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EARNED VALUE MANAGEMENT SERIES

The Power of Data

New Thinking and Technology Can Keep EVMS Relevant

GAO Best Practice Guides Light the Way

Cutting the Cost of Earned Value Management

Improving Threat Support for DoD Acquisition Programs

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The **Power** of Data

New Thinking and Technology Can Keep EVMS Relevant

Melvin Frank
David Kester
Karen Urschel

The U.S. Department of Energy provides clear and compelling evidence that an automated, data-driven approach is the best option for delivering accurate and cost effective EVMS compliance for the government.

—Gary C. Humphreys, Humphreys & Associates

The first in this series of Earned Value Management (EVM) articles, "EVM System's (EVMS) High Cost—Fact or Fiction?," published in the January-February 2017 issue of *Defense AT&L,* was a compelling review of why anecdotally based perceptions of EVMS implementations are not substantiated by the facts found by the Joint Space Cost Council (JSCC) study. The conclusion from the JSCC study suggests that there is a point at which the government's implementation of EVMS requirements can drive costs upward and beyond the point of benefit to either the government or its contractor. However, the study also revealed that EVMS, when properly maintained and its data used optimally, provides a high-value and cost-effective management tool that supports product delivery through the genuine stewardship of U.S. taxpayer dollars. Now perhaps more than any other time we need to be reminded that a project management methodology that genuinely embraces the principles of EVM is the best way to position the government for success.

Treat Every Tax Dollar As If It Were Your Own

An EVM methodology and the associated EVMS requirement are designed to ensure that agencies acquire major systems in the most effective, economical and timely manner. Specifically, Federal Acquisition Regulation (FAR) Subpart 34.2 directs that an EVMS be required for major acquisitions in accordance with the Office of Management and Budget's *OMB Circular A-11.* The FAR further states that government may also require an EVMS for other acquisitions, in accordance with agency procedures.

On EVM for managing large scientific, engineering, construction and environmental cleanup projects, the Department of Energy (DoE)—like other government agencies—sees EVM as a disciplined methodology that integrates the work scope, schedule and cost parameters of high-value, complex projects via

Frank *is the director of the Project Management Policy and Systems (PM-30) Division in the Department of Energy (DoE).* **Kester** *is a program analyst for the DoE's PM-30 Division.* **Urschel** *is a DoE support contractor from Humphreys & Associates, an EVMS consulting company.*

systematic planning and effective monitoring and control to permit a detailed assessment of overall performance during the project's life cycle. The *32 Electronic Industries Alliance (EIA)-748 Guidelines* outline the qualities and characteristics of a credible, reliable and compliant EVMS. By definition, a compliant EVMS provides for the generation of valid and verifiable performance data, permits the evaluation of progress, and allows for the calculated probability of meeting programmatic and contractual requirements for cost, schedule and technical viability. A key aspect is the ability to capture physical and technical progress to determine what "done" looks like, rather than what work has been done. EVM is founded on the premise that project teams make the best decisions when they have the best information.

While EVMS is but one of many tools used to plan and control project performance, decision making and communications

Guidelines by providing greater clarity and consistency in how the department does its business. In practice, loosely defined EVMS Guidelines have led to long-term inconsistencies in the interpretation of requirements. The release of the DoE E*VMS Interpretation Handbook* (*EVMSIH*) rectified this by providing more precise definitions and translations.

We believe this to be a positive first step toward addressing the White House OMB's Office of Federal Procurement Policy memorandum titled "*Reducing the Burden of Certifying Earned Value Management Systems.*" The memorandum's purpose is to encourage agencies to enter into reciprocity agreements to recognize EVMS certification across agencies. Reciprocity would reduce burdens both on the agencies that assess EVMS capabilities and the contractors that are required under FAR Subpart 34.2 to have certified EVMSs. The cost of obtaining EVMS certification can be significant, and, under current

Big data are at the core of this different thinking—using data sets and algorithms to summarize, detect patterns, and draw conclusions.

are impaired when EVMS data are deficient and do not accurately reflect current project status or provide acceptable forecasts. This means that the project performance data including cost and schedule conditions, and the progress made toward completing contract deliverables by the project manager to customers and stakeholders become highly subjective rather than a comprehensive measurement of an unbiased EVMS to highlight inefficiencies and looming risks to schedule and budget.

A New Strategy

Paul Bosco, director of the DoE's Office of Project Management Oversight and Assessments, is challenged with demonstrating to departmental leaders a way of implementing an EVMS strategy that consistently provides timely, accurate and reliable project information in the most cost-effective manner. The implementation of an automated, data-driven analytics-based EVMS compliance strategy is viewed as key to meeting the DoE's EVMS strategic goals while dramatically improving the assessment of a contractor's EVMS compliance.

For years, government and industry have debated the finer points of EVMS compliance with no real result. To reach common ground, the DoE is actively working to ensure that industry understands and complies with the *32 EIA-748 EVMS*

practices, contractors sometimes are required to obtain multiple agency EVMS certifications. We believe that providing one face of government to industry by sharing EVMS review information between and among agencies, with each following a standard automated testing protocol, will reduce waste and promote efficiency.

We also believe that an automated compliance strategy can eliminate EVMS compliance barriers that result in some government agencies and contractors thriving while others fail. Efficiency through automation reduces operating costs, is compatible with smaller staffs and allows agencies to operate with fewer resident experts.

It has often been observed that if you keep doing the same things you generally get the same results. By extension, if you keep doing the same thing in an environment of shrinking budgets and changing priorities, you probably will suffer worse results.

It is now time to rethink how we perform EVMS compliance assessments and reviews (both initial certification and follow-on surveillance). Big data are at the core of this different thinking—using data sets and algorithms to summarize, detect patterns, and draw conclusions. A data-driven approach is used

Figure 1. Typical Process Flow

QUALIFYING EXPECTATION—LINES OF INQUIRY (QELOI) TESTING PROTOCOL
5.A.5. Are control accounts established at appropriate levels based on the complexity of the work and the control and analysis needed to manage the work effectively?

A CAM may be responsible for more than one CA. The key is that the CAM must be able to demonstrate effective control of the CA(s). The larger the staff, the more CAs open at the same time means the CAM, all other factors equal, has more difficulty demonstrating effective control. There are no dollar/span of management thresholds limiting a CAM's responsibility. A CAM's technical background, experience and time devoted to the CAM responsibilities are the only limits/factors that guide how many and the scope of CA(s) one CAM can be responsible for.

COMPLIANCE TESTING PROTOCOL BASIS

1. Identify "Major" control accounts (CAs) if the following are met: CA > 7% of Total BAC (and) CA > 10% of Period BCWS
2. For each major CA, assess span of control by monitoring consecutive CA level VAR trips for period SV or CV at +/- 10%.
3. If a CA trips a VAR for period SV or CV, for (3) consecutive months, a "Red" will be recorded for the project.
4. If CA trip continues, a project level ribbon chart will show "red," and will continue until the CA level is within the metric threshold.

Abbreviations appearing in graphics: ACWP = Actual Cost of Work Performed; BAC = Budget at Completion; BCWP = Budgeted Cost of Work Performed; BCWS = Budgeted Cost of Work Scheduled; CA = Control Account; CAM = Control Account Manager; CV = Cost Variance; IMS = Integrated Master Schedule; PMB = Performance Measurement Baseline; PP = Planning Package; SV = Schedule Variance; VAR = Variance Analysis Report; WP = Work Package.

Figures and table by the U.S. Department of Energy

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to efficiently test the reliability of core management processes from initial implementation and continually afterward to reduce the risk of system failure during sustainment and maintenance. The capability to remotely test a contractor's EVMS data greatly reduces and may eliminate the need for multiple government assessments, and the labor and travel costs associated with numerous visits to a contractor's plant.

Piloting an Automated Data-Driven Protocol

The DoE EVMS compliance process uses an automated, data-driven approach to efficiently test the reliability of core management processes from a project's initial implementation and continually thereafter to reduce the risk of system failure. Data-driven testing reveals vital information about the cause of a deficiency and its symptoms (diagnosis) and is invaluable in monitoring the effects of any corrective actions. Automated processing shortens the assessment cycle with the advancement of data collection and analytical techniques using technology.

The DoE *EVMSIH* clarifies the intent of the *EIA-748 Guidelines* through the use of Qualifying Expectation—Lines of Inquiry (QELOI) that identify the qualities and characteristics distinguishing each guideline from the others. To support the verification of the QELOI, DoE and its industry partners, both directly and via the Energy Facility Contractor's Group (EFCOG), developed a series of QELOI Test Steps and Test Metrics designed to measure performance of each of these attributes. These Test Steps and Test Metrics establish EVMS compliance parameters for evidenced-based assessments.

To test its hypothesis that EVMS compliance can be accomplished using an automated, data-driven analytics-based approach, the DoE entered into a 10-month pilot project with a contractor, Consolidated Nuclear Security, LLC, in Oak Ridge, Tennessee, to determine whether observations of the approach agree with or conflict with the predictions derived from a hypothesis. One of the objectives of the pilot project was to produce an updated *EVMSIH* that was fully tested, appropriately automated (to the greatest extent practicable), and ready for use by other DoE projects subject to the requirements of DoE Order 413.3B, "Program and Project Management for the Acquisition of Capital Assets." Those requirements provide program and project management direction, inclusive of a compliant EVMS, for acquiring capital assets within the original performance baseline scope, cost and schedule.

The pilot project methodology established a collaborative laboratory-type environment designed to develop and test a comprehensive *EVMSIH* update, while understanding the

Table 1. Test Result Example

GUIDELINE	TEST NO.	TEST DESCRIPTION	TEST STEP	THRESHOLD	TRIP
1	1.A.1-1.1	Verify that the numeric CA/WP/PP WBS codes align between the WBS Dictionary and EVMS Cost Tool.	01_A_01-01_01_d	0.05	NO
1	1.A.1-1.2	Verify that the numeric CA/WP/PP WBS codes align between the IMS Flat File and the EVMS Cost Tool.	01_A_01-01_02_d	0.05	NO
1	1.A.2-1.1	Verify the Dollar value, at the CA/WP/PP WBS levels, align between the IMS Flat File and the IPMR/CPR Format 1.	01_A_02-01_01_d	0.05	NO
1	1.A.2-2.1	Verify the WBS Dictionary and Work Authorization scope statements align.	01_A_02-02_01_d	0.05	YES
2	2.A.1-1.1	Verify the dollar values at the functional categories align.	02_A_01-01_01_d	0	NO
2	2.A.1-1.2	Verify the total PMB dollar value is the same.	02_A_01-01_02_d	0	NO
2	2.A.1-1.3	Verify the RAM to the Cost Tool	02_A_01-01_03_d	0.05	NO
3	3.A.1-1.1	Verify physical percent complete aligns between IMS and EVMS Cost Tool for active WPs.	03_A_01-01_01_d	0.05	YES
3	3.A.1-2.1	Verify forecast start and/or actual start dates for incomplete CAs, WPs and PPs align between IMS and the EVMS Cost Tool (Excluding SVTs and Milestones).	03_A_01-02_01_d	0.05	NO
3	3.A.1-3.1	Verify forecast finish and/or actual finish dates for incomplete CAs, WPs and PPs align between IMS and the EVMS Cost Tool (Excluding SVTs and Milestones).	03_A_01-03_01_d	0.05	NO
3	3.A.1-4.1	Verify baseline alignment of hours between the WA and the EVM Cost Tool for WP, PP and CA.	03_A_01-04_01_d	0.05	NO
3	3.A.1-4.2	Verify baseline alignment of dates between the WA and the EVM Cost Tool for WP, PP and CA.	03_A_01-04_02_d	0.05	NO
3	3.A.1-4.3	Verify baseline alignment of dollars between the WA and the EVM Cost Tool for WP, PP and CA.	03_A_01-04_03_d	0.05	NO
3	3.A.1-5.1	Verify the charge codes align at the CA/WP/PP level between the IMS and the WA.	03_A_01-05_01_d	0.05	NO
3	3.A.1-5.2	Verify baseline dates align between the IMS and the WA (excluding SVTs and Milestones) for CA/WP/PPs.	03_A_01-05_02_d	0.05	NO
3	3.A.1-6.2	Verify dates align between the IMS and the EVMS Cost Tool for CA/WP/ PPs.	03_A_01-06_02_d	0.05	NO
3	3.A.1-6.3R1	Verify BAC aligns between the IMS and the EVMS Cost Tool for incomplete CA/WP/PPs.	03_A_01-06_03R1_d	0.05	NO
3	3.A.1-6.4	Verify EOC aligns between the IMS and the EVMS Cost Tool for incomplete CA/WP/PPs.	03_A_01-06_04_d	0.05	NO
3	3.A.1-6.5	Verify hours align between the IMS and the EVMS Cost tool for incomplete CA/WP/PP	03_A_01-06_05_d	0.05	NO
3	3.A.1-7.1	Verify baseline hours and total dollars at CA level align between BCP Log and WA.	03_A_01-07_01_d	0.05	NO
3	3.A.1-8.1	Verify the IMS forecast start and finish dates align with the ETC start and finish dates in the EVMS Cost Tool for active CA/WP/PPs.	03_A_01-08_01_d	0.05	NO
3	3.A.1-9.1	Verify the RAM dollar values align to the CPR Format 1 Dollar Values.	03_A_01-09_01_d	0	NO
5	5.A.1-1.1	Verify the EVMS Cost Tool has only one OBS assigned to each CA.	05_A_01-01_01_d	0.05	NO
5	5.A.1-2.1	Verify the EVMS Cost Tool has only one WBS assigned to each CA.	05_A_01-02_01_d	0.05	NO
5	5.A.1-3.1	Verify if there SLPPs that the PMB-Total CA Budget-UB = SLPP value.	05_A_01-03_01_d	0	NO
5	5.A.2-1.1	Verify there is a CAM assigned to each CA and is in alignment with the IMS and EVMS Cost Tool.	05_A_02-01_01_d	0.05	NO
5	5.A.3-1.1	Verify the CAM assignment aligns between the RAM and Work Authorization.	05_A_03-01_01_d	0.05	NO
5	5.A.5-1.1	To verify effective CAM Span of Control, identify the Major CAs (> 7% of the total BAC and >10% of the period BCWS) and if the current period SV% and/or CV% greater than 10%	05_A_05-01_01_a	0	YES

commercial practices used in managing engineering and construction projects, to obtain the most effective and efficient and EIA-748-compliant EVMS. This lab environment employed a build-deploy-test workflow to automate cost-effective EVMS compliance as much as reasonably achievable. This included the determination of thresholds reflecting the relative importance of the attributes. There would then follow an iterative process to collaboratively evaluate the results and refine the testing specifications to confirm expected outcomes. Thus, the DoE would focus only on those test metric values that are outside the defined threshold value, getting to the real issues and reducing EVMS oversight costs.

The expectation is that by documenting, classifying and sequencing the EVMSIH QELOI, contractors will be able to find the underlying causes of core management process issues and self-correct prior to any government involvement.

Figure 1 shows a typical process flow and how the pilot project went about defining, interpreting, and documenting EVMS compliance requirements for each *EIA-748 Guideline*. Each

process flow was then provided to the developers to build the code necessary to extract data from the EVMS and the algorithm to calculate the result and assign an assessment result—green (not a compliance concern) or red (a compliance concern)—based upon a predetermined threshold.

Table 1 shows a small sample of the test results from the automated calculation identifying the test results from the automated calculation identifying those QELOI requiring attention.

The contractor responded to the expressed needs of the pilot project, providing access to its project information and performance data, and dedicating key resources throughout the 10-month effort. The contractor also responded by making a significant commitment and investment in development and deployment of new testing technology, thus accelerating the automation of EVMS testing. The robust collaboration and collegiality validated the objectives of the pilot project, which involved alignment of EVMS implementation interpretations and the reduction of costs, while preserving individual public and private identities and missions. Several key lessons can

be learned from the pilot project experience and applied to similar environments:

- EVMS assessments can come through both automated and manual testing.
- The method chosen comes down to the ability to digitize the analog process.
- More assessments can be accomplished and issues identified quicker using an automated method.
- The team is able to react more quickly, saving time and money.
- Innovation requires a mindset shift toward trusting the data.

It is important to stay the course and pursue the goal regardless of obstacles or criticism.

Eliminating Excess

At the start of the pilot project, the number of EVMSIH QELOI, Test Steps, and Test Metrics were 134, 345 and 597, respectively. Of the latter, 481 Test Metrics (81 percent of the total) were initially categorized as requiring a manual approach to determine EIA-748 compliance. The Test Metric to QELOI ratio was approximately 4.5 to 1. Based on expert opinion, the optimum ratio is on the order of 2 or 3 Test Metrics to 1 QELOI, while still providing a valid basis for testing EVMS compliance. The challenge faced by the Pilot Project was picking the right number and level of Test Metrics and the quality of the data gathered to ensure the effectiveness of the analysis and interpretation of the automated, data-driven EVMS compliance. Figure 2 displays the Pilot Project final totals.

A live demonstration of DoE's automated, data-driven approach was provided at the January-February 2017 National Defense Industrial Association (NDIA) working meeting in Orlando, Florida. The proof-of-concept demonstration processed hundreds of thousands of contractor EVMS data elements for 236 Test Metrics. It took mere minutes, using a flat file to access data base architecture, to verify the validity of automating a manual task using hard copy artifacts that previously required days if not weeks and months to assemble, calculate, observe, conclude and document. We believe the benefits (i.e., clarity, consistency and cost) associated with automated, data-driven EVMS compliance can better position the DoE and other government agencies to meet all government requirements at best value while providing an optimal project controls tool.

