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Is COTS on Track to Meet the Needs of the Military?

Overview

Intending to reform the military's acquisition process, U.S. Secretary of Defense William Perry issued his famous 1994 directive to purchase commercial off-the-shelf (COTS) products whenever possible. The primary objective was to save money, as components designed to meet MIL-SPEC requirements—with over 30,000 standards and specifications—tended to have an inflated cost. Unique military requirements were converted to performance standards, which better indicated how a product was actually used. For instance, why use military grade 125˚C/257˚F electronics in aircraft cockpits when pilots can't even tolerate 85˚C/185˚F industrial temperature?

Fast forward to today, and acquisition reform is still having a great impact on the defense electronics market. Prime contractors are also feeling the pressure of new requirements as some initiatives are limiting funding, shortening development cycles and increasing the level of competition. These challenges can be mitigated with COTS technologies, which were historically used to reduce cost and are now well-positioned to address current needs. This paper discusses how COTS products based on open standards and the surrounding ecosystem are alleviating key pain points for military equipment manufacturers.

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Acquisition Reform

Despite the tremendous effort made by military agencies to develop comprehensive MIL-SPEC standards, these specifications were often broadly applied in a one-size-fits-all manner, which resulted in the over design of many components. For instance, every computer chip had to be hermetically sealed in a ceramic package, and in some cases, the cost was 100 times more than the high volume, commercial version in a plastic package. Not only is ceramic more expensive, but newer components and technologies are not available in ceramic packages due to the cost and low volumes. Although ceramic is a good preventative measure against humidity for a missile sitting in a silo for twenty years, it is excessive for a system located in an environmentally-controlled command center.

In addition to adding cost, obsolete MIL-SPEC specifications contributed to another major problem—military components were falling behind the technology curve. In the mid-1990's, the widespread usage of MIL-SPEC was restrained, allowing for performance standards that opened the door to standard commercial components, requirements permitting. The move away from MIL-SPEC standards has paved the way for substantial cost and performance benefits resulting from the adoption of COTS technology.

The Rise of Open Standards in Mil-Aero

One of the first examples of an open standard COTS-based product that moved away from the MIL-SPEC process was the M1 Abrams Tank (Figure 1). Put into service in 1980, the M1 Abrams Tank was retrofitted with open standards-based boards under the Abrams Integrated Management (AIM) recapitalization program that was established to combat obsolescence.[1] The program identified components and subsystems with a high risk of becoming outdated and developed upgrade strategies, including technology insertions. A focus area was the network box, which routed control, interface and power lines throughout the tank; the box was identified as a performance limiter in the late 1990's.

Figure 1. *Abrams Tank*

The network box was updated with higher performance Versa Module Europa (VME) boards that maintained functionality, supported Plug and Play and provided a roadmap for future upgrades. In subsequent years, the system was upgraded to VME64 to add more switching capacity and capabilities. The Abrams Tank is a highly successful example of the longevity and design flexibility of COTS based products.

Key Pain Points for Prime Contractors

Defense agencies are ratcheting up the pressure on prime contractors by providing no funding during the bidding process, driving more aggressive schedules and increasing competition. Providing relief, standards-based COTS components and some simple strategies can give a contractor a leg up on the rest of the pack, as described in the following.

Limited Government Funding

More and more, military procurement is expecting contractors to bid and develop prototypes at their own expense, where only the winner is compensated. In some cases, multiple contracts are awarded to keep second and third-sourcing options open, and consequently, purchase orders are divided up, making it harder for the winners to recoup expenses. Given the uncertainty over the outcome and their increased risk exposure, contractors are clearly motivated to minimize investment cost and development time. An important consideration is that over the lifetime of a program, a COTS-based approach can be half the cost of a fully custom system (see sidebar on page 5: *Program Costs: Fully Custom Versus COTS*).

COTS Strategy: Contractors can dramatically lower the cost of developing prototypes by using COTS solutions that have been pre-validated by suppliers. COTS hardware and software are readily available, greatly reducing the effort to develop early prototypes—the basis for fielded production equipment that can be qualified to the required performance specifications. Furthermore, leveraging COTS hardware frees up technical resources for software development and other value-added features that could create a competitive advantage.

