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Defense AT&L

Acquisition, Technology and Logistics

A PUBLICATION OF THE DEFENSE ACQUISITION UNIVERSITY

Aesop's Guide to Space Acquisition

Glimpses of Past and Future

Getting "Best Value" for the Warfighter and the Taxpayer

by the Under Secretary of Defense for Acquisition, Technology, and Logistics

International Defense Sales Roadmap

An Industry Perspective

Communities of Interest

Collaborating on Technology Challenges

2014 Defense Acquisition Workforce Award Winners

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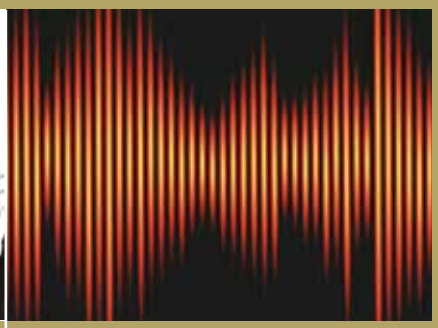

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Defense
AT&L

Vol XLIV No. 2, DAU 243

Published by the
DEFENSE ACQUISITION UNIVERSITY

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Defense AT&L (ISSN 1547-5476), formerly *Program Manager,* is published bimonthly by the DAU Press and is free to all U.S. and foreign national subscribers. Periodical postage is paid at the U.S. Postal Facility, Fort Belvoir, Va., and additional U.S. postal facilities.

POSTMASTER, send address changes to:
DEFENSE AT&L
DEFENSE ACQUISITION UNIVERSITY
ATTN DAU PRESS STE 3
9820 BELVOIR ROAD
FT BELVOIR VA 22060-5565

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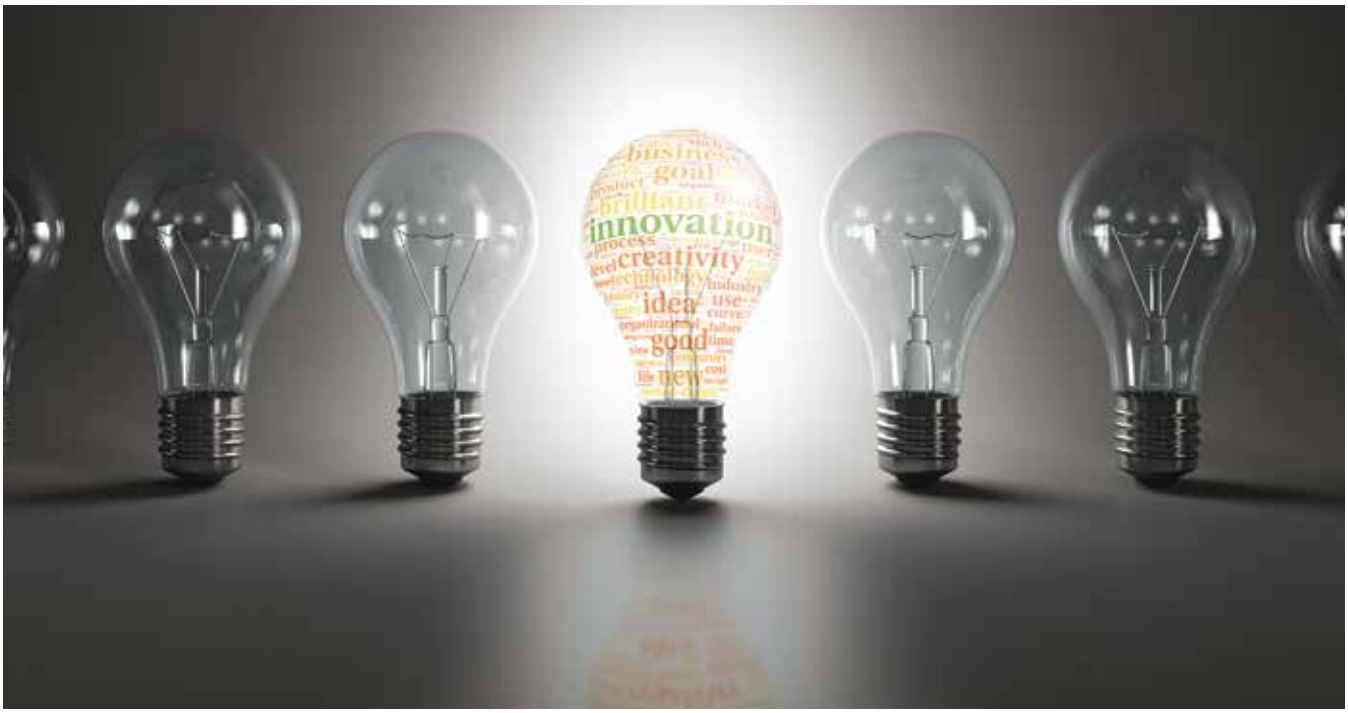
Getting "Best Value" for the Warfighter and the Taxpayer

Frank Kendall

We use the phrase "best value" fairly often, usually to describe the type of source-selection process or evaluation criteria we will use in a competitive acquisition. Under the Better Buying Power initiatives, we have emphasized using a more monetized and less subjective definition of best value. As a way to spur innovation, we also have emphasized communicating the "value function" to the offerors so they can bid more intelligently.