The next step in exporting the automated, data-driven EVMS compliance process across the DoE complex is to replicate and tailor where necessary the results of the pilot project with Los Alamos National Security, LLC, at the Los Alamos National Laboratory in Los Alamos, New Mexico.

Transforming Into the Digital Realm

When looking to an EVMS future, one of the most important questions is what technology can be added to an organization's operations. We believe that the challenges facing project managers and their teams to deliver accurate and reliable data, and to provide adequate checks and balances, can only be met by looking at new ways of doing things. Technology must play a key role in delivering this.

In the future, everyone conducting EVMS compliance will need extensive knowledge of the technology solution to execute the automated, data-driven methodology. To get the actionable information they need from the EVMS, both government and contractor personnel alike will perform diagnostic tests with the data to determine the presence, materiality and systemic nature of the issue. Test results will be evaluated based on predetermined thresholds to measure compliance and indicate when corrective action may be needed.

In the end state, a digital dashboard will let customers and stakeholders know the compliance (or health) status of the EVMS performance data upon which they are making financial and other programmatic decisions.

Any measurement that falls outside historic norms or deviates from a predetermined threshold will be flagged. Within minutes, government will know what issues to focus on and whether additional engagement with a contractor is required. The future direction for EVMS compliance efforts will be based on these results. DoE's level of engagement with a contractor

Figure 2. Final Test Metric Statistics

Total Test Metrics by Process Area

Automated vs. Manual Tests
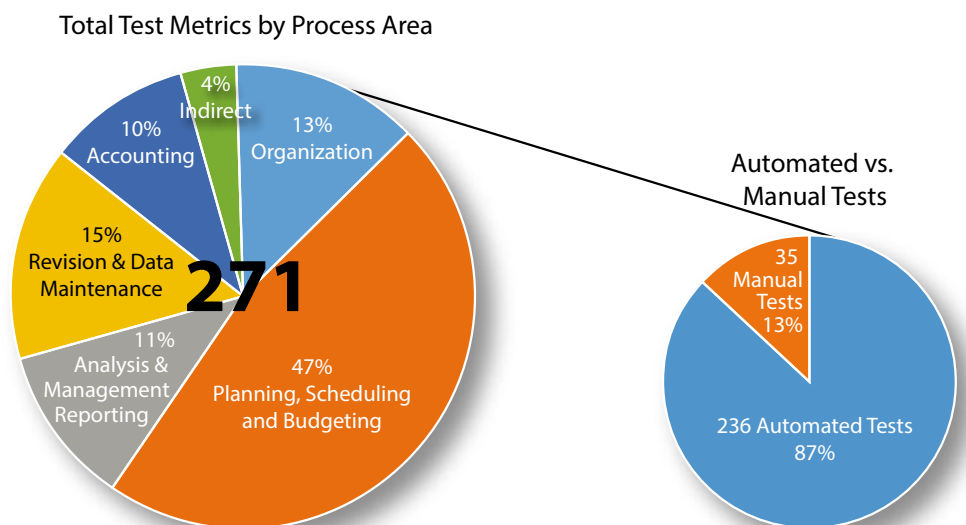
will be carried out through a three-stage process, beginning with a less formal approach. This should engender a more collaborative approach and produce quicker results.

The stages are:
- Stage 1: Limited Engagement. When the tests do not exceed thresholds, the results will be shared with the contractor, and DoE will minimize additional surveillance activities.

- Stage 2: Investigation. When any test exceeds the thresholds, DoE will discuss the issue with the contractor, which will investigate whether a breach has occurred. Based on the investigation, DoE may issue advice to clarify and/or

way to emerging issues, allowing a contractor to take preemptive action to remedy data quality issues before they escalate to major deficiencies.

System Maturity Scoring

The DoE approach is data rich, taking the EVMS compliance assessment down to the core attributes of each *EIA-748 Guideline*, through the testing of management processes, including organizing, work authorization, planning, scheduling and budgeting, forecasting and change control. Next, value weightings can be assigned to each QELOI for appraising the maturity of an EVMS. Similar to how FICO Scores are calculated from many different pieces of credit data in a credit

With fewer EVMS personnel needed, DoE will depend heavily on technology to remotely test a contractor's EVMS data.

interpret the relevant provisions of the attribute interpretation for the contractor to follow.

- Stage 3: Corrective Action. If the issue continues, DoE will require a more formal investigation by the contractor that will include a root-cause analysis and corrective action plan. Throughout this process, government personnel will ensure that concerns are promptly considered by the contractor and that any necessary action is taken as swiftly as possible.

Remote Diagnostics

Automation and mobility are central to DoE EVMS compliance. One of its core functions is designing, developing and deploying a Web-based content delivery system. Within the DoE, that is the Project Assessment and Reporting System (PARS), the flagship enterprise system of record for project data and information. The more automation and mobile capabilities PARS can provide to the EVMS compliance process, the more it will help move the mission toward greater consistency and clarity and consolidate operations for cost savings.

A small and dedicated group of DoE subject-matter experts control PARS capability development, configuration management and systematic functionality upgrades throughout the system's life cycle. With fewer EVMS personnel needed, DoE will depend heavily on technology to remotely test a contractor's EVMS data. This will eliminate the need for multiple DoE assessments and costs and time of numerous visits to a contractor's facility. PARS will mark suspect data and point the

report, an EVMS maturity score can reflect how compliant or noncompliant a contractor's EVMS is at any point in the project life cycle. QELOI weighting could be adjusted accordingly to best implement the EVMS through the different phases of the project.

Conclusions

The first step is realizing the importance of EVMS as a key project management tool—and compliance is a government requirement. Agencies must reinvigorate the government benefits from its implementation, while being prudent and financially responsible. We must work to achieve maximum value of this tool in the most cost-effective manner.

This article has presented several insights into how DoE has changed its approach to EVMS compliance. There is a needed and inevitable journey away from single points of expertise and gut feel toward a smarter EVMS compliance, aided by the power of data, analytics and technology.

However, all efforts to rethink EVMS compliance are meaningless unless the EVM methodology and the associated EVMS are simplified to be timely and intuitive and allow both government and contractor project managers and their teams to realize the greatest benefit. When this happens, EVMS compliance becomes a management standard operating procedure and not a burdensome requirement.

The authors can be contacted at **melvin.frank@hq.doe.gov**; **david.kester@ hq.doe.gov**; *and* **karen.urschel@hq.doe.gov**.

GAO **Best Practice Guides** Light the Way

Karen A. Richey

Fifth in a series of articles

Since 2005, the U.S. Government Accountability Office (GAO) has developed and distributed a series of guides that address shortcomings, recommend best practices, as well as related case studies regarding integrated program management (IPM). All were developed to support improved performance and end results of federal government programs through better planning, risk awareness and enhanced management decision making.

Overview
Best practices guides are compilations that federal organizations and industry use to develop and maintain reliable project controls and management tools throughout the life of a government acquisition

Richey *is the assistant director for the Applied Research and Methods team at the Government Accountability Office.*

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What's in It for You?

First off, seeing your name in print is quite a kick. But more than that, publishing in *Defense AT&L* can help advance your career. One of our authors has even been offered jobs on the basis of articles written for the magazine.

Now we can't promise you a new job, but many of our authors:
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• Are invited to speak at conferences or symposia
• Get promoted or rewarded

For more information and advice on how to submit your manuscript, check the writer's guidelines at https://www.dau.mil/library/defense-atl/p/Writers-Guidelines or contact the managing editor at datl@dau.mil.

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program. Guides can be used across the federal government for developing, managing and evaluating various aspects of federal acquisition programs. Guides provide principles for GAO auditors to use in assessing various aspects of acquisition programs.

It is important to note that all guides were developed in collaboration with experts in one or all of the cost, schedule or technical management disciplines covered by the best practice guides. This approach was implemented with the development of the first best practice guide and has become a well-understood process that has been applied to other publications. The process itself involves GAO seeking input from a wide range of experts, starting with planning and design through report development.

GAO's best practice guides are developed through an iterative, consultative process that involves a committee of experts in the related domain(s). Members are from government agencies, private companies, independent consultant groups, trade industry groups and academia. On the *Cost Guide*, comments were invited from nearly 1,000 experts representing a broad range of industries, international perspectives and program environments. Expert meetings are open to anyone with the requisite experience and interest in the topic. Meeting minutes are extensively documented and archived after review by the GAO team and all participants.

The foundational guides that have been published to date and are in development are as follows:

The Cost Estimating and Assessment Guide (GAO-09-3SP)

GAO's original intention was that the *Guide* would provide GAO auditors with a standardized approach for analyzing program costs. Internal GAO research found that federal guidelines were limited on processes, procedures and practices for ensuring credible cost estimates. The team concluded that GAO could best serve the Congress and the federal community by filling that gap. GAO began drafting the *Guide* in 2005, issued a draft release in 2007 for public comment and officially released the *Guide* in 2009.

The purpose of the *Cost Assessment Guide* is to:

• Address generally accepted best practices for ensuring credible program cost estimates applicable across government and industry.
• Provide an explicit link between cost estimating and earned value management (EVM).
• Discuss how both cost estimating and EVM are needed for setting realistic program baselines and managing risk.

Schedule Assessment Guide (GAO-16-89G)

The *Schedule Assessment Guide* expands on the scheduling concepts introduced in the draft *Cost Guide* and was intended to be an appendix to the official release of the *Cost Guide* but

instead was issued as a publication in its own right. Drafting of the *Guide* began in 2010; a draft was issued for an 18-month comment period in 2012, and the final draft was issued in 2015.

The purpose of the *Schedule Assessment Guide* is to allow GAO auditors to assess the reliability of reported dates through an assessment of project schedules. It is also a useful resource for agencies to create or append existing policies and guidance on creating and maintaining project schedules.

Agile Implementation Guide (Draft)
This *Guide* will fill a criteria void on "cost," "schedule" and "performance" (particularly technical) in the "cost-schedule-performance" trio of management elements of capital acquisition programs when specifically auditing programs utilizing an Agile, rather than traditional, software development approach. It also addresses the cultural and organizational changes that are needed for Agile development to effectively work in a government agency. Drafting of the Guide began in 2016; a draft

On the *Cost Guide*, comments were invited from nearly 1,000 experts representing a broad range of industries, international perspectives and program environments.

Technology Readiness Assessment Guide (GAO-16-410G)
The *Technology Readiness Assessment Guide* fills a criteria void on "performance" (particularly technical) in the "cost-schedule-performance" trio of management elements of capital acquisition programs. Drafting of the *Guide* began in 2013, a draft was released for a 12-month comment period in 2015, and the final is scheduled to be issued in 2018.

This *Guide* was designed to bring understanding and practice of technology readiness assessments, invented decades ago by NASA and utilized extensively in the Department of Defense, but now available to other agencies that lack a large technical staff. It also allows GAO auditors to assess the reliability of the identification and management of technologies critical to the success of a given capital acquisition program. It is intended to help agencies create or append existing policies and guidance on creating and maintaining technology readiness assessments, whether they are for ongoing, day-to-day project management or major milestone decision points.

Cost Estimating and Assessment Guide— Update Document
This revised version of the *Cost Guide* updates the original 2009 *Cost Guide* and is intended to improve definitions of criteria and leading practices based on lessons learned over 8 years of application and to provide the latest industry and government practices along with updated references to existing laws and federal guidance. This *Guide* provides updated graphics, more recent case studies, and provides integration with the *Schedule Guide*, the *Technology Readiness Guide*, the *Agile Guide*, and *Standards for Internal Control*. Drafting began in 2016, with release scheduled for 2018.

is expected to be released for a 24-month comment period in 2019, with final issuance probably in 2021.

The *Agile Guide* is intended to foster a better understanding and practice of Agile software development, codified in a 2001 manifesto drafted by software development experts in the private sector, but now utilized extensively by federal agencies and soon to be promoted as the preferred approach to software development by the Office of Management and Budget. It is intended to allow GAO auditors to assess the reliability of the management of processes and technologies critical to the success of capital acquisition programs using an incremental or Agile approach to software development and the risk assumed by federal agencies in transitioning from a traditional to Agile approach to software development.

The *Agile Guide* is meant to be useful for agencies seeking to create or append existing policies and guidance on developing software using an Agile approach, whether for ongoing, day-to-day project management or overarching organizational policy.

All GAO best practice guides are available free of charge online by browsing at http://www.gao.gov/search.

All of the best practice guides include numerous case study examples highlighting the advantages and disadvantages of varying degrees of following their recommended practices. These case studies are also documented and available at the same Web resources free of charge for those wishing to explore the topics in greater depth. &

Cutting the Cost of Earned Value Management

Jerald Kerby ■ Matoka Forbes ■ Stefanie Terrell

Sixth in a series of articles

The Civilian Agencies and Industry Working Group (CAIWG) on Earned Value Management (EVM) recently released its guidance on Earned Value Management System (EVMS) reciprocity and EVM scalability. Both initiatives resulted in products that can be used to help lower the burden and cost of implementing EVM. The initiatives can be found at http://caiwg.mycpm.org.

In today's competitive environment, it is imperative that both government and industry seek ways to reduce costs and gain efficiencies. There is continuing discussion about the cost of implementing EVM, a disciplined process

Kerby *is NASA's Earned Value Management (EVM) Program Executive and chairman of the Working Group that supports EVM implementation and development of NASA's EVM policy and handbooks. He also is responsible for providing both classroom and hands-on EVM and data analysis training to the project management community at NASA and the Marshall Space Flight Center in Alabama. He has a bachelor of science degree from Alabama's Athens State University and a master of science degree from the Florida Institute of Technology.* **Forbes** *is the Federal Aviation Administration (FAA) EVM Focal Point. She is an active member of the Civilian Agency Industry Working Group and ensures the EVM implementation on FAA programs.* **Terrell** *is a program analyst with more than 8 years of industry and government experience on all matters related to scheduling and EVM.*

that identifies cost and schedule variances primarily based on comparisons between planned work and performed work. To date, numerous studies have offered insight into the real costs of using EVM. An article in the January-February 2017 issue of *Defense AT&L* ("EVM System's [EVMS] High Cost—Fact or Fiction?") concluded that EVM can be done in an efficient manner at a low cost if implemented correctly.

The CAIWG was created to bring civilian agencies together to share best practices for implementing EVM and to promote consistent integrated project management across agencies. Though not a formal member, the Department of Defense (DoD) participates in this group to help ensure consistency in the application of project management principles and EVM requirements across the government and industry.

Reciprocity Agreement

The intent of EVMS reciprocity is to create an established, universally applicable set of standards for use in conducting reviews across the government. The desire is to find a standard generic enough to address the requirements and objectives of any agency, yet specific enough to ensure that uniform rules are applied. This approach provides added value when EVM review reports are shared between agencies and departments and used to reduce the need for duplicative reviews.

The Office of Management and Budget (OMB) supported this reciprocity initiative. A presidential memo was issued on Oct. 23, 2015, to address reducing the burden of certifying Earned Value Management Systems. It stated:

> … agencies are encouraged to enter into reciprocal agreements with other agencies and to post their EVM processes and procedures on their public websites. Sharing information should help identify redundancy in the certification processes. If an agency determines that its certification process is substantially similar to the certification process of another agency, the agency should consider whether it is feasible to enter into an agreement with the other agency for the mutual recognition of the EVMS certification.

On this topic, the OMB released a statement in 2016 by Anne Rung, former administrator for the Office of Federal Procurement Policy, which stated:

We're committed to reducing the burden on both government agencies and contractors, and our October 2015 guidance encouraging the use of these reciprocity agreements for EVM system certifications is a significant step in that direction. If agencies recognize each other's certifications, we can avoid costly, duplicative compliance reviews. NASA [National Aeronautics and Space Administration] and the FAA [Federal Aviation Administration] are leaders in this area—having been the first to sign an agreement recognizing each other's EVM system certifications earlier [in 2016]—and we encourage other agencies to consider a similar arrangement.

This memorandum of understanding (MOU) is intended to serve as an umbrella agreement that provides for the sharing of EVMS compliance reports between federal agencies. Agencies retain the right to make their own determination of system compliance in accordance with each organization's policies and procedures. It is also anticipated that agencies would enter into supplemental agreements providing more specific details tailored to the unique requirements of future projects and partnerships.

The first EVM reciprocity MOU was established by NASA and the FAA in March 2016. That MOU states that recognition of another agency's certification, as appropriate, eliminates duplicative compliance reviews and results in cost savings for both the contractor and the taxpayer. Both agencies agree that the other participant will recognize the supplier's EVMS as EIA-748 (EVMS Standard) compliant and will ensure that the system is continuously maintained. This MOU could result in significant savings to the government and contractors, given that an EVMS review can cost $1 million to $2 million and can take a few years to complete.

In December 2016, DoD also issued an umbrella EVMS reciprocity MOU, which established the sharing of EVMS review information with the aim of increasing the efficiency with which agencies determine a supplier's EIA-748 compliance. The MOU further recognizes that collaboration between agencies will help improve that efficiency. Under this reciprocity MOU, the FAA currently accepts EVMS certifications for industry by the Administrative Contracting Officer of the DoD's Defense Contract Management Agency. In addition, NASA has a standing MOU with DCMA to delegate EVMS reviews

Figure 1. Scaling the EVM to Project Needs
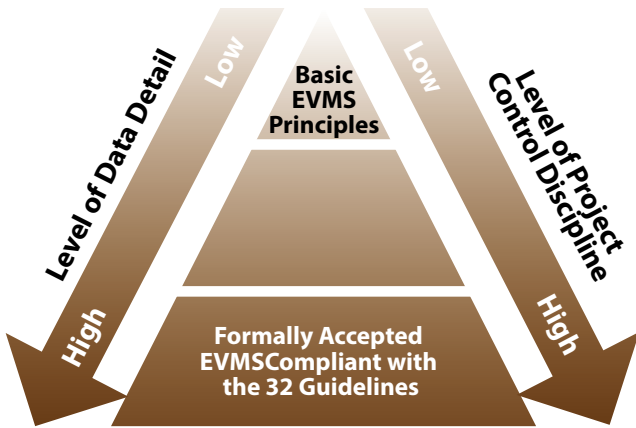
Source of graphics: The National Defense Industry Association's *Earned Value Management System Guideline Scalability Guide.*

and surveillance activities among companies for which DoD already does this type of work.

