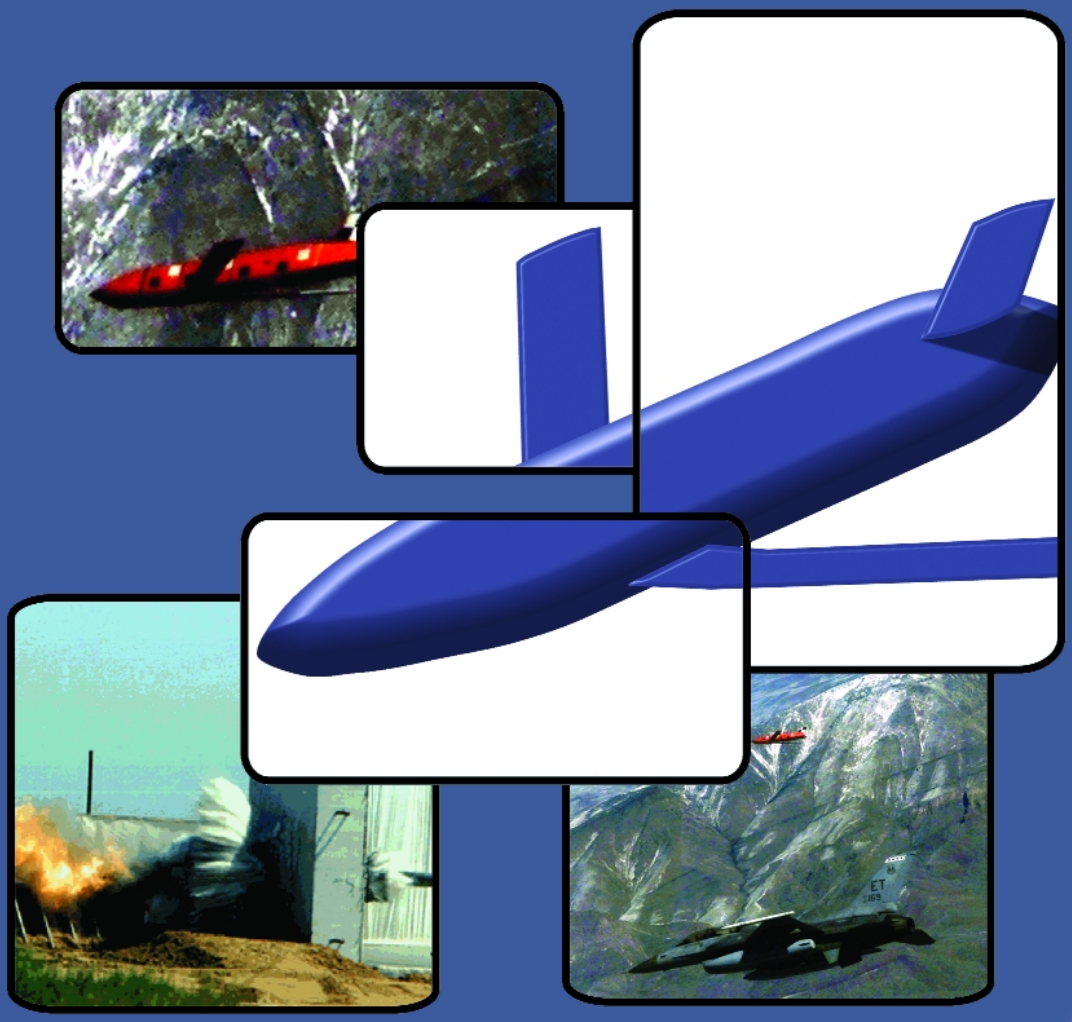
Defense Standardization Program

Case Study



Joint Air-to-Surface Standoff Missile

Standardization Delivers More for Less

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Joint Air-to-Surface Standoff Missile

Standardization Case Study

Standardization Delivers More for Less

This case study illustrates the application of important standardization practices including strategic standardization, market research, and item commonality. Strategic standardization is the use of standard items across different weapon systems, Military Services, or applications to achieve strategic objectives such as interoperability, logistics readiness, or cost savings. The study shows how the Air Force and Navy worked together to apply innovative technology to produce a next-generation missile, the Joint Air-to-Surface Standoff Missile (JASSM).