Some reluctance and understandable concern arose about the unintended consequences of trying to define best value in monetary terms. In fact, this decision can't be avoided. I would like to explain why it is unavoidable, provide some examples of using this approach, and discuss how we can avoid those unintended consequences some of us worry about. I'll also touch on the proper use of Lowest Price, Technically Acceptable (LPTA)—which is a form of monetized best value, but with a very restrictive definition and range of applicability.

A "traditional" best-value source-selection process combines disparate metrics in to one overall evaluation. In a recent example that I reviewed, four separate and unrelated metrics were proposed for the source selection: risk (high, medium or low), cost ($), performance (a composite scaled metric) and degree of small business utilization (with its own scale). Think how this would have played out in the source-selection decision making. Setting aside the small business metric, assume that there was a slightly more expensive and higher-risk but much higher-performing offeror and a slightly less expensive and lower-risk but significantly lower-performing offeror. The Source Selection Authority would have to decide whether the increased price and risk of the higher offeror was worth the difference in performance. That acquisition official, not our customer (the warfighter), would have needed to make the "best value" determination as a subjective judgment by weighing cost against the other two



metrics. In effect, that individual in the acquisition chain would make the precise cost versus performance and risk judgment we intend when we recommend monetizing the value of performance and including it in the evaluated price.

The likely bias for an acquisition official making the source selection is to take the lowest-price offer; it's much easier to defend than the subjective judgment that the higher-cost offeror was worth the difference in price. Is this the best way for us to do "best value" source selections? To the extent we can do so, we are better off defining "best value" by a single parameter we can readily compare. The easiest way to express that parameter is in dollars—using value-based adjusted price for evaluation purposes (e.g., bid price with predefined dollarized reductions for performance above threshold).

I believe there are some very good reasons to take the approach of monetizing performance metrics. First of all, it forces our customers—the operators who set requirements—to consider how much they are willing to pay for higher performance. Our normal practice in the requirements process is to define two levels of performance—threshold and objective. Unless we provide industry an incentive to do otherwise, we can expect it to bid the threshold levels of performance and no more. The simple reason is that we usually don't give industry any competitive incentive to offer higher performance. The lower threshold levels of performance almost always are the lowest-cost levels of performance.

Getting the requirements community to consider what it would be willing to pay for different levels of performance also has an important side benefit: It forces that user community to recognize that its requirements are not free and to engage the acquisition community on prioritizing those requirements. We must work as a team to be effective. Involving our customers in decisions about best value before releasing the final Request for Proposals (RFPs) builds our mutual understanding of the real-life trade-offs needed in almost any product or service acquisition. Monetizing best value to industry also provides benefits that accrue to the government. By not providing industry with a business reason to offer higher performance, we create a disincentive for innovation. We want industry to be in a position to make informed judgments about what level of performance to offer. The easiest way to accomplish this is to tell industry exactly, in dollars and cents, what higher levels of performance are worth to us. Industry then can compare its costs of meeting higher performance levels to our willingness to pay and decide what performance to offer.

We also should provide this information as early as possible, so industry has time to react to the information, including, when possible, time to develop new technologies that are integratable into their offerings. In addition, communicating this information to industry allows uncompetitive firms to avoid wasting company funds (allowable Bid and Proposal costs in overhead that the government reimburses) on proposals that have no chance of success. We have to define best value if we want industry to offer it to us.

There is a side benefit to monetizing best value criteria in that the objective source-selection criterion are harder to contest successfully. I don't believe we should design our source-selection criteria or acquisition strategies around minimizing the likelihood of a protest, whether it is a successful or an unsuccessful protest. But I don't mind having that feature as a byproduct of our approach. Avoiding successful protests is about setting down the rules for source selection, following them religiously, documenting the decisions we make so we can explain them if challenged, and maintaining the process integrity. All our source selections, of any type, should be conducted in this manner. At the end of the day, however, no one should be able to argue with the government about the monetary value we place on a specific feature or level of performance before we conduct a source selection (as long as we have a reasonable rationale for our choices and aren't being arbitrary). This judgment also is easier to defend if it is transparent and communicated to offerors well before we start the source-selection process.

About 15 years ago, while in industry, I tried for months to get the Air Force to provide some allowance, some competitive

credit, for my company's AIM 9X air-to-air missile's above-threshold performance. We had a novel design with exceptional off bore-sight capability, well above the threshold requirement. I didn't succeed and we lost the competition, but the Air Force also lost the opportunity to acquire an innovative design with superior performance. I find it hard to believe that performance had no value whatsoever to the Air Force. In any event, we received no credit in the source selection for offering what we were certain was a better product.