The key to progress in EVM reciprocity is for those government agencies that are heavily involved with EVM—including DoD, NASA, FAA, the National Reconnaissance Office (NRO) and the Department of Energy—to establish a government-level standard for recognizing an EVMS. In the future, OMB and the CAIWG expect to see multiple agencies implement EVM reciprocity agreements and, over the long term, employ a single, government-wide reciprocity agreement.

Scalability Guide

In addition, the CAIWG developed an *EVMS Scalability Guide* that outlines how EVM implementation can be scaled to meet varying project needs. The *Guide* was developed specifically for organizations that typically don't have contracts that require EVM, or those lacking the large infrastructure typically supporting a fully compliant EVMS. This *Guide* was jointly developed with industry and is now part of the National Defense Industry Association (NDIA) document library.

Historically, EVM has been used on large development and production contracts, so prior to the *EVMS Scalability Guide* little guidance existed for smaller projects. The *Guide* enables EVM scalability based on project size, cost, risks, complexity and other factors. As the size and complexity

of the project increases, so does the project controls requirement, as indicated in Figure 1 (which initially appeared in the NDIA's *Earned Value Management System Guideline Scalability Guide*, issued in November 2016).

Figure 2, also drawn from the *NDIA Scalability Guide*, is an example of a responsibility assignment matrix for a small project with a limited number of control accounts. As the project grows in size and complexity, the application of earned value management techniques also will increase.

The *Scalability Guide* also is intended for suppliers that may not have a contractual requirement in place for EVM but would like to benefit from implementing EVM practices. The *Guide* is intended for industry and government personnel within:

- Entities such as universities, laboratories, small businesses and suppliers with small to midsize projects
- Large organizations with small projects that issue contracts to small businesses or other suppliers that may not have an existing EVMS in place
- Any government agency with small contracts and an EVM requirement

Although this document is primarily targeted at contractors, there is a requirement within government agencies and organizations to follow the process outlined in the OMB Circular A-11, *Capital Planning Guide* for government in-house projects with development work. The *EVM Scalability Guide* can provide government project teams with information on optimizing their EVM implementation based on each project's characteristics.

The *Scalability Guide* is intended to provide guidance for setting up and establishing fundamental project management

Figure 2. Responsibility Assignment Matrix

processes rather than focusing on EVM-specific information. The *Guide*'s initial chapters cover planning and organizing the work, such as establishing a Work Breakdown Structure (WBS) and assigning responsibility. Subsequent topics include scheduling work and establishing budgets. The *Guide* then transitions into the execution phase of the project: managing a baseline, controlling changes, managing subcontracts and material, controlling costs and analyzing data that can be used to make project management decisions.

The *Scalability Guide* has received a positive response both from industry and government partners, largely because the *Guide* effectively takes into consideration all 32 guidelines from the *EIA-748 EVMS Standard.* It further provides tips and suggestions for each guideline and identifies ways they can be scaled, thus gaining the full value of EVM while reducing the burden of implementing a compliant EVMS.

Small organizations without the full benefit of a corporate EVMS also should realize a significant benefit from the *Guide.* For example, a university's accounting system may be limited to collecting labor costs at the top WBS level of a project. The guide offers options for establishing budgets and collecting costs when an organization's accounting system is under constraints. It also discusses workaround plans to address other limitations within other business systems that support EVM.

In summary, discussion of the cost and burden of EVM is not likely to decrease any time soon. The civilian agencies have taken the initiative, however, to reduce the burden and costs associated with EVM by developing EVMS reciprocity agreements and the *EVM Scalability Guide*, which respectively can reduce duplicative future EVMS reviews and provide guidance for small projects to customize EVM for optimal project management.

For more information on the CAIWG activities, visit the website at http://caiwg.mycpm.org.

The authors can be contacted at **jerald.g.kerby@nasa.gov**; **matoka.forbes@faa.gov** and **stefanie.m.terrell@nasa.gov**.

Where Can You Get the Latest on the
Better Buying Power
Initiatives?

Improving **Threat Support** for DoD Acquisition Programs

Paul Reinhart ■ *Brian Vanyo*

Accelerating advancements in threat military capabilities are driving sweeping changes in acquisition intelligence support. Defense acquisition and intelligence leaders recognize that greater consideration of threat capabilities throughout a program's acquisition life cycle can reduce developmental cost and operational risk. To facilitate threat-informed acquisition decisions, the defense intelligence community overhauled its threat support products and procedures in 2016. This article discusses these reforms and the outlook for improved intelligence integration.

In late 2013, then Assistant Secretary of Defense for Acquisition (ASD[A]) Katrina McFarland formed an integrated product team (IPT) to improve acquisition intelligence support by making it, in her words, "more agile to the emerging threat environment and efficient in the application of better business practices." Mrs. McFarland sought more rapid delivery of threat information to acquisition customers in order to more effectively support program requirements and design decisions. To that end, she directed intelligence producers and acquisition customers to "work together to develop a better way to make threat support more timely, relevant and dynamic."

In a series of meetings in early 2014, the IPT studied existing threat support products and practices to develop recommendations for improvement. Initial discussions focused on two intelligence products that have traditionally supported acquisition customers: the

Capstone Threat Assessment (CTA), which forecast threat capabilities in specific warfare domains; and the System Threat Assessment Report (STAR), which supported a specific defense acquisition program by identifying all relevant threats and their forecast capabilities at program initial operational capability (IOC) and 10 years after. The IPT identified many problems associated with CTA and STAR development, including the following:

Insufficient customer support: CTA and STAR updates occurred biennially with little input from customers on desired content. Regardless, their lengthy production period precluded timely response to any expressed intelligence needs. Moreover, Department of Defense (DoD) policy did not require STAR production to support early program-design decisions that greatly impact program cost.

Limited threat forecasting: CTA and STAR threat sections were sometimes more historical than predictive and consequently of limited value to acquisition customers, who often desire 20-year threat projections due to the lengthy span of time between program initiation and IOC.

Redundant production: Many CTAs and STARs contained similar threat sections that intelligence analysts had to separately write and review, placing a huge production burden on limited analytic resources in the Department of Defense Intelligence Community (DoDIC).

Analytic inconsistencies: Because each CTA and STAR was produced individually on different timelines, they sometimes contained slight differences in analysis.

Lack of analytic prioritization: CTA and STAR production is federated among various intelligence support offices, so the DoDIC as an enterprise has little insight into threat topics that affect the most critical or greatest number of defense acquisition programs. As a result, the Defense Intelligence Agency (DIA) could not influence analytic prioritization to better support acquisition needs.

Proposed Intelligence Reforms

To correct these threat support problems, the IPT recommended intelligence reforms aimed to reduce production inefficiencies, thereby enabling increased levels of intelligence support throughout a program's life cycle. The IPT specifically proposed replacing the CTA with a new, centrally managed threat library and replacing STARs with a new product called the Validated Online Lifecycle Threat (VOLT) report.

The Defense Intelligence Threat Library is a collection of approximately 300 threat assessments, known as threat modules, each of which addresses threat capability developments in the next 20 years in a specific topic area, such as electronic warfare; air-to-air missiles; early warning radars; laser weapons; cyberwarfare; and adversary tactics. Authored by Science and Technical Intelligence (S&TI) experts in the DoDIC,

threat modules provide broad threat technology trends and projections with hyperlinks to supporting foundational intelligence. DIA's Defense Technology and Long-Range Analysis Office centrally manages the production and update of threat modules to ensure their currency and availability for use as the primary threat content in VOLT reports. Module updates occur on schedule approximately every 2 years or as needed to account for significant threat developments.

A VOLT report is the primary threat document supporting a specific defense program. It includes all threat modules deemed relevant to the supported program and explains their relevance to program requirements. The VOLT report also answers specific intelligence questions or requests raised by the program, capability developer, or test representative. VOLT delivery includes a static record copy of threat as well as a dynamic report that is hosted on classified intelligence networks and embeds only the most current threat modules. Therefore, when a single module is updated, all VOLTs using it are updated online simultaneously to guarantee that all affected programs have access to the most current threat information at the same time.

The IPT perceived many benefits of such reform. Centralized management of all threat projections would improve analytic resource management and eliminate redundant and sometimes inconsistent CTA and STAR production efforts. Intelligence support offices traditionally responsible for STAR production would be able to assemble VOLTs much faster and earlier in the acquisition cycle using validated threat content maintained in the Threat Library. Moreover, S&TI experts would have more time to devote to futures analysis in threat module production to improve the overall quality of acquisition intelligence support. Their assignment to produce specific threat modules would also enable more direct feedback from acquisition customers to improve these products. Finally, the dynamic design of VOLT updates would offer programs instantaneous awareness of threat developments to quickly inform acquisition decision making.

Although these proposed reforms were conceptually promising, three pilot programs between June 2014 and March 2015 verified their actual value. VOLT delivery was achieved in a fraction of the time it took to publish a STAR. New VOLT processes drove closer interaction and increased communication between the VOLT author and acquisition customer to improve product relevance. S&TI experts reported spending much less time on threat module production than they typically spent on CTA and STAR reviews in a 2-year timeframe. Finally, the intelligence community demonstrated that dynamic VOLTs could support all programs, even those requiring special DoD clearances.

Threat Support Reform Implementation

The pilot programs' positive findings ultimately led to a formal action for reform. In his April 2015 Better Buying Power 3.0 Implementation Directive, former Under Secretary of Defense for

Acquisition, Technology, and Logistics Frank Kendall ordered the ASD(A) to partner with the Services and the intelligence community to "develop a plan for reducing latency and improving intelligence data integration through transition to the Validated Online Lifecycle Threat (VOLT) and Threat Library."

Since then, DIA has taken a number of actions to facilitate the expeditious transition to Threat Library and VOLT. It transformed existing CTAs into threat modules to accelerate Threat Library development and to insure against late module delivery by S&TI experts. DIA began tasking S&TI experts to produce threat modules in December 2015 and is validating those modules upon completion. Throughout 2015 and 2016, DIA hosted many working groups of acquisition and intelligence professionals to refine threat module and VOLT content and process requirements. These meetings shaped recent changes to policies governing threat support (DIA Instruction 5000.002, updated on Sept. 19, 2016, and DoD Instruction 5000.02, updated on Jan. 26, 2017) to officially replace STARs and CTAs with VOLTs and the Threat Library. Finally, in late 2016 DIA began developing the Threat Library System, which will host all published threat modules and VOLTs on classified intelligence networks, assist in dynamic module and VOLT production, and enable improved customer feedback; expected completion is late 2017.

Until the Threat Library System is completed, DIA is managing the Threat Library on classified collaborative editing websites. By the end of 2016, the library included more than 100 expert-published threat modules, and almost 200 new threat modules will be published in 2017. For topics that lack a published threat module, DIA has identified approved alternate sources for use in VOLTs.

In January 2017, Service intelligence offices began producing VOLTs in place of STARs, and their anticipated benefits are being realized. VOLT authors have provided threat support within 90 days, and in some cases within 30 days, to sufficiently meet acquisition event timelines. The threat content in published VOLTs is more current than traditional STAR content—by more than 1 year on average. And because a VOLT's relevant threat modules are continually updated, acquisition customers no longer have to wait 2 years or more (the average STAR-update rate) before being notified of threat developments.

Customer-Driven Production

The biggest change with new threat support procedures is that acquisition customers truly drive VOLT production. DoD policy now mandates VOLT support at the Materiel Development Decision, Milestone A Decision Review, Development Request for Proposals Release Decision Point, Milestone C Decision Review, and the Full-Rate Production or Full Deployment Decision. But acquisition customers may request VOLT delivery to support other events or design decisions as needed.

Customers initiate VOLT production by submitting a VOLT request form and system documentation to their intelligence support offices. In that request, customers communicate key threat areas of interest, select desired levels of content tailoring and provide specific intelligence questions for the VOLT author to answer.

Customers have another opportunity to shape VOLT content at a threat steering group (TSG) meeting, which is a formal threat discussion involving the program manager and/or representative, capability developer, service test representative, VOLT author, VOLT validator, and, as applicable, a representative of the Director of Operational Test and Evaluation. This meeting gives every TSG member the opportunity to comment on the scope of threat discussed in the VOLT and to make other intelligence requests to ensure that the final product best serves each member's needs.

Threat Support Reform Outlook

When the Threat Library System becomes operational later this year, acquisition customers will have a single place to access all threat modules and VOLTs. They will be able to subscribe to specific threat modules or VOLTs to receive notifications when these products are updated. Users will also have the means to provide direct feedback to module or VOLT authors and drive changes to subsequent product updates.

Feedback is vital to the success of this effort, for it remains a work in progress. A working group of Threat Library System users will continue to shape its requirements during development. The complete list of threat modules will continue to evolve as new modules are added or existing topics are reorganized. Acquisition, requirements and test representatives can help refine threat module and VOLT content by engaging with authors and the DIA.

As these threat support reforms mature, their benefits will likely accrue. The pilot programs already demonstrated that reforms will save the DoDIC thousands of hours of analytic work each year and give DIA leaders unprecedented insight into threats affecting defense programs, enabling improved analytic prioritization and intelligence enterprise management. More importantly, these reforms will enable more responsive threat support to better serve the informational needs of a variety of acquisition customers throughout a program's life cycle.

In today's rapidly changing threat landscape, it is vital to our national security that adversary capabilities are considered in every decision that shapes future U.S. defense capabilities. Improved intelligence integration will give acquisition leaders the kind of agility they seek to factor threat developments into milestone decisions alongside traditional programmatic considerations such as cost, schedule and performance. Ultimately, these reforms will arm DoD leadership with the best intelligence today in their efforts to equip our forces for the emerging threats of tomorrow. 🖂

*The authors can be contacted at **paul.reinhart@dodiis.mil** and **brian.vanyo@dodiis.mil**.*

Could Your Organization Use a **Leadership** Booster Shot?

Woody Spring ■ *John Larson*
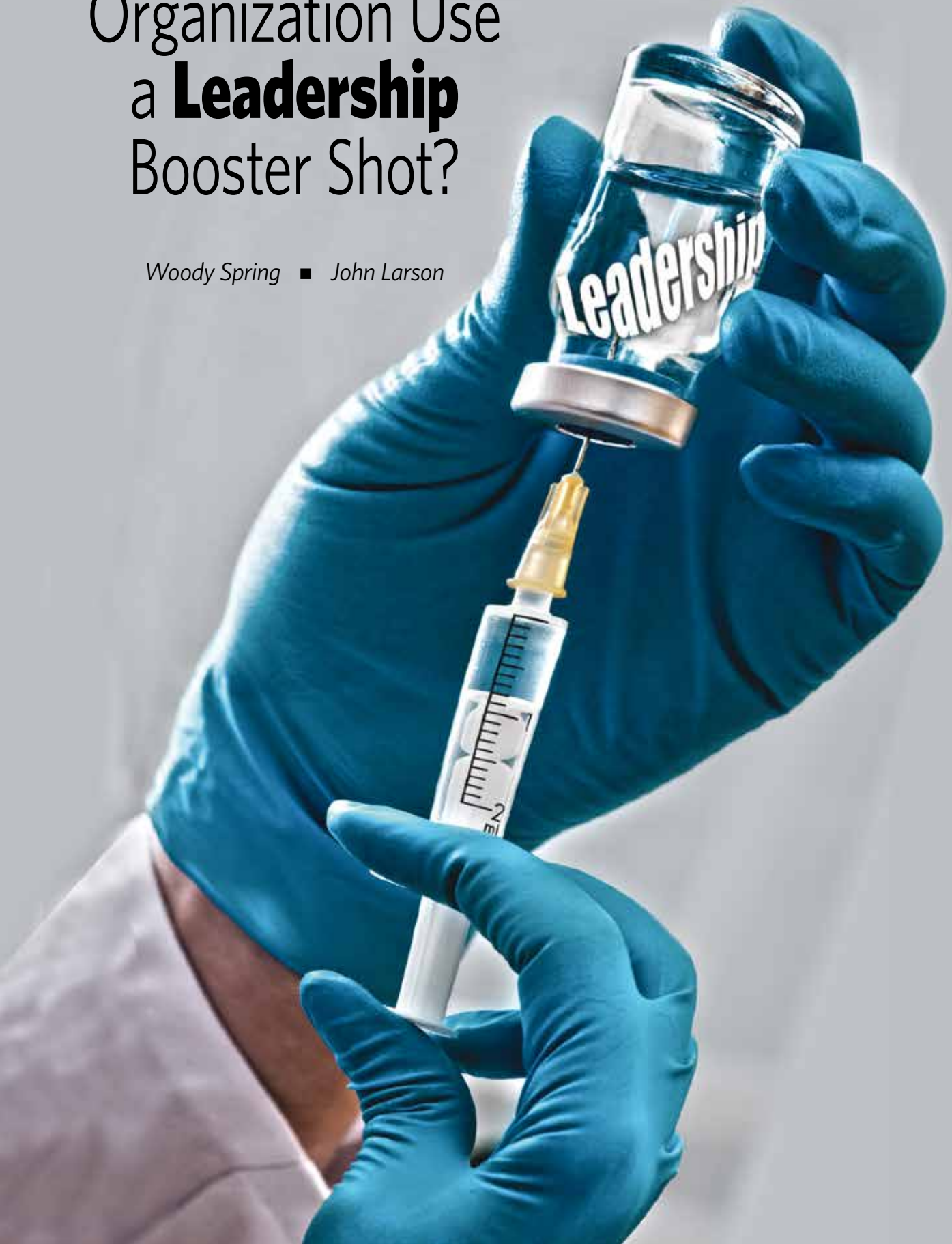
Leadership is a key ingredient for all organizations. In the professional acquisition community and others like it, functional experts can quickly find themselves in situations where they need more leadership dexterity when promoted to fill key leadership positions.

