Logistics Challenges With COTS Dominated Army ATE

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Abstract— *The last 30 years has seen the use of Commercial off the Shelf (COTS) components in military systems increase and most recently explode because the “as advertised” benefits of speed to fielding and rapid technology improvements were being realized, however some of the other claimed advantages are less than apparent and there are some challenges to be overcome as the military begins to look at the long term support requirements for COTS systems. This paper focuses on the logistical challenges faced by the Army’s Standard Automatic Test Equipment (ATE) program that is taking advantage of the benefits of utilizing COTS components.*

Keywords—component; COTS, ATE, Army, NGATS

I. INTRODUCTION

In the early 1980's, the Army started its ATE standardization programs and chose the Integrated Family of Test Equipment (IFTE) as the DoD standard program and family designation [1]. The Army applied specific constraints which included operating the IFTE ATE, known as the Base Shop Test Facility (BSTF), shown in Fig. 1, in a standard S-280 shelter requiring the system adhere to some unique and demanding environmental and operational requirements and was procured through the traditional developmental acquisition process. While the BSTF used instrument-on-a-card technology to achieve downsizing, its implementation pre-dated the development of Verso Modulo Europa eXtensions for Instrumentation, and used an early

implementation of some Modular Measurement System instrumentation. A unique interface to the BSTF was developed, aimed at improving interconnection reliability. The S-280 housed ATE was designed to have three siblings: a Commercial Equipment Equivalent for Test Program Set development, an Electro-Optics (EO) Test Augmentation, and a Contact Test Set [3]. All were planned to be contractor developed solutions. The implementation of the Army’s EO concept in form of the Electro Optics Test Facility (EOTF), shown in Fig. 2, presented an opportunity to include modernized test capability and use (albeit in a limited role) of COTS components for the first time in Army ATE.

The Next Generation Automatic Test System (NGATS), shown in Fig. 3 and Fig. 4, is the latest iteration of the Army’s IFTE off-system automatic test capability. With strong emphasis on reducing system acquisition and sustainment costs, the US military has embraced COTS solutions (through adoption, adaption, or modification) as a way to realize cost savings while also speeding up the equipment acquisition process. NGATS seeks to take advantage of COTS test instruments and open system architecture, which enables interchangeability of COTS products. Use of COTS in NGATS should result in a significantly increased system capability, reliability improvements, and reduced system procurement and sustainment costs from the previous IFTE off platform test systems [2].

Fig. 1. Base Shop Test Facility

Fig. 2. Electro Optics Test Facility

Fig. 3. NGATS Exterior

Fig. 4. NGATS Interior

In conjunction with open architecture, using COTS based instrumentation allows the NGATS to take full advantage of modern test program development tools improving the speed of test development for weapons systems and reducing total development costs.

II. WHY COTS?

NGATS represents the evolution of the IFTE off platform test capability and the achievement of the DoD and Army goal to reduce the multiple unique Automatic Test Systems to a single tester, however, what are the implications of using a predominately COTS system in this volatile electronics environment? The most significant benefit of using COTS items for military application is the ability to put more capability into the hands of the war fighter faster [6]. This is particularly important as mission requirements become less predictable and as traditional acquisition cycles are extended to greater than 10 years [2].

COTS, in most cases, can offer a faster more effective acquisition cycle due to a reduction in development time. With COTS solutions, research and development activities are reduced to performing market surveys, sample testing, and integration activities. Hardware production can start as soon as contracts are awarded. This reduced acquisition duration comes with additional benefits.

- Reduced development costs as product development costs are shared over many users.

- Reduced development time/risk when the COTS product provides all the needed features.
- Large user base to find “bugs”, limitations, and performance issues in the product.
- Faster adoption of newer technology without purpose driven development.

Use of COTS items can reduce technical risks. For COTS items with a large customer population, performance is well known and documented. In most cases, a small number of units can be procured for testing and there is an opportunity to survey commercial users for performance data. Generally multiple sources exist and competition can be used to apply downward cost pressure.

III. CHALLENGES

Though the benefits of applying and integrating COTS solutions to military requirements have been well claimed and documented, experience indicates that these benefits do come with a downside relative to the sustainment logistics even to the point where some of the gains in speed of deployment and reduced upfront acquisition costs mean a lifecycle cost increase and increased complexity in the support area.

Although COTS has great potential for reduced development, maintenance time, and cost, the advocates of COTS have not adequately addressed some critical issues concerning logistics supportability because of the short product cycles, configuration management, and increased cost associated with managing technology changes in the COTS environment. Though the acquisition costs are generally reduced in a COTS environment, the total ownership costs (TOC) can see an increase because of the increased sustainment actions required to address the top level challenge of using COTS items in an ATE system which is the speed at which change occurs because of the volatility in electronic component designs.

Electronics technology is highly competitive and evolves rapidly. The environment dictates that if a commercial vendor is to remain competitive, it must keep pace with industry changes and constantly push their product lines forward. Unfortunately, the Army assumes a 25-year lifecycle for most systems with many exceeding that assumption. This assumption appears incompatible with the COTS electronics industry. The EOTF was the Army’s first effort to integrate COTS components into its off platform automatic test system and during its development it experienced component obsolescence issues immediately simply because COTS components reached the end of a very brief life cycle.

The challenges associated with this COTS volatility can begin as early as the logistics planning stage when trying to match the COTS capability to the military requirement. In the case of the Army ATE program, it was found that in many cases the COTS capability typically exceeds the required capability and includes more than is needed. This excess

capability can lead to increased and unnecessary sustainment costs if detailed analysis isn't applied to the inherited "as is" support concept for the COTS item to determine if what the vendor offers is consistent with the military application. Due to the inherited nature of the COTS support concept, the user can be constrained in that regard by the non-availability of technical data. Therefore, the concept of "design for support and support the design" is out of the user's control. This can be problematic in the ATE component environment because over time, the military's ability to influence design and support is relative to the sales volume we represent to the COTS item vendor.