We have been using the technique of monetizing performance differences in source selections under Better Buying Power 2.0 and will continue this emphasis under BBP 3.0, but the practice didn't start with BBP.

One early use was in the second KC-46 Tanker competition. There was a successful protest by the losing offeror in the first competitive best-value source selection conducted in 2008. In the second competition in 2009, we moved to much more objective source-selection criteria, using evaluated price as the primary metric. In addition to folding fuel costs and operational efficiency into the evaluated price, we allowed for consideration of a long list of "desired but not required" features, but only if the evaluated prices were within 1 percent for the two offerors before we considered these features. Essentially, we bound the value of all these objective features as being worth no more to us than 1 percent of evaluated price. Notice that this had nothing to do with the cost of those features.

Value or worth to the buyer has nothing to do with cost; it is only about what we would be willing to pay for something. The tanker situation is analogous to buying a car and deciding what options to include. All those options, the "fully loaded" version of the tanker if you will, were only worth a 1 percent price differential to us. Having this information allowed industry to be a smarter offeror and propose a product more in line with our "value function."

More recently I had an experience with the acquisition strategy for a tactical radio program where the program manager intended to use a LPTA approach. He was asking for threshold performance and didn't plan to provide any credit to higher performance in the evaluation criteria.

I asked him hypothetically if he would want to buy a radio with twice the range and twice the message completion rate for 1 percent more. The answer, of course, was yes. We changed the evaluation criteria. Sometimes LPTA makes sense but it doesn't make sense if we are willing, as we usually are, to pay a little more for a much better product. LPTA may be an easier way to do a solicitation and a source selection, but that shouldn't be our metric. The warfighter and the taxpayer deserve better from us. LPTA is appropriate when we have well-defined standards of performance and we do not place any value on, and are therefore unwilling to pay for, higher performance.

LPTA is used in many acquisitions for services. As discussed above, it may be appropriate—if there is no value to the government in performance beyond well-defined thresholds.

The arguments against monetizing best value include a concern recently expressed by an Army program executive officer: Industry is likely to game the system to try to win. He was right, of course. We want "best value." Industry wants to win. Nevertheless, I don't find this to be a strong argument against monetizing best value. I do find it to be a strong argument for getting it right and making sure we align our source-selection criteria with what we want (what we value). If we have properly defined what is important to us and what we are willing to pay for that "best value," industry will position itself to meet our best-value proposition.

There are various possible ways to meet our best-value proposition—and from industry's point of view, that's not gaming us; that's doing what it takes to win. Our concern should be with getting the "best value" criteria right. We need to monetize best value in a way that doesn't permit an unintended consequence imposed on us by a crafty proposal team. I have worked on a reasonable number of proposals from the industry side and I know the concern has some validity. When we set source-selection criteria, we need to do our own red-teaming process to ensure we don't produce unintended and negative consequences. Basically, this is just a matter of running through the range of possible approaches to bidding to see if

we have neglected an excursion that has an unintended and negative effect. You can count on industry to do the same.

I have also heard the concern that industry may inflate its pricing to come just under what we are willing to pay, even if the cost is substantially lower. In a competitive acquisition, we should be able to count on the fact there will be other bidders to prevent this behavior. Offerors have to beat the competition, regardless of the government's willingness to pay. Incidentally knowing our published budget figures also provides industry with a strong indication of what we could pay for the product. In any case, we must use either competition or, in a sole-source environment, discussions about actual costs to ensure we get a reasonable price for the warfighter and the taxpayer. Monetizing best value doesn't change those processes.

In development contracts, we often are concerned about risk, and it's fair to ask whether it is possible to monetize risk considerations. We can set subjective risk scales for evaluation purposes and do so routinely, using High, Medium, and Low—or a more finally grained alternative. Translating these comparisons into relative monetary value takes some thought, but it can be done. One has to be careful because risk valuations can be very nonlinear. For example, "low-risk" and "medium-risk" offerors might have fairly small differences in "value," but a high-risk offeror could (and probably should) have prohibitively high cost adjustments to overcome. We would expect both low- and medium-risk offers to be obtainable but with cost and schedule impact differences. A high-risk offer has a finite probability of being outside the realm of the possible.

A better way to handle risk factors is to create thresholds or "gates" as opposed to comparative assessments. If an offer has acceptable risk, it is considered responsive and evaluated for cost and performance. If an offer has high risk, it is eliminated from the competition. This is one of the many areas in which we have to use professional judgment and a real understanding of the actual risks involved in order to make a good decision.

It is argued that this approach is more difficult and time consuming. A former senior official once told me that "convenience" was the biggest determiner of an acquisition strategy. I certainly hope that is not so. We do have finite capacity, but we owe our customers our best efforts in every acquisition. I am not persuaded that monetizing best value is prohibitively difficult. It is a new approach for many in the requirements community, and they won't be comfortable with it until they have more experience.