The best leaders not only continue learning new leadership techniques throughout their careers; they also develop and mentor leadership within the organization to enable:

- Developing managerial effectiveness
- Inspiring others
- Developing employees
- Leading a team
- Guiding change
- Managing internal stakeholders and politics

More and more leaders have begun making strategic investments in the professional development of their personnel. They know the vital importance of long-range planning, which includes the people variable—one of the keys to an organization's long-term success. In the last 6 years, the Defense Acquisition University (DAU) has had the good fortune to be part of their learning formulary through its Acquisition Leadership Development

*Spring, a graduate of West Point and former NASA astronaut, is a professor of Engineering, Test and Evaluation at the Defense Acquisition University (DAU) West Region in San Diego, California, as well as chief learning officer and executive coach. **Larson**, a retired U.S. Navy commander, is a DAU professor of Systems Engineering in San Diego. He is Level III certified in Life Cycle Logistics; Production, Quality and Manufacturing; Systems Planning, Research, Development and Engineering (SPRDE); and Program Management.*

Table 1. Modules and Focus Areas Explained

Module	Focus Area
What is Leadership?	Leadership attributes and their effectiveness in an acquisition environment
Recognizing Leadership Differences	Personality preferences (i.e., temperaments) in the context of your strengths and challenges
Recognizing People's Differences	Personality preferences of others and how best to work with them
People's Styles at Work	People's styles to enhance relationships, increase productivity and add richness
Leading High-Performance Teams	Building and leading teams that raise the bar on performance standards
Leading in Different Environments	Leadership differences in various acquisition leadership environments
Integrated Product Teams (IPTs)	Importance and challenges of IPTs
Team Facilitation Skills	Facilitating small teams and developing associated competencies
Four Roles of Leadership	Four essential functions required of successful leaders
Change Leadership	Dr. John Kotter's eight-step model and Dr. Kurt Lewin's three-step model
Coaching in a Changing Environment	Reflective and effective learning and performance
Developing Acquisition Leaders	Leadership tenets in the Department of Defense and the guidelines for leadership development plans

Workshop (ALDW) series. These workshops provide a mixture of hard-hitting content and practical exercises representing typical workplace challenges.

ALDW Explained

At its core, ALDWs promote the development of leadership skills that the acquisition workforce requires through customized training solutions based on workplace needs. Organizations can select from a variety of workshop variations. The sample modules along with their focus areas are outlined in Table 1 and were distilled from a wide range of parent DAU courses.

This "menu" of ALDW options are especially applicable for intact teams to help them work together to explore and develop (or refine) their skills. With few exceptions, each ALDW module is a standalone topic; although many modules work synergistically when integrated and embody a greater understanding of the leadership essentials. ALDWs can be applied to grow leadership skills in junior personnel, or perhaps more rigorously help senior leaders explore complex and impending leadership challenges they sometimes face. Simply stated, an ALDW is a very flexible construct that can address organizational imperatives at all levels, especially those that pave the way for high-performance teams.

Table 2. Acquisition Leadership Development Workshop Modules

Leadership Development			Self - Development	Skills for Leadership	Skills for Teams	Stakeholder Relationships
What is Leadership?	Leading High-Performance Teams	Four Roles in Leadership	Emotional Intelligence	Critical Thinking	Dealing with Conflict	Forging the Relationships
Recognizing Leadership Differences	Leading in Different Environments	Change Leadership	Providing Effective Feedback	Problem-Solving Tools	Building Trust	Stakeholder Engagement Plan
Recognizing People's Differences	Integrated Product Teams	Coaching in a Changing Environment	Mentoring	Communication Strategies	Accountability & Empowerment	Stakeholder Communication Plan
People's Styles at Work	Team Facilitation	Developing Acquisition Leaders	Declaring an Extraordinary Future	Dale Carnegie: Influencing People	Groupthink	

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Table 3. Various Self-Examination and Evaluation Modules

Name	Focus
Emotional Intelligence	Learning how to know yourself and read other's emotions
Effective Feedback	Delivering feedback using various techniques
Mentoring	Teaching, training and enabling the workforce through mentoring
Declaring an Extraordinary Future	Choosing to exceed a predictable future; done as part of executive coaching
Critical Thinking	Learning to think clearly and completely; tools and techniques
Problem Solving Tools	Various tools for group problem solving and issue resolution
Communication Strategies	Various ways to get the message across and connect with others
Influencing People	Various techniques to influence stakeholders and others
Meyers Briggs (Personality) Type Indicator	A self-awareness of individual personality preferences and, by extension, an understanding that other people have different preferences

ALDWs can start with a discussion on leading up, down and across, or ignite the participants' interest with a critical thinking challenge. No matter what the facilitator uses at the starting gate, the participants quickly learn more about the deeper context of leadership and the extensive tools that are at their disposal. To enrich the workshop experience throughout an ALDW, DAU facilitators draw from their technical knowledge and personal experiences to reinforce the lessons learned from similar leadership challenges they faced. ALDW participants need not be employed in acquisition-coded positions to attend the workshop. Unlike other training solutions, there are no prerequisites—just two expectations that participants need to: (1) approach these workshops with open minds and (2) demonstrate a willingness to think more about their own thinking (i.e., metacognition) as they learn how to put proven methods into action.

Table 2 shows how ALDW modules can be aligned for growth and alignment within intended focus areas (e.g., self-development, skills for leadership, skills for teams, and stakeholder relationships).

These delivery combinations can also include modules that focus on self-examination and evaluation—all key tools that promote more self-awareness such as shown in Table 3.

Since intact teams very often face challenges (and future opportunities) that require agreement, the delivery combinations can include modules that help teams break through various decision logjams characteristic of some workplace challenges:

- Dealing with Conflict
- Building Trust
- Accountability and Empowerment
- Groupthink

In a more magnified view, Figure 1 shows how a module focused on building (or restoring) trust can be addressed in a customized ALDW. The resultant practical exercise includes

Figure 1. Logical Plan Building Toward Action

Modules

| What is Leadership | → | Problem Solving | → | Building Trust | → | Change Leadership |

Take away

- We are all leaders
- Lack of trust is a leadership issue

- Using tools, students determine root cause of trust issue

- Understand steps to build/rebuild trust

- Develop leadership strategy and plan to restore trust
- Plan is to be left behind for execution

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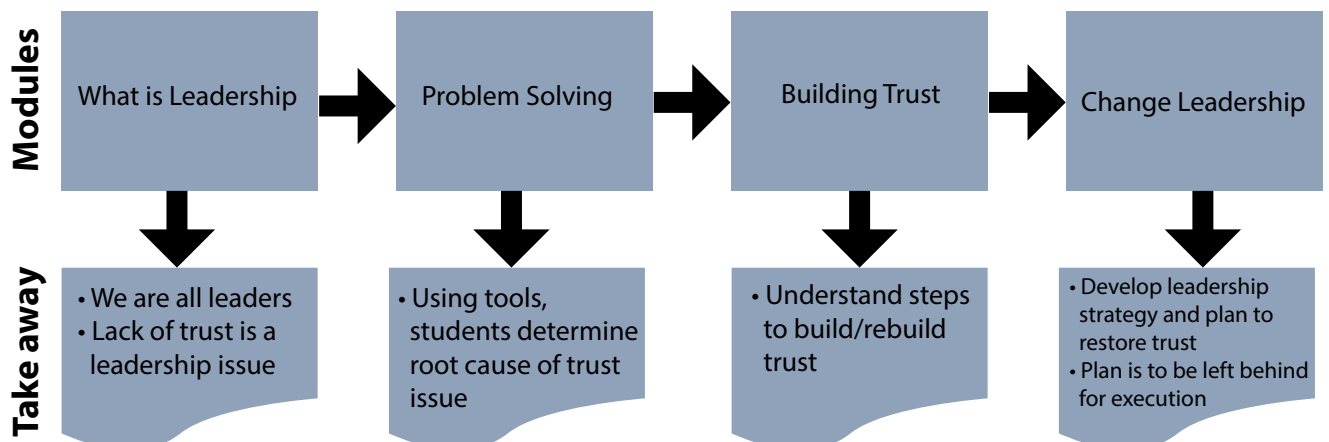
a structured activity model that drives to the root cause of a known case of mistrust followed by the steps and strategy to restore trust. After the participants complete a rigorous exercise, their commander is asked to join the workshop for a decision brief, which includes a review of their strategic plan to guide the workforce and specific performance targets to verify the participants achieved their targets. The participants take a lot of pride in their plans, and show a great eagerness to hear their commander say, "Make it so."

Stakeholder management has become more and more crucial in promoting leadership gains, and DAU developed a series of workshops that address stakeholder management, including:

• Forging Stakeholder Relationships
• Stakeholder Engagement Plan
• Stakeholder Communication Plan

What Can You Expect in the Workshop?

In addition to our commitment to best meet the needs of acquisition professionals, DAU provides certified and seasoned facilitators. Our facilitators help participants collectively understand their risks and issues, investigate the solution space and develop actionable recommendations. This last item is all about ownership and leaves the intact team with the responsibility to implement the actions to achieve the intended outcomes. As the participants craft

As the participants craft their own heading, they also become ideally suited to serve as the actions' champions back in the workplace.

their own heading, they also become ideally suited to serve as the actions' champions back in the workplace. Something else happens at these workshops that is less apparent at the beginning: After the first couple of hours, the participants not only are exposed to some very relevant material but form conspicuous bonds within the team and can serve as the guiding coalition across the organization to see the required changes through to their conclusions.

What Past Participants Have to Say

If testimonials indicate the usefulness of ALDWs, the comments below reinforce the reports of its efficacy. More important, what measurable impacts have these ALDWs had? Note that many customers were very grateful but preferred not to be quoted. The following statements were made by a representative group that volunteered to be quoted:

■ Howard Goldman, Commander Naval Undersea Warfare Center Division, Newport, Rhode Island: "… developing the stakeholder plan was valuable in that it forces you to give a thorough examination of who your stakeholders are and what their interests are. The DAU instructors were outstanding." The real value of the training will be in our follow-up and execution of the four communication plans that were initiated during the workshop.

■ Student comments from recent 2-day workshop:
"This is a very insightful class…able to use the tools… ."
"VERY informative class! Well worth my time"
"Material is very relevant in a team environment."
"Relevant. Beneficial. Informative. FUN!"
"Very useful and I will recommend to others."
"Outstanding course."

■ Acquisition Manager, U.S. Pacific Fleet: "DAU has been an excellent resource for me and together, we have ensured hundreds of Navy and Joint personnel have been able to take classes in preparing performance work statements. We will never know the true impact of all that training but I have seen the results in multiple performance work statements prepared by graduates of your PWS classes. I've seen first-hand how much more confident the employees are in preparing their requirements."

■ PEO C4I Tactical Networks Program Office (PMW 160): DAU provided PMW 160 leadership an independent and objective assessment of the CANES [Consolidated Afloat Networks and Enterprise Services] program and organization. Additionally, the effort provided the PM [program manager] and DPM [deputy program manager] actionable organizational and related process improvements to enable more successful execution for CANES. Impact: Mr. Jim Churchill (Acting PM) commented the Independent Program Review was "pure gold" and asked for DAU West to support future efforts to implement recommendations with the PMW 160 Leadership team.

■ Naval Weapons Station, Seal Beach, California (one of many customers who seek this workshop series): The ALDW helped rectify a corrective action by bringing shop workers,

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Depending on your need, we may recommend an organizational assessment survey tailored to your organization which is intentionally designed to uncover any issues.

foremen and supervisors together to explore leadership, accountability and building (restoring) trust, as well as problem-solving tools for use by all personnel.

■ RADM David Lewis, Space and Naval Warfare Systems Commander: "We've seen an increase in critical thinking. An example is DCGS-N. ... Two years ago, we saw classic acquisition thought for a monolithic 5-year program to get capability out to the Fleet. Now we are fielding full capability builds every 18 months. We've also seen deeper thought into CANES integration issues among the variety of platforms. DAU's training in this area has helped."

■ Col Ryan Britton, former ICBM Program Director, Air Force Nuclear Weapons Center: "DAU conducted a series of Acquisition, Risk Management and Source Selection workshops that focused on tackling the major issues including workforce competencies, and acquisition and program strategies that could interfere with program achievements. I planned for a 9-month protest—didn't materialize—attributed to DAU's support. These workshop series were well received and directly resulted in improved acquisition outcomes."

Author Spring's Leadership Retrospect

As a former Army officer, whether a platoon leader in Vietnam, an Experimental Test Pilot team lead, a major acquisition program manager, a NASA astronaut, or a division manager with industry, I have experienced the requirement for continuous growth in different types of leadership and the need for various tools and techniques for both my personal success and that of my programs in different environments. In many instances, I wish I could have had an organization like DAU available to me to help facilitate the issues and challenges my programs and I faced on our journey to success. Leading programs—to be able to function without you, mentoring subordinates to be leaders, enabling organizational innovation, trust, and responsibility and leaving programs in better condition to succeed than when you assumed the leadership are universal leadership challenges. John Larson, this article's co-author, and I thoroughly enjoy our current jobs as DAU professors and our involvement with Mission Assistance workshops in the workplace and at the point of need. We are not alone; every DAU Mission Assistance facilitator feels the same way.

Summary

Does your organization require a shot of energy to gain the learning lift it needs? With a booster shot of the leadership "knowhow," found in our Acquisition Leadership Development Workshops, organizations can achieve noticeable performance gains with greater efficiency and effectiveness. How can we help you? Visit the DAU website at **www.dau.mil** or contact the DAU Business Unit in your region to learn more. Depending on your need, we may recommend an organizational assessment survey tailored to your organization which is intentionally designed to uncover any issues (See Spring's article—"Take a Deep Dive with DAU" in the January-February 2017 issue of *Defense AT&L* magazine). Based on survey results, DAU would then have enough objective data to help you determine the most appropriate workshop agenda that draws from the modules described above. Contact us for your leadership inoculation, today. &

The authors can be contacted at **woody.spring@dau.mil** *and* **john.larson@dau.mil**.

MDAP/MAIS Program Manager Changes

With the assistance of the Office of the Secretary of Defense, *Defense AT&L* magazine publishes the names of incoming and outgoing program managers for major defense acquisition programs (MDAPs) and major automated information system (MAIS) programs. This announcement lists the one such change of leadership reported for both civilian and military program managers for the months of January and February 2017.

Navy/Marine Corps

COL David C. Walsh relieved **COL Steven R. Girard** as program manager for the H-1 Upgrades (4BW/4BN) program in PMA 276 on Feb. 14.

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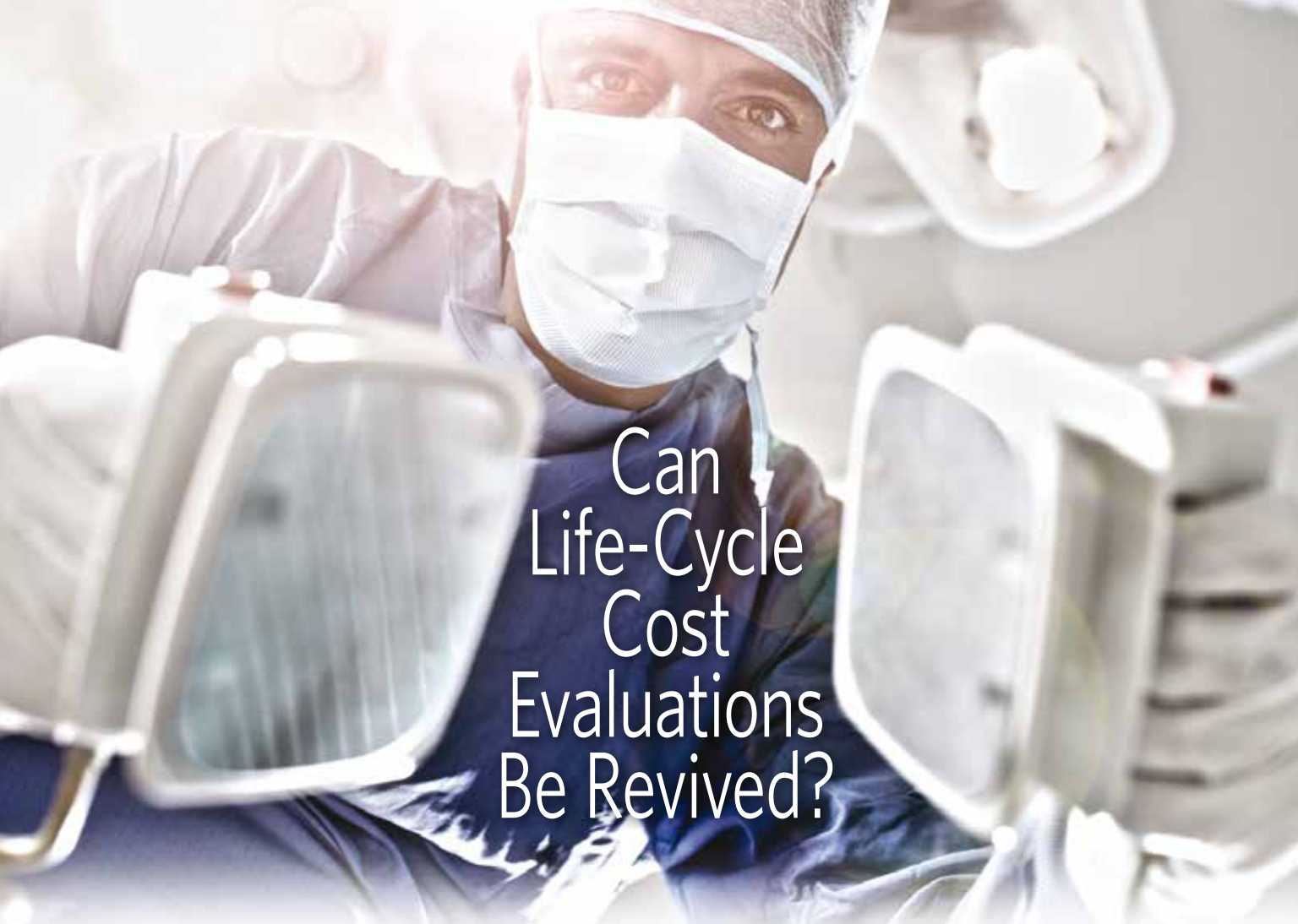https://www.dau.mil/library/arj

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Can Life-Cycle Cost Evaluations Be Revived?