Though early obsolescence is significant it only represents the start of a series of challenges when using COTS. In mitigating obsolescence, component redesign and/or replacement may be required at some point. Typically, in a military developed system, configuration control of this will reside with the Program Manager (PM) where the system capability growth is managed, planned, and executed based on a timeline that considers capability requirements, technology availability, and funding [4]. In a COTS environment this control actually resides with the commercial vendor to the degree that a vendor can decide to discontinue the component or implement a change that makes the component incompatible with the ATE system [6]. This lack of control must be understood when integrating COTS components into military ATE systems and can force the system PM to take action to implement unplanned "modernization" and incur additional program costs even in instances where the current capability is adequate and requires no change. This can lead to increased testing requirements and renewed integration efforts to accommodate the component change. The Army has experienced this first hand when a COTS vendor redesigned a critical system component and claimed "fit, form, and function" compatibility. However, in the complex ATE environment, such a change can have many second and third order effects on system and its ability to perform its mission. A simple component driver change can wreak havoc on an ATE system and result in costly sustainment work to reintegrate the change.

From the vendor perspective, the relatively low density of sales to military users means they may not be as responsive to the issues that are unique to those users. Despite their best intentions, simple economics may dictate that the vendor cannot accommodate military requirements within their basic product line; therefore the military ends up with a unique variation of the COTS product to support a specific military requirement. In this instance, the benefits of COTS is at the very least reduced and possibly eliminated as the PM has to assume the development cost for the change and sustainment derivative product line as well.

IV. PLANNING FOR COTS

According to the NGATS Capability Production Document, April 2007, NGATS is to be "designed using Commercial-

Off-The-Shelf (COTS) technology." This requirement supports the evolutionary acquisition approach of the NGATS due to its reduced acquisition duration and incremental capability improvement options. This acquisition strategy will allow for technology insertion and product improvement linked to normal improvements in the commercial marketplace, which occur as a matter of competition and achieves the goal of rapid capability fielding at a reasonable cost. The challenge is to manage this link to the commercial market to avoid the logistics complications and potential cost. It may seem a daunting task, however it is not unmanageable if a systematic approach is applied. Rapid change in the commercial industry, which ironically is the advantage of using COTS, is the source of these challenges. Systems engineering management, as depicted in Fig. 5, can be the PM's most significant weapon in addressing the challenges of the COTS environment [5]. A system designed and managed through this process to accommodate the rapid turnover and relative short life span of the system components can take full advantage of the benefits of COTS and potentially minimize the downside challenges that are inherent in a COTS based system integration/development approach. On the front end, careful consideration and understanding of the system requirements is imperative. Constant communication and monitoring of the market and technology trends is equally important as components are mapped to the requirements. Early consideration and in-depth scrutiny of component support concepts will result in the most significant cost avoidance because of the impact on system TOC.

PMs, through early recognition and resource allocation supporting the areas that require intensive attention (including configuration management, integration requirements, alternative logistic support, increased test and evaluation, and requirements auditing and tracking) can overcome the challenges of using COTS in modern ATE systems. Fortunately, Performance Based Logistics (PBL) is a tool that can be used to address the long term sustainment support challenges of the NGATS system. It is an alternative support concept that allows several aspects of sustainment to be purchased as a performance outcome where the details of system sustainment are left up to the product support provider(s) as long as performance metrics are achieved.

Fig. 5. Systems Engineering Management

To keep pace with the rapidly changing requirements of the war fighter, the use of COTS items in ATE is now a necessity. COTS provides a cost-effective way to get new technology into the hands of the war fighter quickly. Long-term support issues remain, but, as with traditional development programs, careful planning up front will mitigate life cycle support problems. PBL offers a possible solution to life cycle support issues.

V. CONCLUSION/RECOMMENDATION

Program Managers can confront the challenges they face when using COTS equipment in today's ATE systems in many ways throughout the system's lifecycle beginning with the system design phase with continuation into support planning and implementation.

During system design the PM can ensure the ATE system is tolerant of COTS component changes by ensuring a hardware abstraction layer is implemented that will allow the ATE operating system to interact with the hardware instrumentation at a general or abstract level rather than at a detailed hardware level. Though this approach won't eliminate the impact of COTS changes on the system it should reduce the degree of changes required to adapt the COTS changes to the ATE since COTS increases independence from lower level evolution [7]. PMs should take this into consideration when selecting device manufacturers and the devices as systems are designed.

Support planning begins with designing for support. "Design for support then support the design" is a phrase often used to describe the relationship between design and support. A COTS based system that performs to the required specification doesn't mean the COTS support structure will be adequate. Component performance and component support

are two separate and distinct areas to consider. PMs should pay attention to support planning for COTS components with emphasis on understanding how the COTS vendor supports the product and how that existing support fits the PM's plan. PMs should ensure they develop a relationship with the vendor and make clear the unique support requirements the DoD user has.

Implementation of the support plan can have many different approaches. From our perspective, a negotiated performance based approach with strong emphasis on logistical support performance is probably the best method to ensure the PM's concerns about control, responsiveness, configuration management and testing are addressed.

COTS is necessary and beneficial to put more capability into the hands of the war fighter faster. Managing the risks and potential increased cost of using COTS is possible when the PM and industry work to understand the challenges and collaborate to ensure they are addressed.

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