My first attempt to use this approach was on the Combat Rescue Helicopter program. It took several attempts to get the user community to stop bringing me cost estimates for various levels of performance. Ultimately, the users concluded that the cost premium the Air Force was willing to pay for objective performance was only about 10 percent. This information caused one company to drop out of the competition. I'm not troubled by that result. It would have been a waste of time for that company to prepare an offer. It does take a little more effort up front to define best value in monetary terms. However, the source-selection process is made simpler, and, more importantly, we can get better results for our customers. That is the metric that should matter most to us.

As we build our teamwork with both the warfighters who set requirements and with industry which tries to win business by meeting those requirements, I believe there will be more acceptance and support for monetizing best value. It is in everyone's interest and well worth the effort.

(Editor's Note: For further review of industry and government assessments of LPTA, see the Acquisition Discussion articles beginning on pp. 16-17.)

Farewell to James S. McMichael

Dr. James S. McMichael—vice president and a former three-term acting president of the Defense Acquisition University in 1991-1992, in 2010 and in 2012-2014—retired in January. He had been DAU's vice president since 2005.

Earlier, Dr. McMichael was director of acquisition education, training and career development in the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. In that position, he was the principal advocate for workforce management and formulated policies and programs to ensure workforce quality and professionalism.

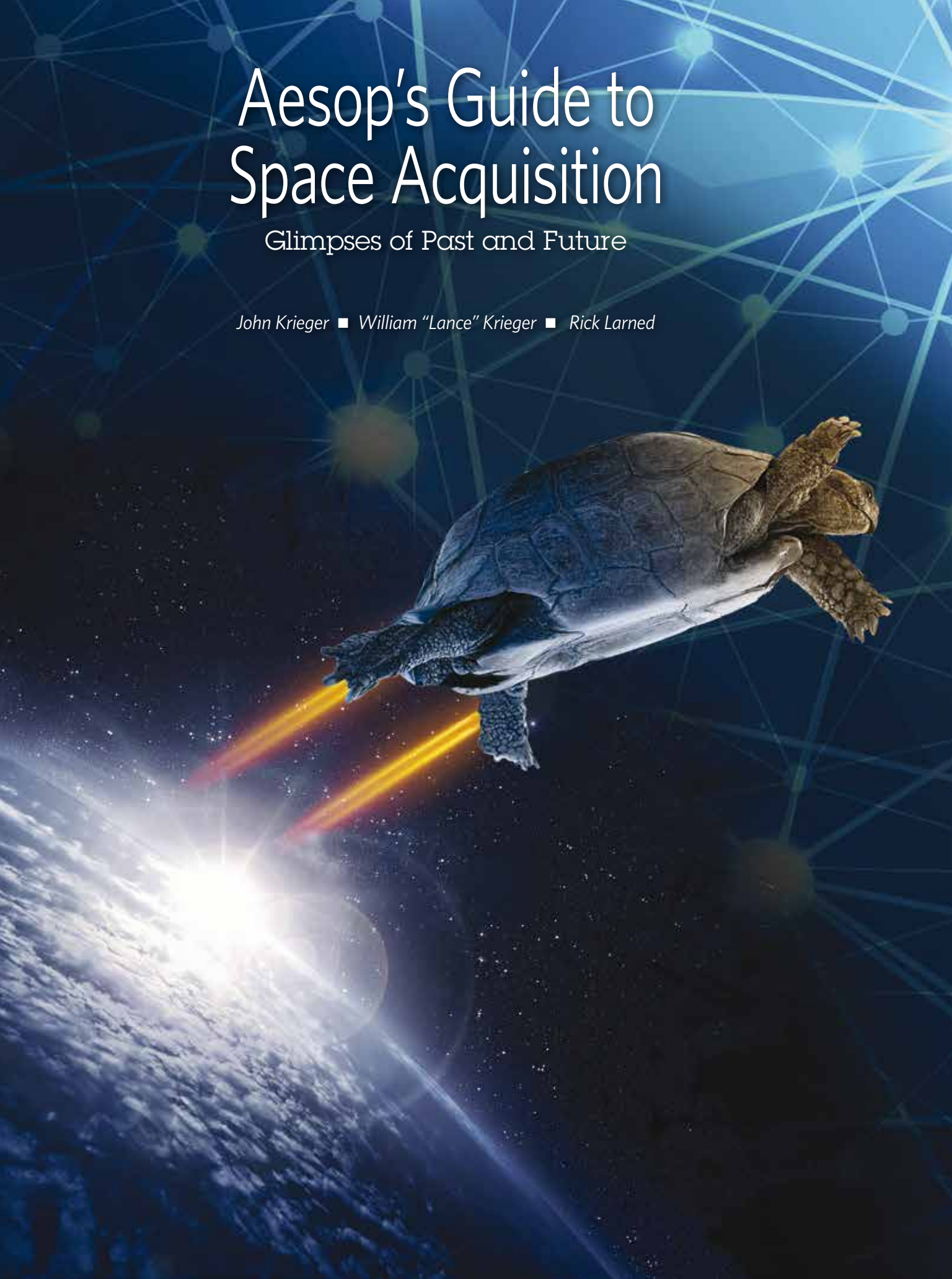
McMichael also has served as the technical director for the Navy Personnel Research and Development Center in San Diego, Calif.; special advisor for manpower, personnel and training in the Office of the Chief of Naval Operations; and chairman of the psychology department at Long Island University in New York, where he taught for eight years.