Value Adjusted Total Evaluated Price Could Be the Answer

Scott Gilbreth

Most people can see the value of evaluating a contractor on the life-cycle cost (LCC) of their solution instead of just the initial purchase price. In some form or fashion, we use a life-cycle perspective for large purchases in our personal life. A typical diesel engine in a truck has a longer service life, greater pulling power and fuel efficiency, and retains its value longer than a gasoline engine. But diesels typically require more routine maintenance, and their repairs and the fuel itself are more expensive. That sounds like a spreadsheet waiting to happen!

LCC as a concept has many fans, but in practice has become undesirable in Department of Defense (DoD) source selections. A source-selection team that wishes to use LCC or the most probable life-cycle cost (MPLCC) for cost contracts in its source-selection criteria will run into a great deal of resistance.

Gilbreth is a professor of Contract Management at the Defense Acquisition University's Midwest Region in Kettering, Ohio, and recently completed a short-term assignment with source-selection advisers from the Acquisition Center of Excellence at Wright-Patterson Air Force Base.

> **Experts I spoke with from both the Navy and Army saw what the Air Force went through and have had their own "close calls" with LCC protests.**

I asked seasoned cost estimators and source-selection experts from each military Service to help me understand why there is such opposition to LCC evaluations. Their general consensus was surprising and the details of each conversation were strikingly similar. Each expert addressed some variation of these longstanding issues:

- Life-cycle cost, by definition, will occur well beyond the life of an individual contract.
- The government would be selecting a contractor based on its estimate of future sustainment cost even though it can't be held accountable for the validity of the estimate.
- The operational life and operational profile of a system decades into the future is wildly unpredictable.
- And 20 or 30 years of theoretical sustainment cost overshadows current, real procurement cost.

Eventually, either the Air Force's CSAR-X (Combat Search and Rescue Replacement Vehicle) or KCX (refueling tanker) protests from 2007/2008 came into the conversation. Although these protests encompassed multiple issues, LCC was a significant component in the Government Accountability Office (GAO) decisions. The legal and political fallout from those protests appears to have impacted acquisition decision making well beyond the Air Force. Experts I spoke with from both the Navy and Army saw what the Air Force went through and have had their own "close calls" with LCC protests.

It is relevant to understand that DoD began a formal standardization effort for department-wide source-selection procedures in the same general time of late 2008. Source selection centers of excellence, designed to promulgate best practices within each of their Services, have become more engaged with their counterparts in other Services. But while the experts I spoke with completely agree with the policy of discouraging LCC in evaluations, their respective Services have addressed the matter differently. For instance, there is a Navy document, now widely referenced throughout DoD, that presents a decision tree to help identify those limited situations where LCC would be appropriate in the evaluation criteria. The Air Force

has taken the more formal route with a requirement in the Air Force Federal Acquisition Regulation Mandatory Procedures for approval at the level of the Secretary of the Air Force-Acquisition (SAF-AQ) before MPLCC can be incorporated in source selections. The current plight of LCC evaluations is interesting, but it becomes compelling in view of the fact that LCC was commonly used in government source selections for more than 50 years.

Life-cycle cost considerations became fully integrated in DoD acquisitions in the late 1950s. In a 1979 decision (B-192488), GAO reiterated, "We have consistently upheld life-cycle costing, stating that it is logical to consider total anticipated costs, rather than merely purchase price." There have been numerous dismissed and/or denied protests, and a few sustained, involving LCC over the years. I couldn't always determine whether these historical cases involved a traditional LCC evaluation or just a selected element(s) from Operations and Support (O&S) cost. A traditional LCC evaluation would closely align with most of the LCC categories: research and development, investment, O&S, and disposal costs. But a modified LCC evaluation might just evaluate a few of the six lower-level elements within O&S: manpower, operations, maintenance, sustainment support, system improvement and indirect support.

Either way, the GAO language from the 2007/2008 protests reiterated comments I found in many historical LCC protests: "the evaluation of sustainment costs must be tailored to each offerors approach" and "hypothetical life cycle costs must have reasonable support." Regardless of how you interpret the details of either the CSAR-X or KCX protest, it does appear that they represented the "last straw" for LCC as a common component of DoD source selections.

Major source selections within DoD today take well more than a year. The number of reviews and the level of scrutiny are overwhelming. There are military leaders, civil servants and politicians speaking to that issue—I'll leave it to them. But in this environment, protests—successful or unsuccessful—just add to the timeline and further delay getting requirements on contract. A Total Evaluated Price (TEP) full of theoretical LCCs can swing drastically by a change in service life estimate and time value of money adjustments. This will always be an obvious target for protesters unhappy with the evaluation outcome.

Source selection experts continually push to limit complexity and challenge teams to select only those evaluation criteria that will truly discriminate between offerors. A look at all the major components of LCC definitely adds complexity, and it's unlikely that each element is a discriminator between offerors. The experts have a strong argument here! Is there value in the LCC perspective, as I believe there is? Does the current acquisition environment makes traditional LCC too risky, which is the experts' consensus view? Given all that, can the trade-off technique called Value Adjusted Total Evaluated Price (VATEP) provide a new platform for LCC?

The 2016 DoD Source Selection Procedures didn't change dramatically from the 2011 version, other than to formally introduce VATEP trade-off. This technique allows the government to place a value on performance/capabilities that exceeds the minimum established by the requirement. The document goes on to illustrate a higher-priced offeror receiving a price decrement and becoming the low offeror, for evaluation purposes, by submitting a proposal responding to a stated objective above the minimum requirement. So although the contractor has a proposed price, that price is reduced during evaluation by a value attached to achieving such specific objective(s).

Another illustration in the VATEP appendix even shows a decrement value attached to receiving a "low" risk. So, why not associate a decrement value for meeting LCC criteria? A contractor can only protest the value of the decrement prior to award, and the standard generated from GAO comments only requires the decrement value to be "reasonably supported by data or analysis." GAO also expects all LCC evaluations to be tailored in accordance with each proposed solution. That requirement can be satisfied by the application of decrement criteria. Therefore, I'm suggesting that the VATEP approach can provide source-selection teams with the LCC construct they desire while greatly minimizing the complexity and risk.

Just utilizing the VATEP trade-off technique doesn't alleviate all the LCC-associated challenges. It will be critically important that those discriminating element(s) of LCC be identified in order to use them in a VATEP calculation. Legacy systems, DoD experts, and external market research efforts can all help identify the key components. Data also will be required to provide reasonable support for a decrement value associated with each LCC attribute. Historical data can be analyzed from the Visibility and Management of Operating and Support Costs system; both a predecessor system and an analogous system can be referenced. There is a strong theoretical case for leveraging VATEP with LCC. But only over time and with acquisition programs that are willing to incorporate LCC elements into their source selections will we truly know its viability. In the interim, let's examine a hypothetical scenario to see how LCC can be integrated into a VATEP source selection.

First and foremost, for LCC to be relevant in a source selection, market research must reveal more than one distinct solution to a requirement—with each solution having different LCC implications. DoD has an ongoing need for long-lasting (72 hours), lightweight rechargeable batteries to power the technology that dismounted troops carry into battle. A quick summary of the current, proven technology is that ballistic-rated lithium-ion rechargeable batteries, providing 150 Watt hours for up to 36 hours at a weight of 1.18 kilograms (2.6 pounds), are built in a flexible casing with standard ballistic plate dimensions to be integrated in body armor vests. Several other battery technologies, labeled as advanced and post-lithium batteries, might meet or exceed the current government requirement. There are obvious technical performance objectives in this requirement that

could be translated into evaluation decrements as illustrated in the 2016 Source Selection Procedures. But what are the potential LCC considerations? Well, we could research the cost implications of those potential solutions proving incompatible with the existing Soldier Worn Integrated Power Equipment System (SWIPES) or the fast recharging and solar-powered recharging systems. What about the value of a battery with an extended service life, maintenance requirements, or disposal costs associated with a complex chemistry? These LCC based questions, while related to performance considerations, are unique and should be separately valued under VATEP.

Isolating and identifying the discriminating elements between various solutions is the next step in developing a LCC decrement. A traditional LCC estimate would include end-of-life disposal costs. Market research indicated that the disposal concerns as well as the minimal maintenance requirements for the various rechargeable batteries were not proven to be discriminators. Likewise, compatibility with SWIPES proved easily achievable regardless of battery type. The remaining considerations were service life and compatibility with existing fast rechargers and solar rechargers. The decrement criteria for service life could read as follows:

$x,xxx,xxx service life decrement for each increment of 100 discharge cycles above the 500 cycle threshold point while maintaining a charge capacity less than 75 percent of the original capability. Not To Exceed $xx,xxx,xxx total decrement value.

Government experts and industry feedback led to the establishment of the 100 discharge cycle increment. The decrement value could be derived by taking 20 percent (100 cycles/500 cycles) of the current Independent Government Cost Estimate (IGCE) for a battery. Or, a more conservative basis would be 20 percent of the cost for existing conformable wearable batteries (CWBs) in inventory. In similar fashion, a compatibility decrement look like this:

$xxx,xxx compatibility decrement for integration of the existing Universal Battery Fast Charger (UBFC) in the proposed solution. $xxx,xxx compatibility decrement for integration of the existing Solar Power Based Charger (SPBC) in the proposed solution.

The service life of chargers greatly exceeds the service life of rechargeable batteries. All things being equal, it would save the government money and prevent the waste of these chargers if future batteries were compatible. Prorating the value of existing chargers and basing the charger quantity on an appropriate ratio for size of this battery requirement led to a defensible decrement value for compatibility.

Yes, this scenario is overly simplistic. But LCC should be part of our decision making in source selections and this hypothetical scenario illustrates that VATEP may just be the mechanism to revive LCC evaluations.

The author can be contacted at **scott.gilbreth@dau.mil**.
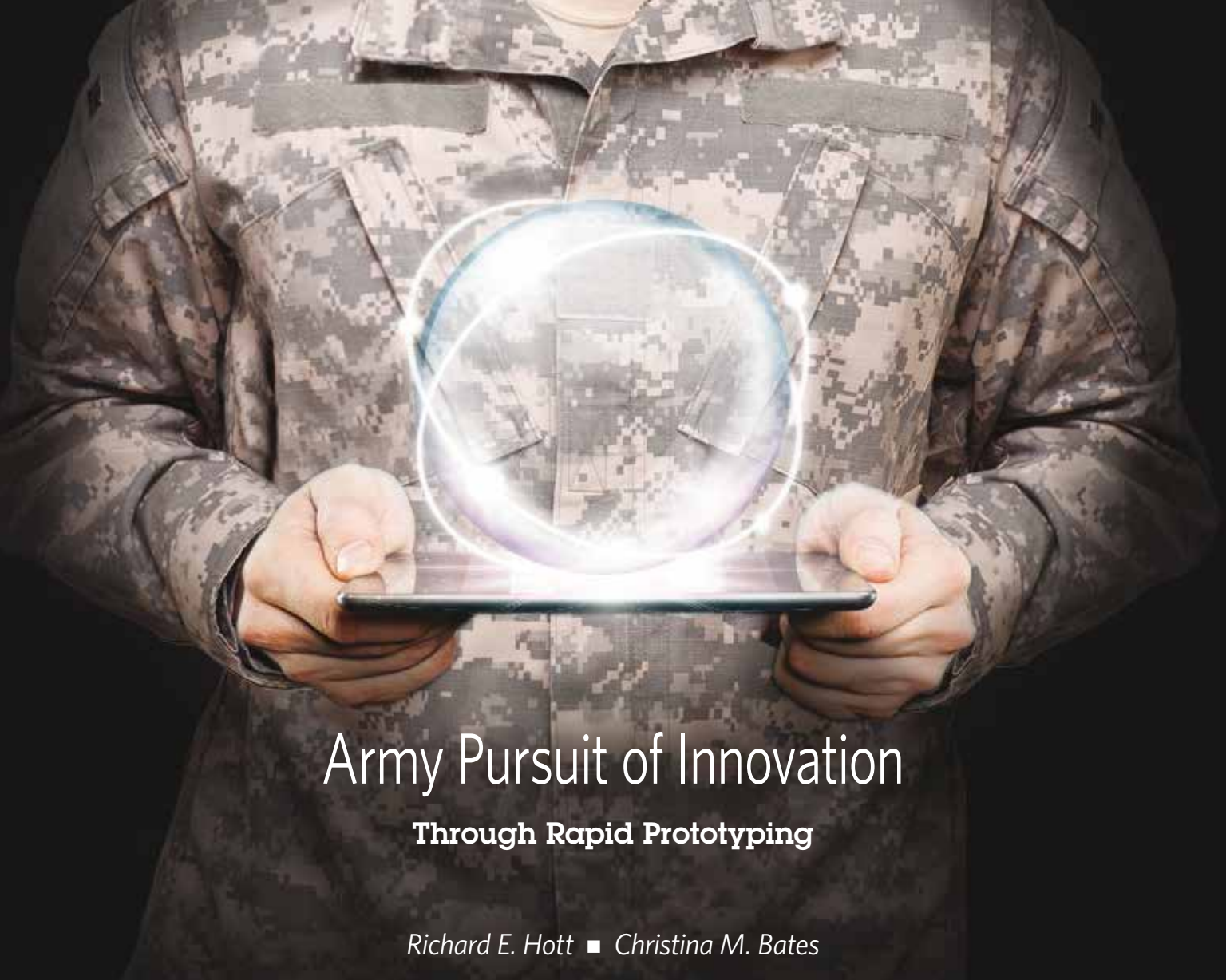
Army Pursuit of Innovation

Through Rapid Prototyping

Richard E. Hott ■ *Christina M. Bates*

As technological advancements increasingly render once cutting-edge capabilities obsolete in just a few years, the Army's ability to maintain technological overmatch, and ultimately combat overmatch, is inextricably bound up in its ability to innovate—and more important, to harness innovation to rapidly develop game-changing technologies and capabilities.

Former Secretary of Defense Ashton Carter emphasized the important role of innovation in the U.S. Army's ability to deliver the most technologically advanced capabilities to our soldiers. An example of one of his recent initiatives

Hott *is the engineering subject-matter expert of the Prototype Experimentation Branch within the Special Products and Prototyping Division of the U.S. Army Communications-Electronics Research, Development and Engineering Center's Night Vision and Electronic Sensors Directorate at Fort Belvoir, Virginia. Hott's professional background is in mechanical engineering design, rapid prototyping, and field testing, and he is a member of the Army Acquisition Workforce with Level III certifications in Engineering and Test and Evaluation. He has a bachelor of science degree in Mechanical Engineering from Virginia Tech.* **Bates** *is the managing director of CM Bates Consulting and supports various organizations within the Army Acquisition and Research, Development and Engineering Communities as a strategic analyst, planner and strategic communications expert. She has a Ph.D. in Communication from Arizona State University, a master of science degree with distinction from Boston University, a Juris Doctor degree from Boston University, and a bachelor's degree from Boston College.*

to advance innovation in the Army was the establishment of the Defense Innovation Advisory Board. Chaired by Alphabet Inc. Executive Chairman Eric Schmidt, the Board is to include up to 12 members who have successfully led large private and public organizations and have excelled at innovating—rapidly identifying and adopting new technology concepts.

Among other things, the Board was tasked with advising the Department of Defense (DoD) on key areas central to successful innovation, including rapid prototyping. At the same time, House Armed Services Committee Chairman Mac Thornberry, Texas Republican, continues advocating rapid prototyping and has suggested that the Services have the budget flexibility to "experiment with, prototype, and rapidly deploy weapon system components and other technologies without requiring those programs be tied to an existing major program."

Delivering Innovative Capabilities Quickly, Cost Effectively

In the Army Acquisition Corps, rapid prototyping enables the material developer to support, test and field cutting-edge capabilities to soldiers in shorter time. Once developed, the prototype product may then be refined to meet very specific user needs and expectations, thereby serving as both the basis for and fruit of innovation.

Specifically, prototyping provides the Army's Research, Development and Acquisition Communities with several advantages. First, it enables designers and engineers to move their concepts beyond the virtual visualization offered via traditional computer-aided design (CAD) models. For example, a project manager in the Acquisition Corps would have the benefit of seeing, firsthand, the "look and feel" of a potential capability long before he or she begins the acquisition process. At this point, design adjustments may be considered and critical changes may be made that improve the capability at the most cost-efficient point in the development process.

