R&M 2000
An Air Force Logistics Command Challenge
Do It Now

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Results useful to: Logistics engineers, managers, design engineers, R&M engineers

Abstract — This paper outlines the priorities of the Air Force Logistics Command (AFLC) in supporting the R&M 2000 initiative; provides an overview of long, mid, and near-term R&M planning; and discusses initiatives within the AFLC depots and material management community. In view of decreasing manpower and funding, AFLC is focusing on the basic elements of R&M with smart applications of developing technologies and innovative approaches within the Air Logistics Centers. AFLC has restructured itself to support such technologies at VHSCIC, composites, and information. Several major offices and centers such as the Air Force Acquisition Center and the Air Force Coordinating Office for Logistics Research actively work R&M/supportability issues. These issues include R&M incentives, logistics support analysis, and advances in avionics leading to greater combat capability through R&M. On a more day-to-day basis the paper discusses R&M integration into the Weapon System Master Plan and ongoing efforts to enhance the R&M of existing systems. Initiatives have begun within depots to identify improvements in repair techniques which will lead to higher reliability and productivity. Within the material management community, new management approaches, use of ESS on repairable assets, and enhancement of the product improvement process all highlight new efforts.

1. R&M IN LOGISTICS PRIORITIES

For the past two years, the Air Force, and particularly the Air Force Logistics Command (AFLC), has continued the pressure and emphasis on ingrafting R&M into the mainstream of the command’s mission. AFLC has enjoyed substantial funding over the past few years and will continue to see the benefits for several years to come. However, in light of continued downward pressure on manpower and funding, attention must be focused on the more basic issues of R&M in order to sustain the force structure now and into the future. This point was driven home by General Earl T. O’Loughlin, Commander, AFLC [1].

“The Air Force’s reliability and maintainability program represents our commitment to creating systems we can operate in any combat environment and deploy with minimum combat support. Through it, we are working to help shape the technologies we inherit from industry and the labs, we are becoming much more literate in technologies and are developing business strategies to exploit technological advances.”

The Command R&M program is built around the fundamental elements of accountability, responsibility, and authority. The program centers on three fronts of activity: the systems AFLC supports, managed by the Commander of the Logistics Operations Center (LOC); the systems AFLC will inherit, managed by the Air Force Acquisition Logistics Center (AFALC); and the business enterprise beyond the year 2000, managed by the Deputy Chief of Staff for Plans and Programs. In addition, the Deputy Chief of Staff for Maintenance is equally involved since the six maintenance depots represent 40000 members of the AFLC team and billions of dollars in plant equipment and industrial capability.

Future R&M direction in AFLC was conveyed to all command elements on 4 Sept 1986 by Lieutenant General Marc C. Reynolds, Vice Commander. The essence of that direction was [2]:

“AFLC reaffirms its support of the Air Force R&M 2000 program. Healthy funding days are over. Resist the temptation to buy your way out of problems. Fix your way out of problems. Manage risk, don’t avoid it.”

AFLC knows who its number two customer is, after the combat warrior. Col John Reynolds, Deputy Assistant to the Commander for R&M stated, “He/she is Blue Two, the Air Force maintainer. They know what needs to be avoided and what needs to be done.” [3] Staff Sergeant Brian Vaughn elaborated on the importance of maintainance:

“Build your company (center) a good name with maintenance. The operations people who set the requirements, solicit, and buy the system will have long since retired, made Colonel, or separated from the service before maintenance takes delivery and discovers the thing is unmaintainable. Invest in maintenance feedback to insure future profits (success) in future contracts (programs).” [3]
2. R&M IN AFLC LONG RANGE PLANNING

Air Force Logistics Command (AFLC) has established six strategic objectives for the future which will determine the Command’s direction for the next 10 to 20 years. These objectives evolved from a strategic vision of how advanced technologies and business practices should affect the Command’s future infrastructure and organization. Reliability and maintainability initiatives and impacts are inherent in each objective. These objectives are:

* Prepare AFLC to maintain modular electronic hardware and software by 1990.
* Prepare the AFLC processes for modular electronics by 1990.
* Prepare AFLC to support advanced materials and structures by 1992.
* Prepare AFLC to use digital data from cradle-to-grave by 1990.
* Prepare the AFLC work force to deal with emerging logistics challenges by 1995.
* Restructure the AFLC organization to exploit information technology by 1998.

