

Introduction

Major changes in U.S. Army missile programs resulted when acquisition reform (AR) initiatives called for use of performance-based specifications rather than military specifications. In addition, the government role transitioned from one of oversight to one of insight, which was a change from the watchful care of government requirements to that of understanding contractor requirements and operations.

One thing that did not change, however, was the independent role of product assurance (PA) on the Javelin weapon system and the complete support provided by the Project Office management. PA functions—quality control engineering, quality assurance, quality management, reliability/maintainability engineering, and component engineering PA functions—continued to perform as they did before AR, ultimately trying to ensure that soldiers and Marines receive the best possible equipment. This goal was met and is being sustained through a government-contractor team effort involving the Close Combat Missile Systems (CCMS) Project Office; the U.S. Army Aviation and Missile Research, Development and Engineering Center (AMRDEC); the Redstone Technical Test Center; and the U.S. Marine Corps System Command and its technical representatives from the Naval Surface Warfare Center, Dahlgren Division; and the Javelin Joint Venture partners, Raytheon and Lockheed Martin.

Since AR, improved partnerships with the contractor team have helped Javelin meet and maintain reliability and availability requirements that were established for system maturity. As with any weapon system, problems have occurred; however, the product assurance focus is to ensure that factory problems are corrected and not sent to the field.

This article addresses the impact AR has had on the Javelin Program from a PA perspective and also looks at a recent experience with another CCMS program, the Tube-launched, Optically-tracked, Wire-guided (TOW) Improved Target Acquisition System (ITAS). Lessons learned are presented and recommendations made relative to future acquisition excellence efforts.

A PRODUCT ASSURANCE PERSPECTIVE OF ACQUISITION REFORM

Billy D. Glover

Background

The contract for the Javelin weapon system is being carried out through a joint venture (JV) consisting of Raytheon and Lockheed Martin personnel. Javelin is in full-rate production (FRP) and is comprised of a round command-launch unit and training devices. When AR was initiated, Javelin had completed the engineering and manufacturing development (EMD) phase and was just beginning low-rate initial production (LRIP). Additionally, Javelin began AR with a PA team strong in government and industry experience, with several team members formally trained in PA disciplines at the Red River Army Depot, Texarkana, TX. A strong components engineering group as well as soldering experts supported the PA efforts. This product assurance team laid a solid PA foundation during EMD and had established a qualified baseline for design and processes.

This qualified baseline documented all product designs, drawings, performance specifications, materials, and processes that were used by each contractor and its suppliers for hardware that successfully completed qualification testing. These were the actual production designs and processes that were then used for manufacture of production hardware.

Following AR and based on the qualified baseline in place, language was incorporated into production contracts to prevent reliability degradations from occurring as the program transitioned to performance specifications from the traditional technical data package. Major PA disciplines established during EMD and in place at the beginning of LRIP were subsequently continued throughout the LRIP phases and into FRP. A closed-loop Failure Reporting, Analysis and Corrective Action System (FRACAS), which was

considered paramount to ensuring high reliability for the Javelin, was also continued, as was the use of failure review boards (FRBs). An FRB was required for failures occurring during qualification, flight, and lot-acceptance testing.

The Environmental Stress Screening (ESS) Program, developed to detect latent, intermittent, or incipient failures, was also continued. An

agreement between the contractor and the government was and is still required prior to any change to the ESS program. The government and contractor team continued to stress root-cause determinations and the establishment of effective recurrence control actions. These actions (ESS, FRACAS, and FRBs) have proven to be key in keeping Javelin's reliability at desired levels.

Prior to acquisition reform, government PA personnel established contractual data requirements that reported PA status. However, following AR, few contract data requirements were allowed. Subsequently, a teaming relationship between the contractor and the government evolved. Teaming has fostered consensus relating to qualification testing or verification for changes to the established baselines for designs and processes.

One year into AR, several disturbing and unacceptable process-related problems occurred within the Javelin Program. The root cause of these problems was unauthorized process changes to the qualified baseline of JV subcontractors. This violated a contractual JV quality assurance clause to subcontractors concerning process change control. Subsequent production problems led the Javelin Project Office to request that government-led product oriented surveys (POSS) be conducted at prime and subcontractor facilities. Based on the type of problems that were noted during these POSS, the JV PA recognized the need to continue this type of survey with government participation. A process oriented quality audit (POQA) then contractually evolved, and contractor-led teams, with government participation, began to annually audit the prime and subcontractor facilities. A supplier management process survey (SMPS), which incorporated the best of the POSS and POQA checklists, resulted.

