related, he believes that research and development to improve the Army R&M could realize a 10-fold return on investment.

Many elements of the Air Force R&M 2000 have Army program counterparts. For example, the control of reliability, availability, maintainability, and durability driven operating and support (O&S) costs has the same target objectives of R&M 2000:

- reduction of maintenance manpower burden and spare support
- improved planning to achieve R&M operational goals
- better management tracking of R&M to find and correct problems earlier
- a demonstration to industry of Army commitment to support more stringent R&M requirements.

FIGURE 4
R&M 2000 vs Army RAM Program

R&M 2000	Army RAM ACCOUNTABILITY
AFC Reviews	PMSA
Independent Audit	Independent Evaluators, MARBs (AMSAA, OTEA, TECOM)
Requirements Process	TRADOC/AMC RAM Rationale working groups
Data System	SDC, Continuous Evaluations
Generic Needs	RAM O&S Cost Improvement
Document Revision	RAM Audit Trail
IG emphasis	Army IG Surveillance
INDUSTRY	
ACQ Planning	Streamline ACQ
Requirements	Get tough on contractors
Source Selection	AVSCOM T-800 Engine SS
Design Reviews	Need more
Warranties	Army Warranties Program
Commitment	MSC Commander Commitment
COMMUNICATION	
Model Program	no
Media Plan	no
Success Story	Need more
Motivation Tools	Need more
Guidebooks	R&M Primer, TRADOC/AMC Handbook 70-11
Symposium	Joint DOD RAM Symposium only (Army RAM Panel)
R&M Workshop	no
Awards	no
DIRECTION	
Goals	RAM Requirements based on O&S cost
Tracking	HQ AMC PMSA Process Required vs Achieved
Indicators	Established R&M management indicators
Parameters	New parameters based on O&S cost
Doctrine	RAM part of TRADOC doctrine development
Policy	New AR 70-1 and AR 702-3
ORGANIZATION	
Air Staff	Get tough on RAM initiative
MAJCOM	Personnel for MSC commanders
Education	Could do more in this area
Career Development	Q&RA intern program
Indoctrinate	AMETA R&M overview course
PLANNING	
Command	CGS no. 135 reliability program plans
Weapon System	more work needed
Technology	more work needed
Modifications	RISE-PIP program
Budgets	O&S cost funding wedge (not on track)

Figure 4 is a side-by-side comparison of current Army initiatives and the Air Force Aerospace Power Program

elements. One area where the Army program needs emphasis is an overall media plan to get the R&M message across a wider audience.

Fig. 3. US Army Reliability Design Tracking

The control of RAM driven O&S costs is an important factor in Army acquisition program management. The customary approach has been confined to the Army's ability to meet the mission need. However, it has become clear that to maximize fighting capability, and at the same time reduce logistic burden in this era of limited resources, RAM driven support costs must be controlled.

The Army has long recognized RAM as a smart investment. A commitment to field systems with higher reliability and less maintenance is essential. The future battlefield demands that the Army exploit new technologies which allow major improvements in system RAM while reducing dependence on a vulnerable support structure.

AUTHOR

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Seymour J. Lorber is a native of Chicago, Illinois; date of birth 1922 May 4. He attended Chicago public schools, and the Illinois Institute of

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During World War II, Mr. Lorber served for three years, primarily in Greenland, as an enlisted man in the infantry.

In 1951, Mr. Lorber entered the Federal Government with the Office of the Chief of Ordnance, Research and Development Division, in Washington DC. In 1953 he transferred to the Industrial Division, Office of the Chief of Ordnance, where he was Chief of the Quality Control Office until the reorganization of the Army in 1962 August. His present assignment is Deputy Chief of Staff for Product Assurance and Testing, Headquarters, US Army Materiel Command, Alexandria, Virginia.

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