As reliability and maintainability are inserted into the Command infrastructure and processes, the long-range implications are becoming more apparent. For example, in the area of modular electronics, the Air Force has made significant progress in developing advanced avionics systems for both current and future weapon systems, based upon Very High Speed Integrated Circuit (VHSIC) technology. Although not yet validated, predictions have been made of mean time between failures (MTBF) of 10,000 to 20,000 hours on some modules. AFLC is planning to be ready to support these new systems when they enter the inventory in the 1990s.

The purpose of the advanced materials and structures objective is to ensure that these materials and structures are logistically supportable. Many advanced materials increase durability by increased temperature tolerance, improved strength, and reduced corrosion. Logistics challenges include developing new inspection and repair techniques to respond to the unique characteristics of these materials.

Digitized data will have a significant positive impact on maintainability. Possible AFLC applications include flexible parts machining and manufacturing on numerically controlled machines at the Air Logistics Centers. Artificial intelligence and automated technical orders enhance the maintenance technician’s expertise in troubleshooting and repairing aircraft. In order to exploit the use of digitized data, AFLC is building a large digital information system infrastructure.

The personnel and organizational structure of the Command will be affected by advances in R&M. Greater reliability and maintainability will reduce the base level infrastructure needed to support the combat forces, but may require enhancements at the depot level. A reduction in skill level may be possible in some areas with the advent of artificial intelligence systems that will give the logic of experts to semi-skilled workers. In addition, the AFLC future organization may be different from today’s in order to provide optimal support to the future force structure.

Information technology will redefine how AFLC conducts its business. Distributed data systems will allow for real-time access to information, thus improving the confidence of decisions that are made. Greater visibility of assets will lead to more effective and timely parts distribution. Productivity and efficiency of logisticians, engineers, and depot level technicians will be enhanced.

3. R&M IN MID-TERM PLANNING

The Air Force Acquisition Logistics Center (AFALC) inserts logistics issues throughout all phases of the acquisition process, from pre-conceptual through production phases, to ensure that fielded systems are supportable. AFALC works primarily through Deputy Program Manager For Logistics (DPML) collocated with each Air Force major program and a core staff of technical experts. A major DPML task is to assist the program office in developing contractual language to ensure user R&M requirements become supportable design considerations. A few of the specialized AFALC activities include a Productivity, Reliability, Availability, and Maintainability (PRAM) office; the Air Force Coordinating Office for Logistics Research (AFCOLR); and the Product Performance Agreement Center (PPAC). The PRAM Program Office is primarily involved in off-the-shelf technology to improve R&M/Supportability of fielded systems. AFCOLR coordinates the Air Force combat support requirements with new technologies, and research and development activities of government and industry.

Some major AFALC activities include laboratory program initiatives, infusion of early logistics support analysis and R&M requirements into acquisition programs, and developing contract incentives through structuring appropriate product performance agreements (warranties).

For the most part, Air Force avionics experience has shown that avionics is notoriously unreliable and requires many maintenance hours. Much aircraft downtime is consumed to test, fault detect/isolate, remove/replace, and retest the system. This practice has required a costly (in terms of dollars and downtime) 3-level maintenance philosophy, and an enormous logistics support burden.

A potential solution to the logistics support problem, size and weight limitations, and increasing equipment complexity is the Integrated Communication Navigation Identification Avionics (ICNIA) program. The current ICNIA program sponsored by the Air Force Avionics Laboratory, the Army Avionics Research and Development Activity, and the Naval Air Development Center realizes this potential using an aggressive design strategy that places reliability, maintainability and supportability co-equal with performance.
ICNIA is designed to a more cost-effective on/off equipment maintenance philosophy accomplishing repairs on the flightline within 15 minutes. To realize this optimized on/off equipment maintenance philosophy, ICNIA will have very extensive built-in test (BIT) capability and a modular design with a fault-tolerant architecture that promotes high mission reliability and maintainability. Supportability objectives have been established within the statement of work such as 98% fault detection, 95% fault isolation with a 1% false alarm rate for BIT, along with aggressive goals for R&M. Designed-in supportability is essential to the ICNIA program and will ultimately determine the system's value by reducing life-cycle cost, increasing readiness, and enhancing weapon systems combat capability. ICNIA is a key laboratory program which will help establish a baseline for other modular avionics programs to follow.