McMichael is a graduate of Princeton University and received his advanced degrees at the University of Delaware. He was a fellow at Princeton's Woodrow Wilson School of Public and International Affairs from 1982 to 1983.

Aesop's Guide to Space Acquisition

Glimpses of Past and Future

John Krieger ■ William "Lance" Krieger ■ Rick Larned



10 United States Code (U.S.C.) § 2273—Policy regarding assured access to space: national security payloads, establishes the requirement for the President to ensure our access to space.
(a) Policy—It is the policy of the United States for the President to undertake actions appropriate to ensure, to the maximum extent practicable, that the United States has the capabilities necessary to launch and insert United States national security payloads into space whenever such payloads are needed in space.

The United States and the world are witnessing a transformation of space. More countries are reaching space, or trying to, crowding it more and more. Years of satellite launches, collisions and anti-satellite weapons testing have left lots of junk and debris. Although we have never faced a situation where wars on Earth have escalated into space, there is a potential to do so. Through all events, the president must assure access to space.

Although the thrust of Section 2273 is to assure payload launch, the authors believe the broader picture includes acquiring the needed assets (e.g., navigation, weather, communication, and reconnaissance), launching them, and ensuring their continued viability and vitality on orbit. This requires a combination of National Security Space (NSS) architecture and smart space acquisition. This paper addresses the latter.

Bottom Line Up Front (BLUF)? Space acquisition needs long-haul, cost-effective solutions to increasingly difficult challenges. We may wish advances in space were like the birth of Athena, born full grown, complete with armor, directly from her father Zeus' head—the reason she is associated with wisdom. Unfortunately, that is not the case with space advances. A more reasonable model is suggested by Aesop's fable of the tortoise and the hare: Slow but steady wins the race—in this case, the space race. This approach has served us well for several decades. Given the transformational upheaval expected in the next century, we need all the tools we can get in our space acquisition toolbox (i.e., new developments, evolution of existing systems, and augmentation with commercial and non-space assets) and a whole new way of perceiving our space systems as an Enterprise.

John Krieger *is a professor of Contract Management at the Defense Systems Management College at Fort Belvoir, Va. His brother and coauthor, William "Lance"* **Krieger**, *has 35 years of acquisition experience on both sides of the partnership, as a former Air Force Senior Executive and retired aerospace executive. Their friend and coauthor, retired Air Force Brig. Gen. Rick* **Larned**, *is a former National Reconnaissance Office and Air Force acquisition official. Together, the authors have more than a century of acquisition experience.*

Table 1. Evolution of Thor to Delta II

Rocket	Height	Circumference	Mass	Payload	Success Rate
Thor	19.76 m	2.44 m	49,590 kg	1,000 kg (Ballistic)	76%
Delta	19.76 m	2.44 m	49,590 kg	45 kg (LEO)	92%
Delta II	38.2 - 39 m	2.44 m	151,700 - 231,870 kg	2,700 - 6,100 kg (LEO) 900 - 2,170 kg (GTO)	99%

Note: Data from Wikipedia, June 4, 2014.

George Santayana offers wisdom to guide us: "Progress, far from consisting in change, depends on retentiveness. . . . Those who cannot remember the past are condemned to repeat it." Although we may strive for breakthroughs, we need to bridge them with incremental advances and evolution of current architectures.

Slow But Steady Wins the Race

Delta Launch Vehicles: We got out of the blocks late in the space race, with the 1957 Soviet launch of the Sputnik satellite providing a wakeup call. Our beginnings were not auspicious. The Vanguard Program had three successes in 11 launches (a 27 percent success rate); total combined payload of less than 34 kilograms (kg)—about 75 pounds—to orbit. Delta was a different story. (See Table 1, above).

The current Delta IV has a single payload launch capability of 22,560 kg to Low Earth Orbit (LEO), 644 times the lift of all Vanguard launches combined, and a 96 percent success rate. Delta IV did not leap forth full grown from the heads of scientists and engineers but evolved from prior Deltas back to the Thor ballistic missile. Delta was the "D" version of Thor.

Mater Artium Necessitas

For those not familiar with Latin, that phrase from William Horma's book *Vulgaria* (1519) translates as "Necessity is the Mother of Invention." Applying that rule to space acquisition is how we develop new solutions or take degraded or useless assets and breathe new life into them.

Space has become exponentially more useful since the 1957 Soviet launch. Utility has grown by leaps and bounds, but each new "out of the box" program usually comes with daunting cost, schedule and software risks. In contrast, steady evolution of existing systems, progressive incorporation of new technologies, and incremental exploitation frequently can provide cost-effective solutions for meeting new requirements or unknown needs. Give people control over a process or system and they will come up with ingenious ways to improve it. On the commercial front, additional uses devised for Velcro, Post-Its and Vicks have demonstrated inventiveness and creativity.