Shorter Development Cycles

To stay current with rapidly changing technology, military agencies are reducing traditional 5-7 year development cycles to 2-3 years. Still, this may not be fast enough to keep pace with computing technologies that typically turn over every 18-24 months. However, closing the gap is difficult due to a long qualification process as well as the time required by military agencies to plan and implement platform retrofits.

COTS Strategy: Clearly, implementing a system based on available COTS components is faster than waiting for a component being designed from scratch and consequently removes substantial program risk. It is important to note that COTS components should be standards-based to ensure interoperability with other components, which greatly speeds up system integration.

More Competition

The transition from MIL-SPEC to performance standards has generated more competition as it is now easier to harden a COTS solution and make it acceptable for military applications. This is because many MIL-SPEC requirements (e.g., ceramic package, copper planes) no longer exist, eliminating considerable barriers that previously kept some suppliers out of the running. Facing an increasingly crowded field, contractors do not want their competitors to be able to buy the same product and sell it to military agencies as spares or for a follow on contract.

One Project, Four Awards

In 2010, prime contractors entered into a full and open competition for a common aviation command and control system (CAC2S), as depicted in Figure 2. In 2011, the Marine Corps Systems Command awarded firm fixed price (FFP) contracts to Northrop Grumman, Boeing, Thales-Raytheon and General Dynamics, not to exceed $5M for the first phase.[2] Once the first phase is completed, each of the four awardees will demonstrate their prototypes to the Marine Corp. The follow-on production contracts will be given to the company with the best solution.

Takeaways

- The prototype development cycle did not provide enough time to develop purpose-built solutions, therefore COTS components were used.
- With the project split into four contracts and a follow-on contract awarded based on prototype performance, it will take a relatively long time for the final winner to make a profit.

Figure 2. *Common Aviation Command and Control System (CAC2A)*

COTS Strategy: It would seem the use of COTS products levels the playing field for prime contractors since they all have access to the same commercially-available components. However, some COTS component vendors are willing to customize their standard products to meet specific requirements, such as quickly redesigning a board to accommodate more memory or lower profile memory chips. This way, contractors can differentiate their solutions without bearing the burden of spinning a custom board themselves, making it more difficult for competitors to replicate designs. A COTS-based approach allows prime contractors to focus on application software and services integration, which are their real competitive advantages.

Meeting the Needs of the Military with COTS

Open standards-based COTS solutions not only address many issues facing equipment manufacturers, they also meet the needs of military programs, including:

- *Interoperability:* Open standards-based architectures, such as ATCA and COM Express, define a common form factor and interfaces that enable interoperability. To lower the total system cost, the U.S. Department of Defense often mandates the use of open standards.
- *Upgradeability:* Offering protection against obsolescence, open standards also make it easier to deploy technology insertions and other performance upgrades in the field that increase the useful lifetime of systems.
- *Extensibility:* Equipment can be easily enhanced and extended to other programs by integrating new software and hardware components supplied by a large number of vendors in the ecosystem.
- *Cost-Effectiveness:* Although many military programs are low volume, the use of COTS-based solutions drives down cost through increased competition and economies of scale.

Beyond COTS

Once a contractor decides to go with an open standards-based platform architecture, what's the next step? It's time to evaluate the COTS offerings and associated ecosystems from the various suppliers to determine which one provides the greatest benefits, such as lowering investment cost, decreasing time to market and increasing differentiation. Excelling in all of these areas, Radisys military-grade, field-proven ATCA and COM Express products benefit from more than 30 years of experience and long-established success in embedded.

