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The following case concerns a multiphase U.S. Army missile development program. The first phase was difficult, and six consecutive flight tests ended in failure, with the contractor paying millions of dollars in fines for the failures. However, the next two tests were successful, and the Pentagon decided to skip a third planned test and move directly to the next phase of the program—Engineering and Manufacturing Development. Before doing so, however, an audit of the program's progress to date was requested of the U. S. Government Accountability Office. The case reports the underlying problems revealed by the audit and the lessons learned by the program managers.

CASE

THEATER HIGH ALTITUDE AREA DEFENSE (THAAD): FIVE FAILURES AND COUNTING (B)*

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It was July 2004. John West and Joy Adams had been through a lot since the THAAD program had begun in 1992. Eleven THAAD flight tests had been conducted in the Program Definition and Risk Reduction (PDRR) Phase. After six initial failures, the first successful missile-to-missile intercept of a ballistic missile target was achieved on June 10, 1999, during Flight Test 10. West and Adams reflected on the contract lessons they had learned.

GAO Study—June 1999

Studies conducted by both Department of Defense and independent sources identified the following underlying problems in the THAAD program:

- The program's compressed flight-test schedule did not allow for adequate ground testing, and as a result, officials could not detect problems prior to flight tests. The schedule also left insufficient time for preflight testing, post-flight analysis, and corrective action.
- The requirement to be able to quickly deploy an early prototype system diverted the contractor and government project management's attention away from the normal interceptor development process and resulted in interceptors that were not equipped with sufficient instruments to provide optimum test data.
- Quality assurance received insufficient emphasis and resources during the time of component production, resulting in unreliable components.
- The contract for developing the interceptor was a cost-plus-fixed-fee contract, a contract type that placed all of the program's financial risk on the government and did not include provisions that

could be used to hold the contractor accountable for less than optimum performance.

Flight-test failures had been caused primarily by manufacturing defects rather than problems with advanced technology. These failures prevented the army from demonstrating that it could reliably employ the "hit-to-kill" technology critical to THAAD's success. The restructured program addressed each of the program's four underlying problems. It

- lengthened the flight-test schedule and increased ground testing
- removed the requirement for the deployable, early prototype interceptors
- increased the contractor's quality emphasis, including its commitment, leadership, and quality assurance staffing
- modified the cost-plus-fixed-fee contract to provide performance-based incentives and penalties and introduced a degree of competition into the program.

Despite these changes, the reliability of the remaining flight-test interceptors remained a concern because most components were produced when the contractor's quality assurance system was inadequate.

Contract Performance Lessons Learned

- The THAAD PDRR missiles had not yet demonstrated any military capability. Acquiring a significant number of missiles from the current design to support a contingency deployment concept was unwise. The hardware for the remaining missiles had been built and procured several years before, and only minor changes or upgrades could be made to the existing hardware. Until new hardware was built that incorporated the necessary design changes and improved manufacturing, product assurance, and test processes, there was no reason to expect any significant improvement in the THAAD missile's performance.
- Stable program funding and guidance was essential for program success. That was especially true with a complex "cutting-edge" technology program such as THAAD. Pressures to quickly field a prototype, budget cuts, program restructuring, and the misapplication of the principles of acquisition reform all strongly influenced the programmatic decisions. The Program Management Office and contractor made tradeoffs that were necessary to meet a budget and a schedule driven by the requirement for early deployment of the User Operational Evaluation System.
- Improved component level design, qualification testing, quality control processes, and product assurance and testing procedures in the manufacturing of the interceptor were needed. Improved component level quality testing to confirm both design and reliability would greatly enhance the reliability and provide increased confidence in the integrated missile subsystems and system.
- More thorough ground and hardware-in-the-loop simulation testing of the THAAD missile assembly, and especially the seeker, needed to be performed. Due to the strong DOT&E influence, the Program Management Office had chartered a team to review the contractor and government hardware-in-the-loop testing capabilities. The team would provide recommendations on where improvements were needed to permit testing of end-to-end integrated missiles and to test critical subsystems (e.g., divert attitude control system, seeker, avionics package, etc.)