4. R&M IN NEAR-TERM ACTIVITIES

The Logistics Operations Center (LOC), managing R&M activities associated with weapon systems that have already been fielded, has made R&M an integral part of weapon system planning. Presently, AFLC System Program Managers (SPMs) are writing Weapon System Master Plans (WSMPs) which derive logistics support programs from projected operational needs. WSMPs cover a 10-year period and are developed with the Major Command (MAJCOM) that actually uses the weapon. Overall, the WSMP consolidates operational planning, engineering developments and logistics support into a big-picture look at the weapon system. For R&M, the WSMP documents the link between MAJCOM R&M goals and AFLC planning.

After deployment of weapon systems, assessment of weapon system capability becomes an on-going process which is accomplished by the SPM and the Logistics Operations Center. Weapon system program reviews are being modified to reflect Air Force R&M goals. In addition, operational requirements, like system modifications and spare parts, will be ranked according to their anticipated contribution to weapon system effectiveness. Then, logistics programs will be developed to meet these requirements. Since weapon system capabilities, operational requirements, and logistics programs are documented in the WSMP, it will become a cornerstone of future AFLC weapon system programming and budgeting.

Effects presently underway in AFLC to improve R&M include a War Readiness Spares Kit (WRSK) R&M analysis, use of Cryofit coupleings, discontinuance/limiting the use of Kapton insulated wiring, and applying Environmental Stress Screening (ESS) to in-service electronics.

SPMs are identifying those items in the WRSK whose mean time between maintenance (MTBM) is less than two times the first 30-day wartime flying hour requirement. Those items will then be reviewed to determine if: 1) actions are underway to improve the item, 2) no action is possible at this time, or 3) action can be taken. Improving R&M of items in the WRSK will improve warfighting capability, decrease mobility requirements, manpower requirements, and costs. A two-times (2X) “reliability increase” is a near-term effort. Mid and long-range plans are to look at 4X and 10X the first 30-day wartime flying hour requirement.

Another action being taken is to introduce Cryofit coupleings at the depot level. The SPMs have been encouraged to use Cryofit where it makes sense. Cryofit coupleings should improve the maintainability of weapon systems by eliminating hydraulic leakage problems.

The third action being taken is to investigate the discontinuance/limitation of Kapton insulated wire in future modifications and acquisitions. AFLC, along with AFSC, is investigating the effects of Kapton wire. AFLC is determining the extent of its use, impact if it is restricted, and what information is needed to evaluate a replacement wire. AFLC is reviewing the F-15 A/B rewire program, the F-4 rewire program, and the C/KC-135 aircraft rewire program.

Finally, AFLC is investigating the use of ESS for airborne electronics. Failed units in depot repair will receive ESS to identify poor workmanship, poor process controls, and low quality parts. Two control groups of approximately 20 to 30 units will be investigated where only one of the groups receives ESS. Both groups will be monitored at a flying squadron where MTBMs will be tracked. This is an R&M initiative to determine whether the MTBM on in-service units can be substantially increased by ESS.

5. R&M IN AFLC DEPOT MAINTENANCE

Reliability and maintainability (R&M) within the depot maintenance environment are primarily a function of high quality repair and highly productive processes. Within the AFLC depots, several programs will lead to improved weapon system R&M. Three of these programs are Technology Repair Center Failure Rate Reduction (TRC-FRR) Analysis, R&M Centers, and Pacer Impact.