Discoverer/Corona/Gambit: The beginning of space reconnaissance was inauspicious—12 successive failures before the first film bucket of photographic surveillance of the Soviet Union was retrieved from space. It turns out space development is difficult. A national commitment supported dedicated scientists and engineers through dark days, but "slow but steady" in all parts of the program—satellites, operations, and data exploitation—won the race, and that success marked the beginning of the end of the Cold War. Improvements continued across programs. The high-resolution Gambit program, designed for low-Earth orbit, was given a second engine burn to fly at a higher orbit for part of the mission.

"The Schoolhouse Gang": Gen. Bernard Schriever set up the organization to build the first IIntercontinental Ballistic Missile and intelligence satellites. ("Schoolhouse" comes from the organization's first residence, a former Catholic boys school in a suburb of Los Angeles.) Schriever created a streamlined program management model that led to the great advancements in space technology that protected this nation.

The satellites evolved over time as two things happened. First, the technology and requirements evolved. Second, the operators, working with the engineers in the factory, learned what the system was capable of doing and learned new ways of using it. A satellite once was left in the wrong orbit by a launch vehicle. At first the satellite was considered useless. But the team created a plan to use the system and found an area of requirements previously unmet. On another occasion, a satellite was nearly out of life and the team used some of the remaining fuel to invert the satellite, flying it "upside down" for years, capturing valuable information. The original Hexagon photoreconnaissance satellite, designed to fly 30 days, was by the end of the program (Block IV) incentivized to fly for a year.

Time and again space operators, their partners in the factory team, and Soldiers, Sailors, Airmen and Marines have shown an ability to use the various parts and aspects of the systems to create new ways of exploiting those systems:

- **Global Positioning System (GPS):** The GPS mission was to develop a precise timing system to improve navigational accuracy worldwide. Originally intended to be a navigation satellite for the nuclear triad, its value as a precise time-distribution system succeeded at the Enterprise level beyond all expectations. "Although the first thing that comes to mind about GPS is navigation, GPS is ubiquitous, even reaching into areas such as banking and investments, through computer clock synchronization. Wikipedia lists a myriad of civilian

applications for GPS (i.e., clock synchronization, cellular telephony, disaster relief and emergency services, geofencing, geotagging, GPS aircraft tracking, GPS tours, mapmaking, navigation, phasor measurements, robotics, recreation, surveying, tectonics, telematics, fleet tracking)." ("An Immodest Proposal," John Krieger, p. 26, *Defense AT&L*, September-October 2012)

- **Milstar:** The original system developers would never have guessed that a few Marines would figure out that Milstar, originally designed to survive a nuclear blast and still provide secure communications for the National Command Authorities (NCA), also could be used to transfer tactical digital data necessary to keep the Marines in the fight.

- **Kepler:** NASA's Kepler Space Observatory looked for distortions in space that could be caused by a new planet. It found 962 possible planets before two reaction wheels failed and it was unable to maintain stability. Engineers found a way to add pressure from the sun to provide the required stability, allowing a "doomed" mission to continue.

These examples show the critical nature of program office, corporate and personnel continuity, knowledge and memory.

The Enterprise

Space: the final frontier . . .

Many will remember the introductory words from the "Star Trek" television series. For those personally involved in space acquisition, they may have been a contributing factor. However, the Enterprise that we discuss here is not the USS *Enterprise* (NCC-1701) but a large, difficult undertaking that requires the commitment of extensive resources (e.g., dollars, personnel and time). Big-picture, Enterprise-level solutions are hard to develop requirements for, to budget for, to justify to Congress, to contract, to design, to build, and to deploy—but may be the solutions that we need the most.

The major advocate for Enterprise solutions is that Soldier, Sailor, Airman or Marine with iPad in hand, who calls out for a complete Enterprise-level solution. If we could give the warfighters what they need, we could save lives. There is a critical need to build the most effective combat-capable space force at the Enterprise level, not the system level. We need a space force that cuts across programs, stovepipes, Services, communities (U.S. Government, commercial, and international) and domains (air, land, sea, space, cyber). Gen. William L. Shelton, then commander of Air Force Space Command, posited that we need to be "reducing costs through cost-effective resilient architectures . . . ." (Global Warfare Symposium, Nov. 17, 2011).

In 1707, the Royal Navy lost several ships and more than 1,000 men off Sicily because navigators could not accurately determine their positions. The British Government passed the Longitude Act providing 20,000 pounds for developing a simple method to measure longitude accurately. John Harrison won the competition in 1765, culminating 35 years of developing a chronometer accurate to 5 seconds. Time was the key.

During the early days of GPS, as program manager Brad Parkinson arrived late for a review, someone commented, "Have you ever noticed how all our meetings start 15 minutes late?" Without hesitation, Parkinson responded, "Yes, but precisely 15 minutes late."