Specifically, with a physical model in hand, its form, fit and function can be soldier verified, which would likely result in fewer design changes and thereby save money. This kind of additive and iterative manufacturing saves both the time and cost typically associated with further development of patterns, molds and metals.

Moreover, rapid prototyping reduces waste and rework—the design may be rapidly adjusted, incorporating user feedback and emerging requirements. Design flaws are more readily recognized and efficiently addressed in the early stages of prototyping. This is particularly important since it enables the Army to quickly ensure that soldiers receive properly working capabilities while fully meeting capability requirements. Finally, building a prototype enables the materiel developer to understand the intricacies of a given product or system design. This understanding can inform the entire acquisition process by better positioning the combat developer to accurately determine performance requirements and provide early information to the materiel developer on systems engineering processes.

In summary, rapid prototyping serves several critical purposes within the research and development and acquisition communities. It may be leveraged to inform and influence early design and development efforts for capabilities under consideration, as well as those that have been fielded and are experiencing design issues and/or not meeting soldier needs. As such, rapid prototyping helps ensure that we provide our soldiers with the very best, innovative capabilities in the shortest time possible.

Army Rapid Prototyping Division

The Army's Special Products and Prototyping Division (SPPD) is one of seven divisions within the Fort Belvoir, Virginia, Night Vision and Electronic Sensors Directorate (NVESD) of the Army's Communications-Electronics Research, Development and Engineering Center (CERDEC). One of SPPD's primary core competencies is rapid prototyping and the development of system surrogates and components to enable the Army Research and Development and Acquisition Communities to assess, test and field innovative capabilities to warfighters very quickly. Rapid prototyping has a rich history dating back to the early 1940s when the very first facilities were established at Fort Belvoir. Prototyping activities in those days focused on providing support for war efforts by rapidly building systems (and components), and this kind of full fabrication service continued until the early 1990s with the facility's fabrication of components and surrogates for the Patriot Missile System and mine plows in support of Operation Desert Storm in 1991. By rapidly responding to soldier concerns in facing in-depth obstacles, the shop quickly designed and fabricated mechanical solutions to neutralize the threat. Then, in 1993, as a result of the Defense Base Closure and Realignment Commission findings, the Model Fabrication Division (and its mission) became the NVESD Prototyping Facility. At the same time, the facility underwent a transition from a limited-production service model to a rapid prototyping service model. This shift in mission better positioned the facility to respond to emerging soldier needs and to provide the Research, Development and Acquisition Communities with the ability to rapidly generate prototypes that could be used to inform both the design and development of a product, and later, its acquisition.

By the late 1990s, the facility was fully engaged in supporting the Army acquisition community. In particular, SPPD forged a strong relationship with the Project Manager Night Vision/Reconnaissance, Surveillance, and Target Acquisition (now known as the Project Manager Terrestrial Sensors). At the time, the program manager (PM) was engaged in force modernization efforts and "digitization" of the battlefield. In particular, SPPD's facility supported the PM's integration of sensors on vehicles by mounting them via masts and custom brackets. These mast-mounted sensors provided critical surveillance capabilities in support of the Bosnia and Kosovo missions.

Bill Ruthenberg, SPPD mechanical engineering technician: "I work extensively with the engineers and customers during the design phase, advising them on fabrication methodology and manufacturability issues."

Phillip Riley, SPPD mechanical technician, in the fabrication shop: "Working directly with the engineers to come up with a product that suits their needs and the needs of the soldiers is extremely satisfying."

Jimmy Duncan, SPPD mechanical technician: "The most interesting project I have worked on is a ground-penetrating radar" for Night Vision's Countermine Division.
Photos by U.S. Army's CERDEC Night Vision and Electronic Sensors Directorate.

After the September 11, 2001, attacks, the facility provided rapid prototyping for various efforts directly supporting both Operation Iraqi Freedom and Operation Enduring Freedom (OEF). Once again, the facility played an integral role in the integration of critical reconnaissance and surveillance sensors, including the Driver's Vision Enhancer and the Long Range Advanced Scout Surveillance System (LRAS3) on vehicles. Particularly during the early years of the War on Terror, each time the armor changed on a vehicle, the vehicle required a new sensor integration, and the facility was able to step in and rapidly conduct the integrations for the PM. Moreover, because the facility was involved in each integration, the machinists were able to keep pace with the various configurations and anticipate the next likely enhancement, saving the PM time and delivering support to soldiers faster and more efficiently. And, when the Army shifted to the use of the Mine Resistant Ambush Protected vehicle in response to the enemy's use of improvised explosive devices, the facility was ready to support sensor integration on these critical vehicles.

Partnering With SPPD

Today, the facility provides rapid prototyping support to various Army organizations. Troops from the field often come to the facility with a particular issue or need. Unlike the facility's internal and regular customers, soldiers often do not have existing relationships with facility technicians. As such, the facility, via its engineer liaisons, works closely with soldiers to understand their needs and to design and develop prototypes for testing and use.

More often than not, Soldiers, like most customers, find it difficult to articulate a need without first seeing an example. To address the need, engineers and scientists deploy as uniformed and civilian science advisers to work directly with soldiers in the field via the Field Assistance in Science and Technology program. They review soldier descriptions of needs and revise them, as necessary, before sending them to and conferring with the facility technicians. Engineers

then work closely with the customer team to clearly define the issue, develop a problem set, and determine options to best address the issue. The effort is collaborative, with facility members providing key subject-matter expertise and advice. Because deployment rotations are fairly frequent, problems and issues frequently are similar to those the facility previously worked on even up to 10 to 15 years earlier. Several of the technicians have worked at the facility for 15 years or more, so they often can recall the very solutions they developed numerous years prior!

Once a preliminary solution is agreed upon, the facility team develops the prototype and delivers it to the user for initial use and assessment. This initial use and assessment is one of the major value-added aspects of rapid prototyping. The user is able to "touch and feel" the product, and, in turn determine whether it meets their needs or requires further development. After the user is satisfied with the prototype, the user then decides whether to pursue funding to produce the product. When funding is secured, facility personnel work with the engineers and scientists in preparing the necessary documentation to begin prototyping once the customer approves the plan. The facility's work is not finished once the prototype is complete. Technicians often provide assistance and training for the product, as well as field support, ensuring that the soldier can realize the full potential of the fielded product.

area assembles the completed items, and incorporates them into the final product, system or platform for which they were intended. This integration begins with the design phase and carries through to the end product.

In addition to the conventional techniques, the facility utilizes 3D printing or additive manufacturing processes to fabricate prototype components that can be readily transitioned to production processes such as injection molding or casting.

Supporting the Nation

Over the last decade, SPPD's Prototyping Facility has provided support that has directly and significantly contributed to U.S. efforts both at home and abroad. Its aircraft integration efforts include design, ensuring compliance with Airworthiness Release requirements, crafting, mounting and integration of prototype experimental sensors on various aircraft, such as the Black Hawk helicopter. These sensors aid pilots by providing, among other things, improved visibility in degraded conditions, thereby enabling safer takeoff and landing.

The facility also provides support to reset and retrograde sensor systems returning from theater. At the height of the wars in Iraq and Afghanistan, security for large forward operating bases became increasingly important. Securing entry points and enabling situational awareness were paramount for warfighter safety and survivability. In response, scientists

> **During the early years of the War on Terror, each time the armor changed on a vehicle, the vehicle required a new sensor integration, and the facility was able to step in and rapidly conduct the integrations for the PM.**

The facility includes five main areas: design; machining; sheet metal fabrication; welding; and integration. The designers interface directly with users, requirements developers, and the technicians to generate and document an optimal system or component design. The machining area utilizes manual and Computer-Numerical-Controlled milling and turning processes to fabricate low-quantity prototype and production-quality components. These machining processes start with large pieces of metal or composites and remove material to achieve the final size and dimensions. The sheet-metal fabrication area constructs mechanical components, enclosures and panels with capabilities to shear, bend, punch and roll many types of material. The welding area performs all common welding processes on materials from thin sheet metal up to armor plate and large steel weldments. The integration

and engineers at NVESD rapidly developed key elements of the Base Expeditionary Targeting and Surveillance Systems—Combined or "BETSS-C" a family of sensor systems managed by the Army's Project Manager, Terrestrial Sensors (PM TS) and intended to provide base defense and security capabilities. Originally intended to provide perimeter security, BETSS-C's legacy configuration was not fully adaptable to worldwide deployments, including expeditionary missions. In response, SPPD developed and supported an innovative reset concept for PM TS that was intended to not only reset the existing BETSS-C systems, but to also make them multi-mission capable, thereby infusing the system with increased capabilities that are essential for succeeding in various expeditionary missions and provide the warfighter with greater flexibility and more value from a single sensor system.

A major change to the BETSS-C family of systems was the upgrade of the Cerberus sensor system. Initially fielded in Iraq in 2007, the Cerberus is a tactical trailer with a tower sensor system that provides warfighters with surveillance and reconnaissance capabilities via a radar and a day/night sensor mounted on a readily deployable 20-foot-high tower. The facility worked with PM TS and a team of engineers to design the components and to build quality into the product at the earliest stages of design. Three kits were developed to upgrade the Cerberus trailer, thereby improving the ease with which it may be deployed to better support expeditionary missions. The facility then led retrofit activities for approximately 100 Cerberus trailers by developing and assembling the initial production kits.

proposal and awarding a contract (to defense contractors) for the production of the Mobile Surveillance System (MSS). The MSS has been deployed along the southern border in direct support of CBP efforts and has proven essential for helping to secure the nation.

The facility also provides support within NVESD. When NVESD needed a laboratory specifically designed to support calibration efforts for various hyperspectral sensors, it called on the Prototyping Facility to assist with designing and fabricating various elements, including sensor mounts to conduct calibration and staging materials to move a sensor among the various calibration stations. The facility's support enabled NVESD to automatically achieve bore sighting at all

> **To maintain its position as the world's best army, the U.S. Army must innovate regularly, rapidly and successfully. Rapid prototyping is an integral part of innovation.**

In addition to supporting military efforts, the facility supports humanitarian efforts around the world. Led by a team within NVESD's Countermine Division, the Humanitarian Demining effort spans several countries that historically have suffered from the effects of years of war, including remaining land mines and other explosive ordnance. The Countermine Division designs the systems that assist these countries with the identification and destruction of underground hazards, and the Prototyping Facility supports fabrication for systems, spares, modifications and repairs. Machinists and Countermine specialists often produce new vehicle "skins," integrate mine removal and mine-detection sensors on vehicles, and design and produce digging devices to remove ground dirt while searching for explosive hazards. Because NVESD designs, evaluates and fabricates the prototypes exclusively in-house, it is able to rapidly deliver to countries in need these lifesaving capabilities at a lower cost compared to traditional methods.

The facility also supported U.S. homeland security efforts. A major project was the development of the long-range variant of the Cerberus tower funded by the Department of Homeland Security (DHS). The facility, working with design engineers within SPPD, and through the spiral development process, fabricated several prototype variants for use by U.S. Customs and Border Protection (CBP) personnel. Based on testing along the southern border and feedback from agents, a final variant was prototyped, which led to DHS submitting a request for

sensor calibration stations following the initial bore sighting. This change automates the process, thereby reducing opportunities for error and also reducing calibration cycle times from 1 week to 1 day.

To maintain its position as the world's best army, the U.S. Army must innovate regularly, rapidly and successfully. Rapid prototyping is an integral part of innovation. At the same time, rapid prototyping also can also help in assessing solutions for a given Army requirement.

As technology advances ever faster, it will become increasingly difficult to maintain technological superiority without continuous innovation. SPPD's rapid prototyping facility is positioned to support the Army's Research, Development and Acquisition Communities in the integration of the Army's innovation efforts by leveraging engineering and technical expertise to inform product design, development and transition to procurement. This support enables the acquisition community to better tailor form, fit and function to precise soldier needs. Harnessing the power of rapid prototyping will better position the Army to discover unique, cutting-edge solutions to today's problems and develop game-changing capabilities that will shape the battlefield of tomorrow. &

The authors can be contacted at **richard.e.hott.civ@mail.mil** *and* **christina.m.bates22.ctr@mail.mil**.

Solving Supply Problems

Tom Gerbe

Over the last 16 years, staff members of the commercial data provider where I work have spoken with more than 30,000 military and government contractors. This experience has given our firm, which is focused on solving supply problems for the U.S. military, a unique insight into the plight of people seeking products and services. The bulk of our traffic can be separated into two major categories:

- Addressing the need to replace a part.
- Conducting market research to assemble formal procurement or justification and approval.

Surprisingly, many items sought are common, everyday things. Wire cutters, fire safety equipment, pulleys, antennae, screwdrivers and laptops are examples. Of course, people also search for equipment designed to meet needs that are specific to the military. One of my favorites is: "rocket motor, trajectory divergence" (National Stock Number [nsn]): 1377-01-256-1971), which is used in ejector seats. We recently have seen a lot of bid activity for FSC 1377, cartridge and propellant devices.

Gerbe *is a defense industry analyst for BidLink.net, a provider of information to defense contractors and the U.S. military. BidLink.net provides tools and training to streamline sourcing and procurement.*

The job of a program manager (PM) involves managing cost, schedule, performance and risk. Efficient acquisition of goods and services is essential to maintaining this balance. I believe that the PM's job was best described in *A Guide for DoD Program Managers* written by William T. Cooley and Brian C. Ruhm and published by the Defense Acquisition University in 2015:

"Eliminating or correcting root causes that will otherwise result in perturbations to the cost, schedule, or performance."

There was some controversy surrounding the F-35 ejector seat. The initial ejector system put F-35 pilots weighing less than 136 pounds at risk of neck injury. Martin Baker implemented a three-point plan reducing weight in the helmets, made software fixes of the rockets' timing, and added a support panel to the headrest. A simpler, one-point-plan might be to order up some Krispy Kreme donuts for those skinny pilots (nsn: 8920-00-194-8601; "cookies, sandwich").

Time and time again we see people without the proper tools who are trying to find something. They usually find us through a Google search for a contract or item name, indicating that they have exhausted the government-provided tools.

More Than Just Contracting

Buyers and contracting officers are not the only ones searching for parts. Often it's someone who needs a particular part or tool in order to complete a job. At the Naval Air Station in Jacksonville, Florida, we met with a fabricator who said that he spends more than half of his time searching for things instead of fabricating. He was trying to locate a specialized pulley that could work with polyethylene rope. Lack of that pulley was preventing him from completing a project. Everyone we met at Jacksonville had at least one item she or he was unable to source.

Without proper tools or training, people can spend many frustrating hours doing things to support their jobs. This directly affects schedule and program performance. With a little training and the right tools, PMs can locate efficient personnel in many departments who can help them quickly find what they need. Perhaps programs could offer specialized assistance in locating commercial off-the-shelf items so that end users can spend more time working and less time searching.

Choosing the Right Tools

The government provides a number of free services to aid acquisition. The System Acquisition Management database includes every defense contractor registered to sell to the government. The Federal Logistics Information Service (FLIS) Program has a reference system for parts numbers. The Federal Procurement Data System (FPDS), although incomplete, provides a basic view of government contracting activity.

On the other hand are commercial providers who add value to the government offerings. For example, FPDS data are reported voluntarily and not as a requirement. Huge gaps can

be seen when FPDS information is compared to a complete Defense Logistics Agency (DLA) procurement history. Commercial data providers spend time filling these gaps, as well as cleaning out errors from the data. DLA often moves decimal places when unit pricing of its data exports.

Commercial services also consolidate the data from many government databases. These data can be displayed together on a single page, instead of having to search a half-dozen databases to find an answer. This saves time and helps maintain program schedules.

Simple Tips for Better Sourcing

We will cover some techniques and common mistakes that we have encountered when helping people source parts and services. These can prove helpful for managers and contracting personnel, as well as end users:

Search Simple: Instead of searching, "12-inch steel mounting bracket," start with the word "bracket." Government nomenclature is in reverse order, with the most broad category first. A mounting bracket is categorized as "bracket, mounting." If there is no specific information available on the item (i.e., NSN, part number, military specification [mil-spec]), an item name search for "bracket" is a good starting point.

Use Mil-Specs: The government maintains a free database of all current and historical military specifications, ASSIST, at http://quicksearch.dla.mil/. The Master Cross Reference Database (MCRD) is part of FLIS. For any item name in FLIS that has a corresponding mil-spec, the mil-spec document ID will be listed in the part number cross reference. Sometimes mil-specs include part numbers, stock numbers and similar items that can be a good starting point for locating a source.

Prior Solicitations: Search historical solicitations for keywords relating to the item. Not all agencies release detailed procurement history. Prior solicitations offer more detail than

procurement history can provide. Salient characteristics or specification numbers are included in the solicitation and can help locate an item.

Colloquial Names: Common names and brand names may not yield any results. As an example, a client was searching for "hard hat" and could not find any procurement history. "Hard hat" is a popular name for the DoD nomenclature "helmet, safety."

Proper Fields: It may seem obvious, but we find many people put a part number in the NSN field. Even though the relevant data might be in our system, it is missed due to a simple error. Try to utilize multi-database, intelligent searches whenever possible to avoid this.

GSA, AbilityOne, Unicor: As required by Federal Acquisition Regulation (FAR) 8.4, 8.6, and 8.7, an item or service provided under these programs should be sourced through the aforementioned channels. We have a number of commercial clients with thousands of items in their catalogs under AbilityOne and the General Services Administration or GSA. Because the FAR requires the use of these programs where available, a formal procurement history may be lacking. Always check these sources before buying.

DoD Email and Credit Card: Full Text search DoD Email and credit card transactions for relevant item names and keywords. Many items that fall below the micro purchase threshold will not appear in the DLA history if they are purchased through Email or by use of a card.