- *Lower Investment:* Dramatically reduce development time and cost by using standard-based platforms that are pre-integrated and pre-tested, and conform to military standards.
- *Decrease Time to Market:* Meet time-critical project schedules by leveraging consulting services and fast prototyping capabilities. Platform specialists, such as BIOS programmers, are on hand to tune the platform, which removes a large burden on contractors. Another time saving vehicle is a COM Express carrier board reference design that gives contractors a head start on development. Radisys platforms are designed for quick technology insertions and have been ruggedized using HALT/HASS methodologies that go well beyond the norm. For many military applications in the mobile and mission-computing segments, HALT (Highly Accelerated Life Testing) and HASS (Highly Accelerated Stress Screening) testing is a necessity.
- *Increase Differentiation:* Create a competitive advantage with standard products architected to enable customization at multiple levels of integration. The products are supported by strong ecosystems that allow contractors to add value in many ways and in different areas (i.e., hardware, software, middleware). With access to Intel roadmaps, Radisys engineers are on the forefront of the technology treadmill and have a working knowledge of the latest technologies, such as virtualization and trusted execution technology (TXT). As a result, equipment manufacturers have more time and resources to differentiate with software features, since the hardware effort has been cut dramatically.

Radisys, a leading manufacturer of ATCA and COM Express products for mil-aero, has the necessary technical expertise to help military equipment manufacturers solve a wide range of design issues, as described in Table 1.

COTS, The Win-Win Approach

With reforms in the military's acquisition process, prime contractors are under more pressure to develop systems at lower cost and more quickly. Just keeping up with rapidly changing technology is a daunting task. Offering reprieve, there is greater acceptance of COTS components in military systems, which is a win-win approach for military agencies and prime contractors. Furthermore, contractors can reduce their risk exposure and development costs by choosing Radisys ATCA and COM Express solutions that are backed by over three decades of embedded design experience.

Common Equipment Manufacturer Concerns	Radisys Solutions
Size, weight and power constraints	Optimal performance/Watt/mm^2 in COM Express architecture
Ruggedized/harsh environments (desert, air, underwater)	Conformal coating capability
High performance	Multi-core processors and modularity for technology insertion in ATCA architecture
High reliability	HALT/HASS, MTBF, IPMI, Diagnostics
Military network connectivity	X86 processors, GbE on boards and servers
Long procurement and product life cycles	Long life support and change control management
Limited R&D budgets	Radisys standard products and design expertise
Cloud computing: performance, I/O and security	Radisys platforms and partners enable high density network computing with a wide variety of I/O

Table 1. *Radisys Solutions for Common Equipment Manufacturer Concerns*

Program Costs: Fully Custom Versus COTS

With traditional military system development, nearly every program required custom, purpose-built electronics. As a result, there was little sharing of development costs and intellectual property between programs. The approach had some other significant drawbacks:

- Development costs were high even before systems were tested and verified.
- With minimal reuse, more redesigns were needed to correct faults, adding cost and time.
- One-off components were expensive due to a low rate of production.
- Fully custom systems took a long time to develop, ultimately reducing their useful lifetime.

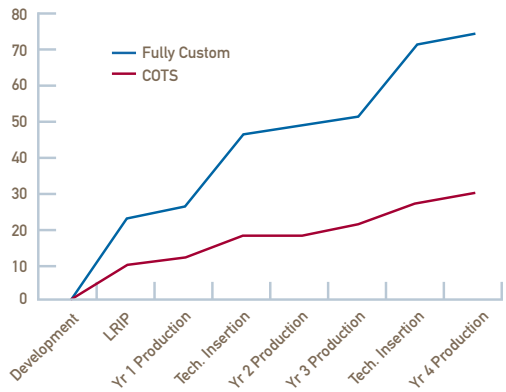

Figure 3. *Lifetime Program Costs for a Military System: Fully Custom Versus COTS*

By the time the fully custom systems reached production, there was already a risk of component obsolescence and lagging performance from legacy technology. In fact, it was not unusual for a program to need a major update (more money and time) early in the production cycle.

A comparison of fully custom and COTS design approaches for a program with a low rate of production is shown in Figure 3. The analysis includes development and support costs over the life of the program, as well as four production runs and two technology insertions. Procurement costs were not factored in, although they are typically less for COTS-based systems. The analysis concluded that the cost of a COTS-based system is less than half that of a fully custom system.

References

[1] www.almc.army.mil/alog/issues/JanFeb03/MS841.html

[2] www.defensemedianetwork.com/stories/common-aviation-command-and-control-system

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