Parkinson focused his team on mission, not hardware, by posting goals in the program office's hallway; Enterprise goals, not satellite goals:

- Drop 5 bombs into a single hole.
- Build a receiver for $10,000.
- Build a receiver that could be carried on a person's back into combat.

(Consider how outlandish the last two seem today, in view of the current cost and size of GPS receivers.)

A satellite was nearly out of life and the team used some of the remaining fuel to invert the satellite, flying it "upside down" for years, capturing valuable information.

GPS is an example of an Enterprise-level solution. While the technical design solution was to move atomic clock accuracy to space for easier signal distribution, from the start the satellite was meant to be "dumb." The "brains" of the system were in the control and user segments. The focus of the program was on the total cost of ownership, with source-selection criteria and award-fee criteria for design to life-cycle cost. The program was not just a satellite program; it was Enterprise architecture.

The Air Force and other space acquirers have an opportunity to optimize existing assets, with some augmentation for new technologies, and to use space to exploit new user requirements, even unknown future capabilities. Space can be a platform for the Internet, and all the opportunities that the Internet and the applications summon to mind. The Space-Based Infrared System, for instance, might be a major node

in a system that includes drones, fighters, ships and other assets that would make it even more capable of exploitation by multiple users. Milstar and Advanced Extremely High Frequency could be seen as space servers in an Enterprise-wide network. A broader perspective would be to see the Defense Meteorological Satellite Program as part of a weather Internet app being exploited by multiple users for multiple applications.

The Path Forward

We look forward to a stronger space force able to meet the challenges of the next 100 years; a space force able to protect commercial interests (in Navy parlance, "freedom of the seas"); a space force able to deter an adversary from contemplating offensive operations in space; a space force able to maintain universal freedom in space.

Common Operating Picture (COP): We need to build a COP as we prepare for the 22nd century. Between now and then, what we can say with certainty is that the next quarter-century will see the advent of the following:

- Cross-domain Enterprise architecture and Enterprise-level solutions
- Embedded resilience
- Mixed government and commercial (assets and approaches)
- Hosted payload acceleration
- Dynamic retasking of national collectors
- An international team approach to greater resilience
- Sharing data across stovepipes, Services, agencies and borders
- Assured access to space and quick launch

Acquisition Transformation: We need to carefully consider how to acquire space assets, including adapting to changes driven by commercial space providers that could serve us well. Candidates include:

- Better Buying Power
- Adapting cost and performance incentives to true motivators
- Multiyear contracting, block buys, and economic order quantity (EOQ)
- Capturing the learning curve—continuous product/process improvement
- Government payloads on commercial satellites
- Commodity contracting for space
- Commercial management of government satellites and constellations
- Performance-based logistics (PBL) and contractor logistics support (CLS)
- "Outsourcing"—mission acquisition as services, not products
- Re-establishment of "Defense Enterprise Programs"

(We must leave the discussions of COP and acquisition transformation to another day.)

Tomorrow's Success and Today's Innovation

Is there more innovation to be had? Absolutely. Think accepting launches at successful satellite placement, not liftoff. Think eliminating chemical-based launch vehicles, using other concepts for satellite launch, like electromagnets—a technology almost a century old. Both the Navy and the Army are developing electromagnetic technology for launching projectiles. Think on-orbit PBL, refueling and repairing satellites, *a la* Lockheed's 1958 Astrotug. Think of the benefits of the last two (e.g., launch on demand, greater reliability, safer, cheaper, less pollution). We must do "smart innovation," making leaps when we can, and incremental improvement when we can't.

The Air Force and other space acquirers have an opportunity to optimize existing assets, with some augmentation for new technologies, and to use space to exploit new user requirements, even unknown future capabilities.

Grand strategy requires grand vision. For space, our grand vision has been set by 10 U.S.C. § 2273—policy regarding assured access to space: national security payloads, as we described it in the introduction. The way to fulfill that grand strategy is to carefully build on what we as a nation already have accomplished in space acquisition.

One final thought, provided by Bernard of Chartres, "*nanos gigantum humeris insidentes*"—"We are dwarfs standing on the shoulders of giants." When you stand on the shoulders of the likes of Gen. Bernard Schriever, that is not such a bad place to be. For the next 100 years, we can build upon the outstanding space systems that are our inheritance—incrementally, at lower cost, with less risk—if we apply proven lessons learned. Given the challenging task of restructuring our NSS architecture to meet the increasingly demanding environment of the next 100 years, we can't afford the luxury of getting sidetracked by endless rounds of viewgraph engineering, of unfulfilled promises.

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International Defense Sales Roadmap

An Industry Perspective

Lawrence E. Casper

This is the second of two articles by the author about international defense system sales. The first article, "International Arms Sales, An Industry Perspective*" was published in the September-October 2014 issue of* Defense AT&L. *This article identifies several key components of an international defense system pursuit and focuses on the U.S. defense industry's (and to some degree the U.S. Government's) in-country campaign to convince international customers that the U.S. solution best meets a given country's overall requirements. It is based on the author's experience in actual international campaigns, and the methodology and actions discussed are intended to provide a notional approach to what often is a complex process.*

Simply presenting a United States system or offering the best solution in the world are not always sufficient reasons for a foreign government to issue a defense contract. An international defense system pursuit can be multifaceted and the outcome can be influenced by both explicit and implied factors.