Technical Characteristics: Once you have narrowed your search to a specific item name, check the technical characteristics for item details. These will include all salient characteristics, which may include dimensions, materials, next higher assembly, voltage output, color, among others. The Item Name provides a broad, general description, while the technical characteristics detail the item's specific properties.

Procurement History: Conduct a key-word search of the all agencies' history to locate sources that previously supplied the item to the military. History often will include pricing information in order to support cost justification. If they are available, always search the original, signed award documents that include information such as buyer names, contact information and shipping destinations. This information is omitted from the feeds available directly from the government. Procurement history also includes the contractor Commercial and Government Entity (CAGE) code, which can be

> At the Naval Air Station in Jacksonville, Florida, we met with a fabricator who said that he spends more than half of his time searching for things instead of fabricating.

used to locate a vendor's website or contact information.

The Contractor's Viewpoint

Working with government and contractors, we get to see both sides of the procurement process. Contractors utilize us to locate solicitations and associated data—including technical characteristics and past pricing. We regularly speak with staff members of contractor organizations, ranging from very large firms to simple two-person shops. Below are a few issues that we regularly encounter:

Better Technical Data: Many qualified vendors scour the Internet for opportunities to sell or repair parts to the military. The single most significant factor in increasing competition is providing vendors with quality technical data from the military. PMs are encouraged to participate in the data management process. I cannot stress how important this is to vendors trying to compete on contracts for obsolete systems. The biggest complaint from contractors is the lack of sufficient documentation on systems.

Access to Pricing Data: Some agencies will not release line-item pricing. This especially seems to be the case with the U.S. Navy and the Army Tank-Automotive and Armaments Command, which intentionally omit key information from all Freedom of Information Act (FOIA) requests—including quantity and unit price. The agencies cite Exemption 4 of FOIA rules, which protects "trade secrets and commercial or financial information obtained from a person [information that is] privileged or confidential." There has been an ongoing battle between the attorneys for large contractors and the U.S. military regarding this information. There were even attempts to clarify the issue in defense authorization bills, to require that this information be released. To date, these agencies still omit unit price and quantity from their responses to our FOIA requests. Both contractors and military need to know what items cost in order to work effectively.

Summary

Supply affects every part of a program, regardless of size. From planning through support, supply is a key aspect of program management. Sourcing is not limited to the formal contracting process, as people throughout all areas of government need to locate products and services to complete their job. With the proper tools and training, sourcing can be more effective, thereby reducing wasted time.

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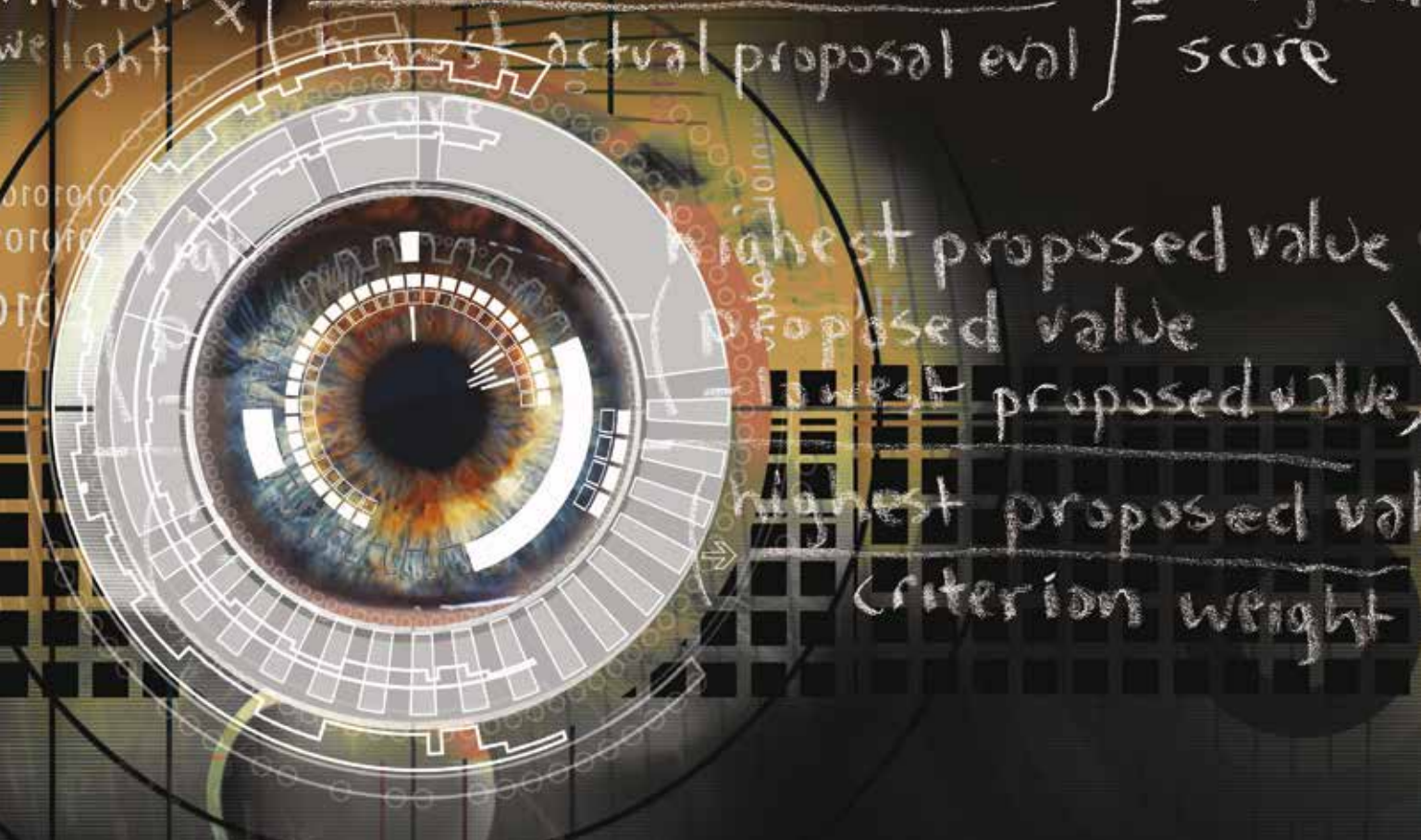
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Tools for Deciphering Best Value

William Sims Curry

T he Department of Defense (DoD) finds it difficult to determine when higher technical ratings for contractor proposals justify paying a higher price. The acknowledged difficulty in making such decisions and the magnitude of DoD acquisitions for which trade-off decisions are needed demand resolution of this problem. The October 2010 Government Accountability Office (GAO) report GAO-11-8, *Enhanced Training Could Strengthen DOD's Best Value Tradeoff Decisions*, emphasized the difficulty:

> According to DOD officials, making sound trade-off decisions, and in particular, deciding whether or not a price differential is warranted, is one of the most difficult aspects of using a best value trade-off process.

The magnitude of technical/cost trade-off decisions is evidenced by the fact that best value process is applicable in roughly 95 percent of DoD's new, competitively awarded contracts valued at $25 million or more as reported in that GAO report.

Curry *is president of WSC Consulting in Chico, California. He is the author of second edition of "Government Contracting: Promises and Perils, 2nd Edition," published by Routledge, 2017.*

The decision matrices prepared by the source-selection evaluation board (SSEB) and presented to the source-selection authority (SSA) often were cryptic or in other ways failed to facilitate technical/cost trade-off decisions.

DoD's contractor selection process is described by an April 1, 2016, memorandum on "Department of Defense Source Selection Procedures," from the then Under Secretary of Defense for Acquisition, Technology, and Logistics Frank Kendall. Use of the guidelines in this memorandum in the contractor selection process is mandated by Defense Federal Acquisition Regulation Supplement (DFARS) PGI 215.3—Source Selection. The source-selection procedures in the 2016 memorandum are superior to and provide greater detail than the 2011 memorandum. Unfortunately, however, certain deficiencies in the 2011 memorandum, were carried over in the 2016 memorandum, resulting in cryptic contractor selection decision matrices. This article examines deficiencies in the 2016 memo's method for rating contractor proposals and describing the importance of factors and/or subfactors. And it pursues recommendations for making improvements.

One approach this author used to understand weaknesses in the federal contractor selection practices involved evaluating GAO decisions that sustained protests from Aug. 1, 2010, to July 31, 2012. The GAO's stated reasons for sustaining protests can be considered as weaknesses in the contractor selection process. GAO-sustained protests during 2015 and 2016 were selected randomly to verify the continuation of those weaknesses. All 65 GAO-sustained protests during those 2 years were evaluated. The author noted one pertinent weakness in DoD's contractor selection process that GAO did not mention: The decision matrices prepared by the source-selection evaluation board (SSEB) and presented to the source-selection authority (SSA) often were cryptic or in other ways failed to facilitate technical/cost trade-off decisions. The SSA is sent a narrative of the SSEB's proposal evaluation activities, but the decision matrices offer an overview of that evaluation and provide the SSA with meaningful additional insight.

I believe that the cryptic contractor selection matrices are due to the DoD restriction of numerically indicating the importance of evaluation factors and of numerically rating contractor proposals. The 2016 memo does, however, allow waivers of the prescribed proposal rating method for technical factors and subfactors. The 2016 memo continues the 2011 memo requirement that only relative terms be used to represent the importance of factors and/or subfactors considered in selecting contractors; adjectival or color schemes may be used to score the proposals. Notably, the numerical rating of factors

and/or subfactors is permitted by Federal Acquisition Regulations (FAR) Section 15.305(a), and numerical representation of the importance of evaluation factors also is permitted for Armed Forces contracting by 10 U.S. Code §2305.

Other independent research into GAO-reviewed protests identified a way to evaluate proposals that could resolve DoD's technical/cost trade-off dilemma. That 2015 research into the best state and local government contracting practices revealed how to clearly identify best value proposals. The findings involved 15 states, 16 large cities, and three other local agencies and was a follow-up to 2006 research.

Two significant errors were found in the proposal scoring by the majority of the government entities reviewed in the 2015 research. But, after correction of those errors, their approach to selecting contractors was found to be superior to DoD's method of identifying best value proposals. The errors had involved using anomalous formulas for weighing proposal evaluation scores, and the agencies using them were provided with corrected formulas. Although a formal follow-through was not deemed appropriate, a separate research project noted that a significant number of government entities adopted the corrected formulas. With that correction of the formulas, the revamped state and local government proposal evaluation process would greatly benefit DoD's technical/cost trade-off identification of contractors proposing the best values. The approach recommended here, besides better identifying best value, will guard against corruption of the contractor selection process.

Table 1. The Difficulty of Technical/Cost Trade-off Decisions

Competing Contractors	GID	Patricio
Management and Staffing Capability	Marginal	Outstanding
Price	$13,915,920	$18,500,928
Past Performance	Substantial Confidence	Satisfactory Confidence

Two recent examples of contractor selection decision matrices that obscure identification of contractors submitting best value proposals are provided below. The first example (Table 1) comes from GAO's decision in the matter of Patricio Enterprises, Inc.; File B-412740, B-412740.3, and B-412740.4, May 26, 2016. This illustrates the difficulty in making technical/cost trade-off decisions.

The proposed management and staffing capability of Patricio Enterprises was undeniably superior to its competitor, GID. The price proposed by GID and the GID past performance rating favored contract award to GID. The solicitation stated that the evaluation factors (management and staffing capability, price, and past performance) were to be listed in descending order of importance. In making the contractor selection decision, the SSA could justify a statement that the superior management and staffing capability of Patricio outweighed the lower pricing and better past performance of GID. But the SSA could just as easily have stated that GID's lower price and better past performance outweighed Patricio's superior management and staffing capability. The best value proposal was not expressly identified in this decision matrix.

The other recently published decision (Table 2) is from GAO's decision in the matter of Jacobs Technology, Inc. (JTI); File B-413389 and B-413389.2, Oct. 18, 2016. In this example of a sustained protest, the decision matrix illustrated the tendency to obtain tied scores despite discerned differences by the SSEB in the quality of the proposals.

Apart from the proposed and evaluated cost/price, all the ratings reflected in Table 2 are identical. The following narrative excerpted from the GAO decision, however, indicated differences were discerned in the quality of numerous factors:

Table 2. Tendency to Tie Scores Despite Discerned Proposal Quality Differences

	AS&D	JTI
Technical		
Scenario	Outstanding	Outstanding
Program Management	Outstanding	Outstanding
Subcontract Management	Acceptable	Acceptable
Phase-In Plan	Outstanding	Outstanding
Past Performance	Substantial Confidence	Substantial Confidence
Proposed Cost/Price	$207,881,101	$208,512,402
Evaluated Cost/Price	$207,881,101	$208,512,402

An agency source selection advisory council (SSAC) then conducted a comparative assessment of the offerors' proposals. The SSAC found that, notwithstanding the equivalent ratings, AS&D's proposal was superior to that of JTI under the scenario, program management, and phase-in plan subfactors (the offerors were considered equal under the subcontract management subfactor). ... Similarly, the SSAC found, notwithstanding the equal ratings, JTI's past performance to be superior in relevance and quality to that of AS&D.

The tendency to reflect tied scores despite factor quality disparities should be disturbing to those interested in the availability of an effective tool for making intelligent contractor selection decisions.

As to the importance of the evaluation factors, the solicitation for the above procurement action stated the following:
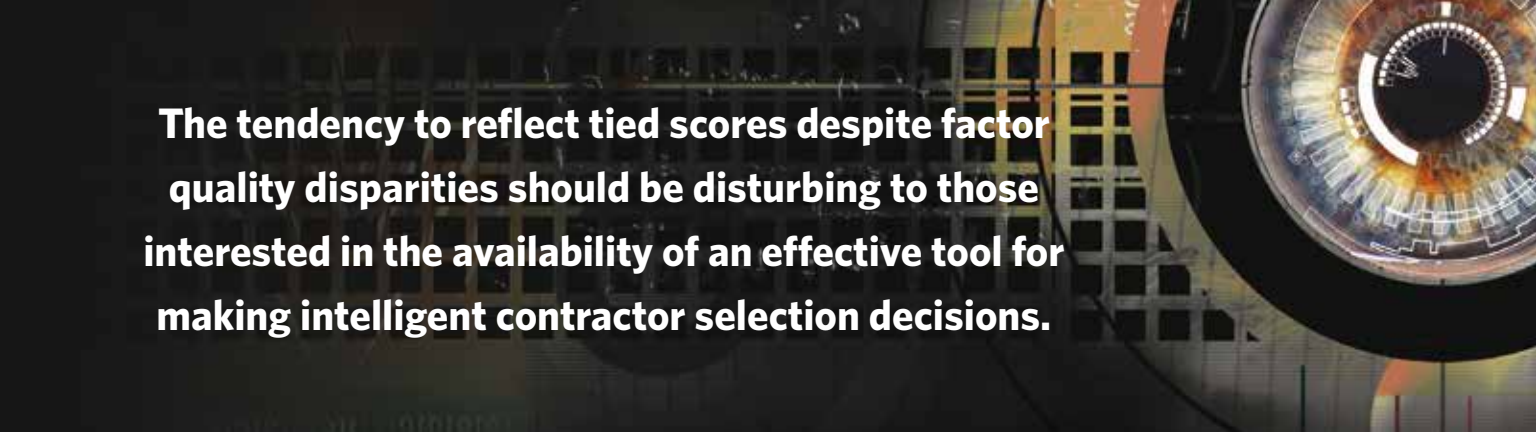
The solicitation established that contract award would be made on a "best value" basis, based on three evaluation factors generally in descending order of importance: technical risk (hereinafter, technical); past performance; and cost/price. ... The technical factor was comprised of four subfactors in descending order of importance: scenario; program management; subcontract management; and phase-in plan. ... The technical and past performance evaluation factors, when combined, were significantly more important than cost/price.

To illustrate a decision matrix decidedly identifying the best value proposal, the author applied his best efforts to assign numerical values to the significance of evaluation factors based on the relative

Table 3. Decision Matrix Identifying the Best Value Proposal

	AS&D			JTI	
	Weight	Raw	Weighed	Raw	Weighed
Technical Scenario	20	10	20.00	9	18.00
Program Management	17	10	17.00	9	15.30
Subcontract Management	14	5	14.00	5	14.00
Phase-in Plan	11	10	11.00	9	9.90
Past Performance	23	6	19.71	7	23.00
Proposed/Evaluated Cost/Price	15	$207,881,101	15.00	$208,512,402	14.95
TOTAL WEIGHED SCORE			96.71		95.15

ranking provided in the Request for Proposals (RFPs). Best efforts were also used to assign numerical proposal evaluation scores based on the comparative relationship of factor scores, as described in GAO's decision.

These best-efforts numerical scores are used in the illustration (Table 3) to show how using them can avoid tied scores by permitting evaluators to reflect the quality differences discerned between competing proposals. Numerical representations of the importance of proposal evaluation factors and numerical scoring of proposals permit weighing of proposal evaluation scores and proposed values to facilitate unambiguous identification of the best-value proposal. The formulas used to weigh the proposed values and proposal evaluation scores will be described later in this article.

In the Table 3 example, AS&D, with the highest Total Weighed Score (TWS) of 96.71, is identified as the contractor proposing the best value. This determination is based on the author's best efforts to quantify DoD's statement regarding the factors' relative importance, the contractor's proposed price, and the adjectival proposal evaluation scores. This example, however, merely illustrates the superiority of the TWS approach. The need to use best efforts for the numerical values in Table 3, does not support the argument that the proposal of AS&D should have been awarded the contract. In an actual procurement, numerical weights and the numerical scoring scheme would have been described in the solicitation. The proposal evaluation team also would have assigned numerical scores in reviewing the proposals.