Background

Airborne cruise missiles have revolutionized the way aerospace assets are used. *Operation Desert Storm*, *Operation Allied Force* in Yugoslavia, and maintenance of the Iraqi No-Fly Zone have demonstrated the ability of airborne cruise missiles to destroy high-value targets from a distance (standoff) without putting crews at risk. At the same time, experience has proven that the current arsenal of standoff weapons has tactical and strategic limitations because of advanced anti-missile capabilities, including improved air defenses and electronic warfare technology.

Recognizing these tactical and strategic limitations, the Navy and Air Force worked together using available technology to develop JASSM.

After many years of development, a similar but unrelated missile program was canceled because of reliability problems and high cost. In 1994, average unit production costs of the canceled missile were expected to exceed $2 million. After the JASSM program was initiated, the Air Force–Navy team recognized that the missile's unit costs must not exceed $700,000; otherwise, they could not procure an adequate number and the program could not be justified. The team's strategy was to leverage existing commercial technologies and previous weapon system developments to reduce technical risks. The team needed to operate more like a commercial firm and take advantage of the numerous cost reduction opportunities stemming from DoD's acquisition and military specification reform initiatives.

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From its outset in September 1995, JASSM has used virtually every acquisition reform initiative. Initially the program entertained proposals from seven contractors. Cost as an independent variable (CAIV) was used to achieve a balance between capability and affordability. The missile's average unit procurement price was designated a technical requirement equal to JASSM's operational requirements. The key to effective CAIV implementation is to provide the contractor with opportunities to offer tradeoffs and alternate approaches to achieve the affordability requirement while meeting operational requirements. To provide this "trade space" most military standards and "how-to" design and manufacture directives were eliminated, and the JASSM Operational Requirements Document specified only three non-negotiable key performance parameters: missile range, Missile Mission Effectiveness, and the ability to operate from an aircraft carrier. Seven other performance objectives were considered desirable, but these could be traded off against each other and against other factors to reduce costs. A fundamental JASSM program requirement that could not be traded was the price ceiling of $700,000 (FY 1995 dollars).

Design and manufacturing costs were contained by using innovative commercial technological and component solutions.

JASSM operational capabilities included all-weather "launch-and-leave" capability from various bombers and attack aircraft; an ability to destroy non-hardened above-ground and hardened buried targets; a pilot assigned targeting; a flight navigation and terminal guidance able to achieve pinpoint accuracy; a high rate of survivability and jam-resistant guidance; and Missile Mission Effectiveness approaching single-missile target destruction. Missile Mission Effectiveness is the expected number of weapons needed to destroy a representative target set considering weapon effects, survival, and reliability. This translates into the number of sorties and missiles needed to destroy a target set.

In June 1996, Lockheed Martin and McDonnell Douglas (now Boeing) won contracts to fully define their concepts. The two contractors competed against each other for nearly 2 years as they refined their designs. They built hardware and conducted tradeoffs. Each contractor was assigned a dedicated help team of five to seven specialists from the JASSM Program Office. Each team's goal was to win the competition. Carrying the principle of applying commercial practices a step further than usual, the contractors had full responsibility and accountability for

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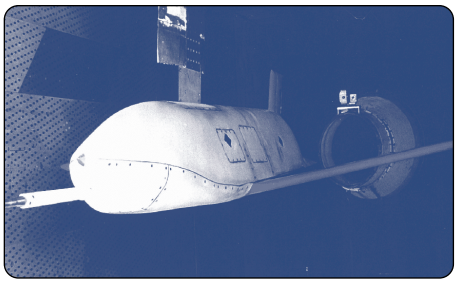
their efforts. They had the flexibility to define their programs without the usual constraints of government imposed "how-to" requirements, and they had total accountability for the final design, including configuration control and control of the system performance specification.