TRC-FRR is a process of completely analyzing all aspects of a low reliability and/or poorly maintainable item. The investigation includes all of the repair processes, equipment, data, training, spare parts, and technology insertion opportunities that could lead to more reliable or more maintainable items. Deficiencies, or outdated maintenance processes, that are contributing to the R&M problems are identified and improvements incorporated. This program will target maintenance R&M efforts on items that can be improved the most through improved maintenance rather than through redesign.

R&M Centers is a program that solicits knowledge and experience of the mechanics and technicians who are actually performing depot maintenance. They see the problems daily and they are the ones who must try to do a good job with what they are given. The R&M Center helps the workers articulate their ideas and incorporate them
into the proper program (i.e., through value engineering or suggestion) that can best solve the problem. These R&M Centers are located in the production areas for high visibility and easy access.

Problems requiring solutions and solutions that have been incorporated are publicized. This work force involvement in R&M is one of the keys to the future success of the program within depot maintenance. Pacer Impact, the AFLC Depot Maintenance productivity improvement program, uses development groups composed of representatives from each depot to address specific productivity improvement areas. The Methods and Process Development Group, for example, evaluates the repair or manufacture process and seeks to improve productivity and reliability while reducing costs. Group members also evaluate high cost throw-away items and identify repair processes that improve maintainability and reduce cost. Since Pacer Impact has a computerized reporting system, it has become the umbrella program within depot maintenance for reporting and tracking all maintenance R&M initiatives.

6. R&M IN THE MATERIEL MANAGEMENT COMMUNITY

The Materiel Management Directorates manage all AFLC modifications to existing weapon systems, develop purchase requests for spare parts, and determine depot repair requirements. A few of the many R&M actions undertaken in the Materiel Management (MM) Directorates include development of a Single Point of Contact (SPOCO) at each center, increasing R&M weighting factors within the modification prioritization process, developing methods for applying ESS in depot repair/manufacturing activities, revamping the product improvement process (code named Rivet Improve), developing technology insertion plans, and including R&M assessments as part of the Requirements Management Review (RMR) procedures.

A single point of contact (SPOCO) has been identified at each Air Logistics Center for all users needing an interface point. The SPOCO receives, distributes and tracks all incoming deficiency reports, R&M hardware initiatives outside MM, performs an initial analysis, and ensures that the right offices are identified to analyze fixes. Additionally, new computer based management tools are being developed for R&M processing and analysis.

The Command modification ranking process is also being altered to give R&M criteria more weight in relation to the factors that are used to rack-and-stack modifications. When completed, R&M factors will have approximately three times as much weight as previously computed. The Command is developing full-scale ESS programs based on a pilot project approach at each center. A temperature and vibration profile will be developed for each electronic item selected for a pilot project. The ESS profile will be applied during the repair process. Performance and reliability of items will be monitored in the field to determine the ESS impact on repairable assets. In addition, generic procurement specifications are being developed for new component acquisition contracts.

The product improvement process is also undergoing enhancement. The Rivet Improve program has been initiated to correct systemic and institutional factors that prevent rapid implementation of weapon system improvements. Rivet Improve involves streamlining the product improvement process by reducing the number of non-critical materiel deficiency reports (MDRs), establishing Product Improvement Working Groups (PIWGs) to handle non-critical MDRs, and limiting MDR submissions to only critical defects. Technology Application Program Management (TAPM) roadmaps are being developed to provide a clear plan for AFLC technology insertion. Focal points are established at each center for selected technology areas. Specific technology acquisition plans have been developed for 22 off-the-shelf and advanced technologies. These roadmaps serve as the corporate plans to insert technology advancements into Air Force weapon systems managed by AFLC.

The AFLC Requirements Management Review is used to assess the validity of purchase requests that are processed for parts reprocurement. The review procedures are being modified to ensure that R&M considerations are included in the decision process that justifies development of new purchase requests for parts. The objective is to ensure that higher reliability preferred spares are procured whenever available.

SUMMARY

AFLC is deeply committed to ingraining R&M across all mission elements. Both AFLC and industry will achieve the goal defined by the AFLC Commander, General Earl T. O’Loughlin:

“My challenge to you is to put us out of business if you possibly can. Make good on your promises of electronic systems that will be better, cheaper and more reliable.”

REFERENCES


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