The TWS approach to evaluating proposals, in addition to distinctly identifying the best-value proposal, provides the needed transparency so that prospective contractors can understand the precise factor weights and proposal scoring. The transparency, moreover, prevents that rare corrupt government official from manipulating the relative value of proposal evaluation factors/subfactors to justify selecting a favored contractor in exchange for a personal benefit. When an RFP numerical representation of the importance of contractor selection factors, that corrupt official will not be able to manipulate factor weights to benefit a favored contractor.

The statement indicating that "technical and past performance evaluation factors, when combined, were significantly more important than cost/price" injects considerable flexibility for concocting and rating contractor selection factors/subfactors. The factor weight for cost/price could have been within the range of 10 to 25 and still have been considered significantly less important than the combined weight of technical and past performance evaluation factors. The statement regarding the relative importance of the nonprice factors and subfactors also permits flexibility in manipulating the relative weights during proposal evaluation to benefit one of the competing contractors.

Formulas for Weighing Proposal Evaluation Scores
The anomalous and correct formulas for weighing proposal evaluation rating raw scores for factors such as technical and past performance are shown below:

Anomalous Formula for Weighing Proposal Evaluation Scores
Criterion Weight x (Actual Proposal Evaluation Score ÷ Highest Possible Proposal Evaluation Score) = Weighed Score

Correct Formula for Weighing Proposal Evaluation Scores
Criterion Weight x (Actual Proposal Evaluation Score ÷ the Highest Actual Proposal Evaluation Score) = Weighed Score

The difference between the anomalous and the correct formula for weighing proposal evaluation scores involves using either the highest *possible* or the highest *actual* proposal evaluation score. The necessity of adding the weighed scores for both the proposal evaluation scores and the proposed values requires compatibility between their respective formulas. The formula for weighing proposed value scores must include the highest actual proposed value because there can be no highest possible proposed value. Using the highest possible proposal evaluation score in the formula, therefore, distorts the algorithm for calculating the TWS. Use of the anomalous formula may result in an understatement of the weighed value for proposal evaluation scores.

The problem with an understated weighed value for a proposal evaluation score is illustrated in the following example where the experience and price factors are both weighted as 10. Evaluation of the proposal with the highest score for a

technical factor (experience) results in a score of 85 on a scale of 70-100. When the anomalous formula is used to weigh the score of 85, the result is 8.5. When the lowest price is weighed with the formula for proposed values, the result is 10.0. The weighed score of 8.5 for the highest rated experience factor is clearly understated when compared to the weighed score of 10.0 for the lowest price. When both factors are weighted the same, the highest rated experience factor and the lowest price factor should have identical weighed scores.

Government personnel more concerned with technical performance and less so with price would have a legitimate reason to object to the calculation of weighed scores with the anomalous formula. Technical personnel are likely to object to a weighed score for the lowest price that is higher than the weighed score for the highest-rated technical factor when both factors have equal weights. When applying the correct formula, the lowest price and highest-rated technical factor will have identical scores when the factor weights are equal.

Formulas for Weighing Proposed Values
Formula A and Formula B, below, represent two differing methods that state and local government agencies express the anomalous formula for weighing proposed values.

Anomalous Formula A
Lowest Proposed Value ÷ (Proposed Value ÷ Criterion Weight) = Weighed Score

Anomalous Formula B
(Lowest Proposed Value ÷ Proposed Value) ÷ Criterion Weight = Weighed Score

Correct Formula
(Highest Proposed Value - (Proposed Value - Lowest Proposed Value)) ÷ (Highest Proposed Value ÷ Criterion Weight) = Weighed Score

The purpose of this formula is to weigh proposed values according to the factor weight and convert low proposed values to high weighed scores. This approach is appropriate for factors, such as price, where low values are favorable to the government. Lower proposed values are also favorable to the government for factors such as "weight" for products that will be placed in space orbit. The formula anomaly is characterized by an underrepresentation of midlevel values when three or more contractors compete for a contract. The anomaly is best demonstrated by considering three proposed equidistant prices. In this example, the equidistant prices are $700 million, $800 million and $900 million, with an equal difference of $100 million between the low and midlevel prices as well as between the midlevel and the highest prices. The factor weight in this example is 30. When equidistant proposed prices are weighed and low prices are converted to high scores, the weighed values should also be equidistant. Weighing the above proposed prices with the anomalous formula yields the following results:

Results With Anomalous Formula

Proposed Value	Weighed Score
$700 Million	30.00
$800 Million	26.25
$900 Million	23.33

The weighed scores with the anomalous formula are not equidistant because the difference in the weighed scores for $700 million and $800 million is 3.75 while the difference between the weighed scores for $800 million and $900 million is 2.92.

Results With Correct Formula

Proposed Value	Weighed Score
$700 Million	30.00
$800 Million	26.67
$900 Million	23.33

The weighed scores with the correct formula are equidistant because the difference in the weighed scores for $700 million and $800 million is 3.33 and the difference between the weighed scores for $800 million and $900 million is 3.34. The .01 difference between 3.33 and 3.34 is a rounding error.

When using the anomalous formula to weigh proposed values where low numbers favor the government, the weighed scores for the highest and lowest proposed values will be accurate. The weighed score for the midpoint values, however, will be understated. The TWS will, therefore, be inaccurate if using an anomalous formula thus subjecting the government to the possibility of selecting a contractor other than the one offering the best value.

Conclusion
The author's contention is that the difficulty DoD acknowledges in making technical/cost trade-off decisions results primarily from its restrictions against numerical representations for the importance of factors and subfactors, and against numerical rating of contractor proposals. State and local government agencies often represent the importance of proposal evaluation factors and rate proposals numerically. These government contracting agencies use formulas to weigh the proposal evaluation ratings, as well as the proposed values such as price, to obtain a TWS representing the score for and the importance of each evaluation factor/subfactor. The formula for weighing price, and other proposed values where low values are favorable to the government, also converts low proposed values to high scores. When weighed scores for factors and/or subfactors are totaled, the result is a TWS. The contractor receiving the highest total numerical score is identified as having submitted the best value proposal.

DoD would benefit from use of the TWS contractor selection process that distinctly identifies the contractor offering the best value proposal, simplifies the technical/cost trade-off decision, and inhibits procurement corruption.

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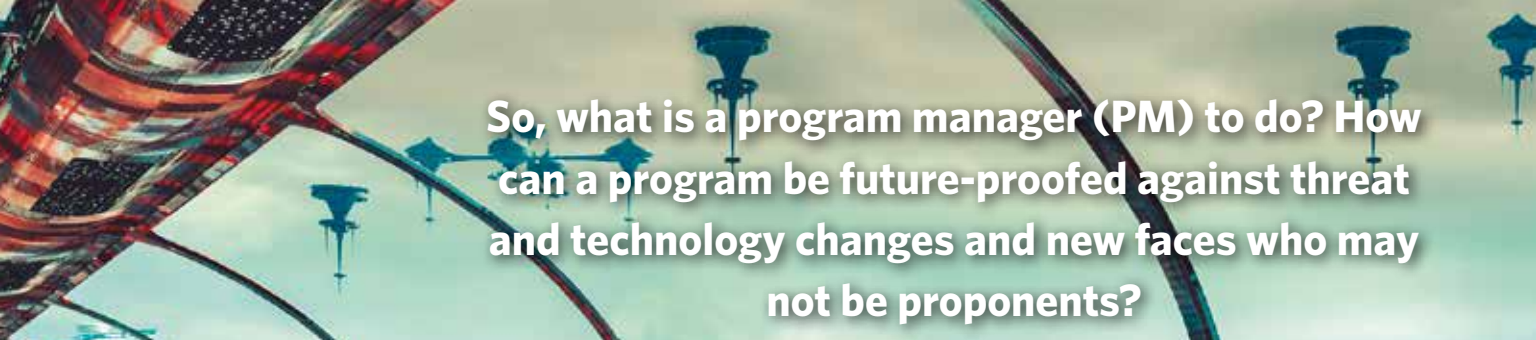
S U R V E Y

Future-Proof Your Program

Roy Wood, Ph.D.

Things change. Stuff happens. Your once indomitable program is now being questioned in your Service, the Office of the Secretary of Defense (OSD), or Congress. You fear your program may be on next fiscal year's chopping block. But you are meeting your requirements—under budget and on schedule. What could possibly have gone wrong?

The answer is that your program may not have been adequately future-proofed. What looked good 5 or 10 years ago to sponsors and acquisition executives is no longer so shiny and valuable. One of three things probably happened.

The threat changed. We rode the operational roller coaster from the early 1990s and the fall of the former Soviet Union to the "long war" against terrorism, and now back to concerns about the emergence of peer-competitors. Warfighting systems designed for limited missions or specific theaters may now be questioned as to their ability to perform in the perceived current threat environment.

Wood *is a former program manager and Defense Department executive. He currently is the dean at Northeastern State University in Broken Arrow, Oklahoma.*

The technology changed. Technology rapidly changes, and we have all heard how difficult it is to synchronize short, frenetic technology cycles with the longer, more deliberate acquisition cycle. Systems with older technologies may seem out-of-date and not as capable.

The people changed. Political administrations change. Military leaders rotate frequently. Key decision makers move into and out of influential government positions. New ideas and competitors emerge who purport to have solutions that are better, faster and cheaper than yours—and can prove it with two dozen or so animated PowerPoint slides.

So, what is a program manager (PM) to do? How can a program be future-proofed against threat and technology changes and new faces who may not be proponents? Let's see … .

The Threat Changed

The PM clearly has little say in how the threat changes. Potential adversaries rarely seek our advice. So the PM must keep an ear to the ground and an eye on the horizon for threat changes that may negate program effectiveness. Here are some ways to do that:

■ Seek out intelligence and counterintelligence briefings on the specific threats your program is designed to thwart. Make sure your intelligence counterparts know enough about your program that they can be on the lookout for changes in the threat capability that may impact your system's effectiveness.

■ Engage with your operational counterparts or system sponsors to get their advice. Get feedback from the field if your system is already in the hands of the warfighter. Look for ways to make your system more valuable to the users based on their feedback. Fans in the field can go a long way to ensuring support for your program. If the threat has evolved beyond your original requirements set, enlist your sponsor's help in updating the requirements documents. Changes in these documents may be the leverage you need to make necessary systems changes.

■ Make sure your system has design margin. New threats may require new sensors or weapons. Does your platform have sufficient design margin to accommodate upgrades? This may include space and weight, electrical power, and cooling capability. Design margin will increase your cost, but will help future-proof your system if and when the threat changes.

■ Use evolutionary acquisition practices. Fielding a system as quickly as possible will often get a capability into the hands of the warfighter before threats change. Then, intentionally laying in planned upgrades to future block purchases will allow the system to pace the threat over its lifetime. Don't forget to also plan for back-fit of the new block capability into earlier, fielded versions of the system.

The Technology Changed

Commercial technology, particularly in computing, control, and advanced manufacturing, is moving ahead at blazing speed. Could your system benefit from technologies of autonomous vehicle control? How about 3-D printing? Here are some ways to enable this:

■ Connect with your science and technology (S&T) colleagues. Do you have a conduit to the right S&T organizations to be able to incorporate new capabilities into your system? Make a deliberate effort to meet with your Services' S&T leaders to describe your program and seek their advice and assistance in lining up potential future upgrades. Also consider seeking help from OSD, which may have insights into applicable technologies being investigated by all the Services, the Defense Advanced Research Projects Agency, and the Defense Innovation Unit Experimental—and point you to the help you need.

■ Work with your prime contractor on ideas for pre-planned product improvements and build these into your extended program and contracting plans.

■ Use Broad Agency Announcements and Requests for Information to canvass ideas from the broader technology community.

■ Again, be sure you have design margin to support new technologies. Is your platform's electrical plant capable of powering your high-energy laser or rail-gun? Does your cooling system support an advanced radar upgrade? Do you have enough space and weight capability to carry a larger missile? If not, what alternative designs, such as self-contained systems with their own power and cooling, could be proposed?

■ Finally, technology insertion into a program of record can best be accomplished through open architecture and an evolutionary acquisition program. Block upgrades with technology on-ramps provide a timeframe where new, sufficiently mature technologies can be inserted without disrupting current production. Open architecture can make system changes easier and cheaper.

The People Changed

Given the frequent turnover of senior leaders in the Pentagon, it is admittedly difficult to keep the leaders informed about your program and its importance to national security. Adding to the challenge, of course, are potential competitors, whose ideas and programs seem to ooze into the building armed with flashy presentations and promises of better, faster, cheaper. How, then is a PM to deal with this? Here are a few ideas:

■ Be proactive. Keep your current sponsor informed and, when that sponsor moves on, get on their replacement's calendar to bring him or her up to speed. Focus on why the program was created and what new capabilities it offers the warfighter. Engage the sponsor in helping you keep an eye on the evolving threat, new technologies, and new people he or she believes you should also brief.
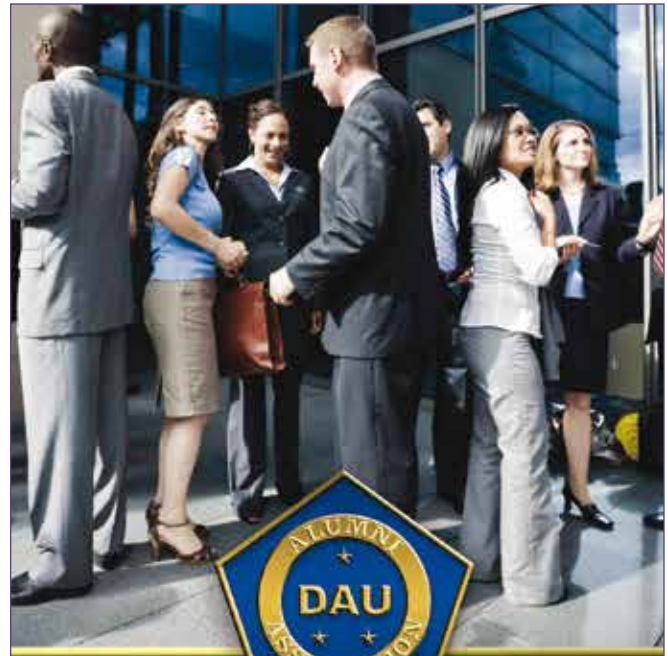
■ Set up a stakeholder "advisory council." Gather your key stakeholders and set up routine opportunities for them to engage in program update meetings. With all your stakeholders in the same room, many sticky, cross-cutting issues and problems (resolution of which might otherwise take weeks of round-robin briefings) can be dealt with during the meeting. Stakeholders at your level who intimately understand your program can be advocates in their home organizations and provide you access to their executives if the need arises. This network can also alert you to potential competing ideas and proposals that have come in through their offices so you can be better prepared to address any opposing claims.

■ Tell the truth, never equivocate—and always tell a consistent story. Engage your stakeholders proactively and truthfully. If you are having issues, be upfront and let them know. They may be able to help. At least they will feel engaged and informed. If you are battling a competing program, technology or idea, do your own analysis and fairly compare the alternative's claims to your program's reality. If the other idea has merit, look for ways to incorporate it; if it is flawed, help objectively and dispassionately to point out its shortcomings and risks. If you have inherited a program that truly is a dog-that-won't-hunt, inform your chain of command and advocate for changes, restructuring, or even cancellation. Your professional integrity will be bolstered and both the warfighter and taxpayer will be better served.

Summary

If you believe that a PM's job is to remain narrowly focused on managing cost, schedule and scope, you are likely to miss the threats and opportunities coming from outside your program. Whether changes to the external environment come from potential adversaries, rapidly evolving technologies, or new decision makers, you must be prepared. To do so, you need to raise your awareness of the things going on outside your program and be prepared to address them appropriately. Good luck. Godspeed.

The author can be contacted at **wood40@nsuok.edu**.

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Defense AT&L

Purpose

Defense AT&L is a bimonthly magazine published by DAU Press, Defense Acquisition University, for senior military personnel, civilians, defense contractors and defense industry professionals in program management and the acquisition, technology and logistics workforce.

Submission Procedures

Submit articles by e-mail to datl@dau.mil. Submissions must include each author's name, mailing address, office phone number, e-mail address, and brief biographical statement. Each must also be accompanied by a copyright release. For each article submitted, please include three to four keywords that can be used to facilitate Web and data base searches.

Receipt of your submission will be acknowledged in 5 working days. You will be notified of our publication decision in 2 to 3 weeks. All decisions are final.

Deadlines

Note: If the magazine fills up before the author deadline, submissions are considered for the following issue.

Issue	Author Deadline
January–February	1 October
March–April	1 December
May–June	1 February
July–August	1 April
September–October	1 June
November–December	1 August

Audience

Defense AT&L readers are mainly acquisition professionals serving in career positions covered by the Defense Acquisition Workforce Improvement Act (DAWIA) or industry equivalent.

Style

Defense AT&L prints feature stories focusing on real people and events. The magazine seeks articles that reflect author experiences in and thoughts about acquisition rather than pages of researched information. Articles should discuss the individual's experience with problems and solutions in acquisition, contracting, logistics, or program management, or with emerging trends.

The magazine does not print academic papers; fact sheets; technical papers; white papers; or articles with footnotes, endnotes, or references. Manuscripts meeting any of those criteria are more suitable for DAU's journal, *Defense Acquisition Research Journal (ARJ)*.

Defense AT&L does not reprint from other publications. Please do not submit manuscripts that have appeared elsewhere. *Defense AT&L* does not publish endorsements of products for sale.

Length

Articles should be 1,500–2,500 words.

Format

Send submissions via e-mail as Microsoft Word attachments.

Graphics

Do not embed photographs or charts in the manuscript. Digital files of photos or graphics should be sent as e-mail attachments. **Each figure or chart must be saved as a separate file in the original software format in which it was created.**

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