Acquisition Reform Benefits

FRACAS. Assurance of a closed-loop FRACAS has been a major government PA focus throughout the life of the Javelin. After AR, improved teamwork and communication between government and contractor PA personnel resulted in a mutual desire to drive failures back to the lowest production level. By driving failures to the lowest level (sub-tier suppliers), problems are solved earlier with less rework at the higher levels, thus saving costs. In October 2000, comprehensive FRACAS reviews were conducted at prime and subcontractor facilities to determine the health of each manufacturing system. If problems were found, management commitment was obtained to implement recurrence control actions. Management was informed that no repercussions should result from this type of review because the purpose was solely to improve the system. Subsequently, a FRACAS checklist was developed for contractors to conduct a self-evaluation and assessment of their FRACAS Program prior to a review.

Javelin product assurance personnel were given a complete database of factory failures for evaluation prior to the arrival of the review team. This effort was a direct result of AR and the teaming approach to improve the FRACAS at all production levels. Prior to AR, a complete factory database could not have been obtained as a contract data requirement. Obtaining a complete factory database and comparing field failures to factory failures enables the team to determine the effectiveness of the military ESS.

To date, FRACAS reviews have resulted in significant findings that have led to continuous product improvements. This has resulted in better identification of trends, hardware and test problems, and resolution of failures classified as "cannot verify" (hardware that fails at a higher assembly level and the failure cannot be verified or duplicated at a lower level). The FRACAS reviews have brought about an increased awareness of failures at contractor facilities and have helped drive root-cause evaluations and recurrence control to the supplier level. This is a direct result of AR and demonstrates how government and contractor teamwork improved the FRACAS.

Parts Management. Without AR, the use of plastic encapsulated microcircuits (PEMs) and commercial parts

would have probably taken many years for incorporation into missile applications. However, with AR, government and contractor personnel were able to work on integrated product teams to resolve the challenge of using PEMs in missiles. This resulted in a parts management program to ensure that only long-term reliable parts would be used.

A Sequential Environmental Test Program of highly accelerated stress testing and temperature cycling was also developed by AMRDEC component engineers. This testing could be applied at the piece-part, circuit card assembly, or subassembly levels. Subsequently, it was determined that this testing could identify problems for materials and processes as well as for PEMs and hermetically sealed microcircuits. This program is now a standard method of qualification and confidence testing for the Javelin missile and for other Program Executive Office, Tactical Missiles programs. Without government PA participation in this process, a large number of failures could have been passed to the field if the initially recommended PEMs had been used in missile applications without further testing and evaluation.

Initial testing demonstrated that failures as high as 25 to 30 percent could be experienced because of parts problems. Subsequently, testing at all levels identified quality defects applicable to both ceramic and PEMs, which are representative of 2 to 20 percent of the problems that can occur in a lot based on fabrication defects, lack of burn-in, packaging problems, etc. Lessons learned have helped our contractors develop procurement strategies and parts management programs to minimize the impact of parts problems during production.

SMPS Process. Without AR, it is doubtful that an SMPS process could have been developed. Acquisition reform provided the freedom to develop comprehensive and value-added surveys. These contractor-led surveys allowed the contractor and government to gain valuable insight into supplier processes and helped ensure that good hardware is produced. In November 2001, the SMPS concept was applied to the ITAS, except that an "opportunities-for-improvement" format was followed. In lieu of surveying to specific contract or documentation requirements, opportunities where improvements could be made were documented for all areas associated with ITAS production and

FRACAS. This proved to be very beneficial in improving the quality and reliability of the ITAS.

Conclusion

There is no doubt that acquisition reform had a major positive impact on the Javelin weapon system. The efforts of a government team dedicated to quality assurance regarding all hardware purchased from the contractor has been critical in preventing quality and reliability problems being sent to the field. The team efforts of the contractor must also be emphasized. Without the effective partnerships between the government and contractors, the success of the Javelin weapon system would not have been achieved.

Lessons learned from the Javelin and other CCMS programs can be applied to other military programs. These include the importance of a closed-loop FRACAS, conducting comprehensive FRACAS reviews, the use of an ESS program and reaching consensus for any changes, employing an SMPS to ensure processes are maintained and changes are authorized by the contractor, and the inclusion of properly trained government PA professionals on the government team.

In conclusion, I want to also emphasize that I have a concern that dedicated, trained PA personnel are disappearing from the Army's acquisition workforce. In this author's opinion, the success of the Javelin weapon system demonstrates the need for a dedicated government product assurance staff. Acquisition professionals must re-examine and stress the role of PA professionals in the acquisition process. Government training programs are again needed to provide a supply of PA professionals.

BILLY D. GLOVER is a Lead Product Assurance Engineer in the CCMS Project Office. He has a B.S. in physics from the University of Alabama in Huntsville and is also a certified Quality Control Engineer. He can be contacted at billy.glover@mssl.army.mil.