As part of this accountability, the contractors proposed 15-year "bumper-to-bumper" lifetime warranties covering not only failures but also problems where the system failed to meet the performance specification. These warranties motivated the contractors to build a highly reliable system. The decision to use commercial parts and practices and contractor logistics support forced all parties—the program office, users, and contractors—to rethink how replaceable parts are chosen, specified, and procured and how to use trade space effectively. A related decision was to promote long-term collaborative relationships with subcontractors and suppliers.

This unorthodox acquisition approach produced two highly competitive designs at prices significantly below the price ceiling. Source selection was totally open to the contractors and they helped define the source selection plan. The program office determined price reasonableness using market research and price analysis similar to commercial methods.



JASSM, Front View

In April 1998, Lockheed Martin was selected as the JASSM prime contractor. Throughout the early stages, cost remained the most important requirement. Cost implications guided tradeoff requirements, systems designs, and component selections that affected acquisition, operation, and logistics support. To achieve low-cost solutions, the design teams also found they had to focus on manufacturing processes and the costs of manufacturing. By using innovative commercial technological and component solutions, design and manufacturing costs were contained.

Outcome

JASSM's creative combination of acquisition, design, and standardization practices produced excellent capability, affordability, and timeliness results. The program office, contractors, and suppliers used every tool available and invented new ones.

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The following practices illustrate some important techniques that enabled development of JASSM at the required cost threshold:

- Allow the contractor flexibility to apply best practice solutions
- Adapt existing and commercial technology to save design and testing costs
- Apply strategic standardization to achieve one missile solution across and multiple weapon system platforms
- Conduct market research to identify and apply cost effective solutions.

Adopting Commercial Solutions

JASSM Strikes Its Target

The decision to allow the competing contractors to seek the best practice solutions in the design and manufacture of JASSM was an important decision in the success of the effort. Requiring military specifications would have severely constrained the adoption of commercial practices.

For example, Lockheed Martin wanted to make the fuselage, wings, and vertical stabilizer primarily out of nonmetallic composite materials; however, standard aerospace composite materials and processes cost from $600 to $1,000 per pound as finished items. Such costs would put JASSM beyond its price ceiling. Lockheed Martin and its subcontractors used market research to look for commercial solutions and found a process, Vacuum Assisted Resin Transfer Molding (VARTM), used in making fiberglass hulls for pleasure boats. This process produces finished fiber composite parts that cost about $5 per pound. Engineers developed a variation that was more expensive than the VARTM process for boat hulls, but only a fraction of the cost of the traditional aerospace approach. The modified VARTM process was used for the JASSM fuselage. To lay down the fiber matrix for the missile body, engineers adopted and modified another commercial technology based on commercial machines used to braid socks, shoe laces, and freeway pillar reinforcement rings.

Market research also enabled the contractor to find and adapt a similar low-cost commercial solution for the JASSM wings and vertical fin.

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Engineers adopted a variation of the same process used by commercial firms to build sailboards and wind turbine blades. This process uses an outer composite shell and an inner foam core to form a durable, lightweight structure. Although the process needed modification, it resulted in large savings compared with the traditional aerospace costs for composite structures.

Adapting Existing Technology

Where no existing commercial product existed to meet the need, JASSM engineers sought existing military technology and parts to avoid development expenses for entirely new items. For example, to achieve its performance requirements for autonomous terminal target acquisition and guidance, JASSM needed to use advanced sensors with target recognition capability. No appropriate commercial technologies existed to meet these needs. Lockheed Martin and its subcontractors developed a derivative of the imaging infrared seeker on the Hellfire and Javelin antitank missiles, appropriate for JASSM needs.

The contractor used a combination of approaches to save development costs on the JASSM engine. Market research again helped designers to select an existing engine that for 2 decades powered the Harpoon antiship missile. Then the prime contractor helped the engine supplier lower the cost of the engine by a third by replacing outdated military specification parts and technology with modern but much less expensive commercial parts and technology. The contractor also was able to choose a modern commercial digital controller to replace the old analog engine controller. This technology adaptation came from an off-the-shelf automobile industry anti-skid processor. By being able to choose from available technology, the contractor also saved development costs on other subsystems using similar creative solutions.