Contract Administration Lessons Learned

- A solid teaming environment (Battle Rhythm concept) early in the program life cycle, including all THAAD stakeholders (DCMA, THAAD Program Office (TPO), the prime contractor, and subcontractors) was critical to solving potential problems prior to any major milestone/funding decision points. This resulted in a proactive, solution-oriented business environment, where issues were identified with real-time resolution.
- Prime contractor DCMA Commander needed to participate actively in the award fee process, and THAAD stakeholders needed to participate in the Award Fee process, to address the then current program risk factors as determined by the Award Fee Board, to focus contractor risk mitigation efforts to reduce program risk, and to ensure overall mission success.
- Utilization of an electronic data management system to provide all players real-time information of all aspects of the program, from basic contract modifications to IPT minutes to program matrices, which had been paramount to the Battle Rhythm initiative success.

The THAAD program entered the engineering and manufacturing development (EMD) phase in 2000, with the award of a $3.8 billion contract to Lockheed Martin Space Systems Company. West and Adams had used the contract lessons learned and incorporated unique incentives into the EMD contract (Exhibit 1).

Between 2000 and 2003, THAAD engineers reworked the entire system and fixed many of its inherent problems and redundancies. In May 2004, production of 16 flight test missiles began at Lockheed Martin's new production facilities in Pike County, Alabama. Flight testing of the EMD system was scheduled to begin in early 2005 and continue till 2009. The system was expected to enter low-rate production, to support initial operating capability (IOC) in 2007.

Then in the development phase, THAAD was implementing a block development strategy designed to get the THAAD system into the hands of our soldiers as quickly as possible, using the latest technology in the most affordable manner. Each two-year block (Block 2004, 2006, and 2008) built on and integrated with the capabilities of the predecessor block. The program continued to refine and mature the system design to ensure that the element performed to an acceptable standard and could be produced efficiently and maintained. This would be accomplished by continuing current component design and development activities, robust ground tests, and quality assurance programs. Flight-testing would resume in late 2004 at White Sands Missile Range, transitioning to the Pacific Missile Range Facility in Hawaii in 2006 to test against representative threat systems.

Army Acquisition Reform Newsletter

Special Incentives for Successful Flight Tests in THAAD Award Fee Contract

The Theater High Altitude Area Defense (THAAD) Engineering and Manufacturing Development (EMD) contract for $3.8 billion was awarded to Lockheed Martin Space Systems Company, Missile and Space Operations (LMSSC/M&SO), Sunnyvale, CA, on June 28, 2000. The THAAD EMD contract is an award fee type contract. The functional performance areas are technical, management, schedule and cost.

Emphasis was placed on the importance of successful flight tests occurring on schedule and within cost by including in the contract an award fee pool with special incentives for successful flight test intercepts for the first two flight attempts at White Sands Missile Range (WSMR) and Kwajalein Missile Range (KMR). If Lockheed Martin achieves a successful intercept within the first two attempts at WSMR, they will receive $25M in award fee. However, if they are unsuccessful after the first attempt, LM will share $15M of the contract cost. If Lockheed Martin achieves a successful intercept within the first two attempts at KMR, they will receive $25M in award fee. However, if they are unsuccessful after the first attempt, LM will share $20M of the contract cost. The clause identifies technical parameters that must be met during each of the first two flight tests at both ranges.

The use of the alpha contracting process for development of the scope of work (SOW) and the integrated Master Plan and Master Schedule as well as proposal preparation/evaluation provided the government with a best value contract. The Integrated Master Plan (IMP) provides the process narratives, events and criteria for the EMD program. The Integrated Master Schedule (IMS) provides the detail tasks and schedule for implementing the IMP. Both of these documents were developed during the alpha contracting process, substantially reducing the normal negotiation time and promoting a better understanding of the EMD requirements and the contractor-proposed approach to meeting these requirements.

EXHIBIT 1 Army Acquisition Reform Newsletter.