Applying Strategic Standardization

Strategic standardization was an integral part of JASSM from the beginning because it was a joint program addressing the needs of multi-

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ple Military Services. The program team and contractors made additional strategic standardization decisions by seeking out common and available solutions already being used in other weapon system applications. For example, two military standards were adopted to ensure JASSM interoperability with various aircraft. MIL-STD-1760, *Aircraft/Store Electrical Interconnection System*, ensured interoperability of the stores and software interface with host aircraft and MIL-STD-1553, *Interface Standard for Digital Time Division Command/Responses*, specified the high-speed bus interface.

Investments and Payoffs

Because it was a joint program, strategic standardization was an integral part of JASSM from the beginning.

JASSM began with a must not exceed price of $700,000 and a target price of $400,000. By applying innovative solutions and sound practices, Lockheed Martin achieved a committed delivery price of $347,000 each for the first lot of 95 missiles. This price is more than 10 percent below the $400,000 target price, 50 percent below the ceiling price, and nearly one-fourth the cost of comparable current missiles. Government analysts had estimated that total missile development costs would be $811 million. Actual development costs were $881 million, but included about $150 million to support a second contractor through the program definition and risk reduction stage.

The results cited above were achieved using lean and agile program resources. JASSM's predecessor had a staff of more than 300 to manage that program using conventional DoD acquisition and development practices. The JASSM project team totaled 75 people, including government and support contractors.

Allocating specific savings to individual acquisition or standardization practices is impossible. The synergy of acquisition and standardization best practices used together can produce outstanding results. Strategic standardization, excellent market research, available hardware combined with well defined performance specifications and the flexibility to use innovative technological solutions are a potent and effective combination. Using this approach the JASSM Program Office achieved the following estimated savings:

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- Airframe— 40 to 50 percent
- Electronics— 40 to 50 percent
- Production support— 40 percent

JASSM's innovative acquisition approach yielded important logistics support and performance benefits. The cost of the bumper-to-bumper 15-year warranty is included in the average unit production price. System performance exceeded requirements, including increased launch standoff range from the original 100 mile goal to an achieved range greater than 200 miles. This additional range reduces the need to negotiate basing and flyover agreements with foreign countries and enhances the survivability of aircrews and their valuable combat assets. If JASSM had been available for *Operation Allied Force*, targets throughout Yugoslavia could have been reached by aircraft circling over the Adriatic Sea or Hungary.

Lessons Learned

Application of innovative acquisition and standardization practices required a disciplined and conscious effort to enable design flexibility, apply best practices, use commercial and existing solutions, and avoid gold plating while achieving performance, interoperability and sustainment objectives. The strategic standardization approach to find joint solutions to shared problems helped yield system-wide savings. The discipline of the CAIV approach and the ceiling price encouraged market research to seek out commercial technology, components, and standards that could lower costs while maintaining requisite performance. When commercial technology was unavailable, military components and subsystems from existing military systems were adopted or adapted yielding development cost savings. Contractors were able to offer innovative design solutions because they were not constrained by mandatory or inflexible "how-to" specification or standards.

Other JASSM lessons learned include the following:

- Clearly defined performance requirements were essential, and tradeoff flexibility was necessary to achieve the target system cost.

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- Design and standardization flexibility stimulated market research, the use of readily available technology, and the application of commercial solutions. These practices in turn reduced costs and provided additional design choices.
- Strategic standardization fostered by using a joint program team produced greater interoperability and yielded significant cost savings. Strategic standardization, however, required cooperative agreement on performance requirements, common interfaces, and acquisition practices.

JASSM demonstrates that dramatic improvements are possible with creative acquisition strategies, disciplined attention to cost and performance, and applied standardization tools and techniques. At the same time it is possible to meet or exceed operational goals.

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Making Systems Work Together

Defense Standardization Program Office
8725 John J. Kingman Road
Fort Belvoir, VA 22060-6221
(703) 767-6888
http://dsp.dla.mil

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