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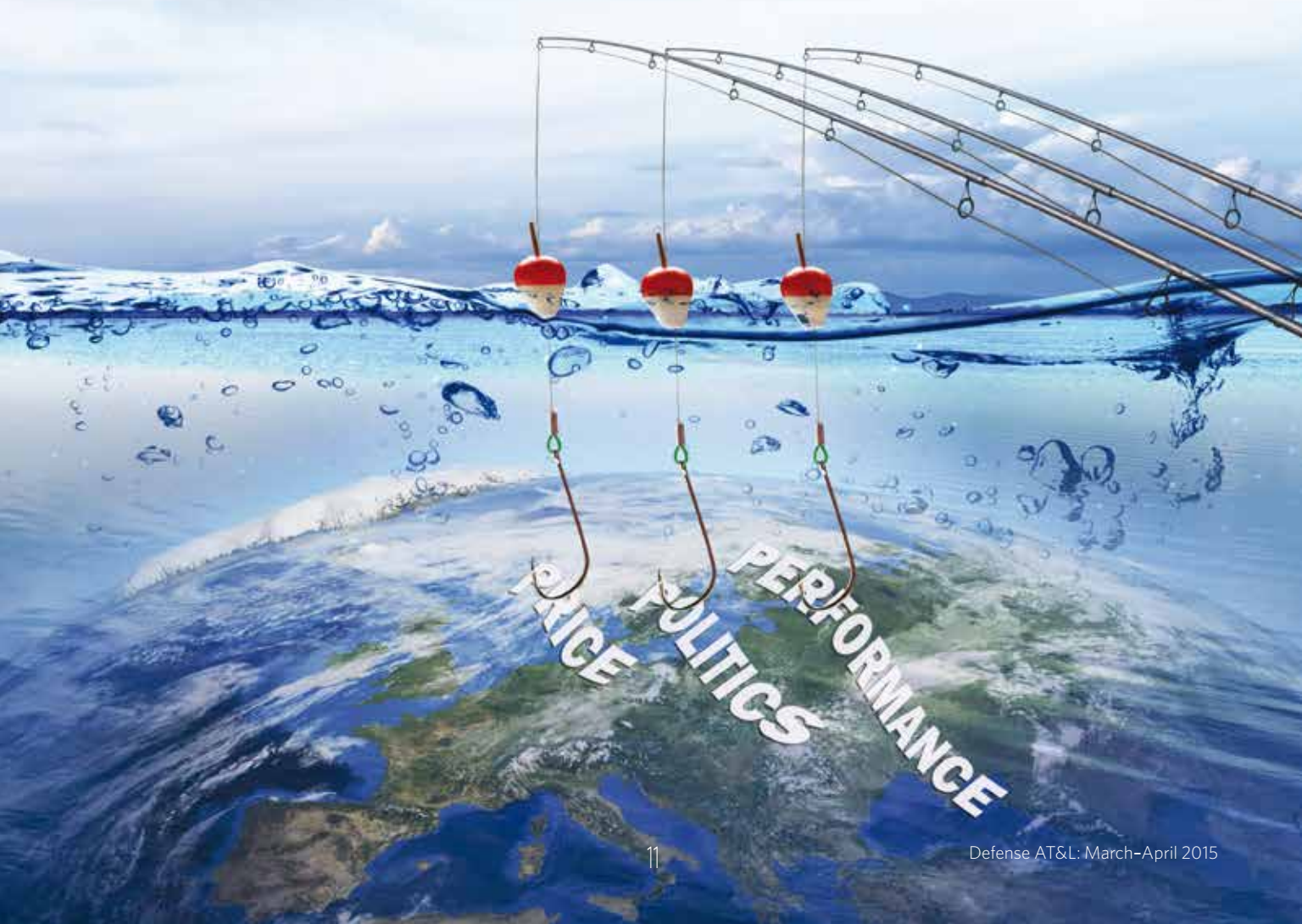


Figure 1 illustrates a series of characteristics that, when addressed during the pursuit of a customer's contract, constitute a viable path to success. Each component along the path can be grouped into one of three pursuit imperatives—politics, price and performance (the "three Ps"). Successfully implementing the three Ps can maximize the probability of winning the contract.

These components are not all inclusive and sometimes may appear to overlap. The components typically are independent of each other and accomplishing one does not necessarily ensure success of another. Furthermore, the components do not necessarily occur in the order depicted, yet the successful execution of each increases the overall probability of success.

The first action in any pursuit should be reading recent and relevant after-action reports. Studying such reports from prior pursuits in the targeted country can provide valuable insight and suggest possible options and requirements for a capture strategy. These insights, coupled with a comprehensive approach to the three Ps, provide a roadmap for success.

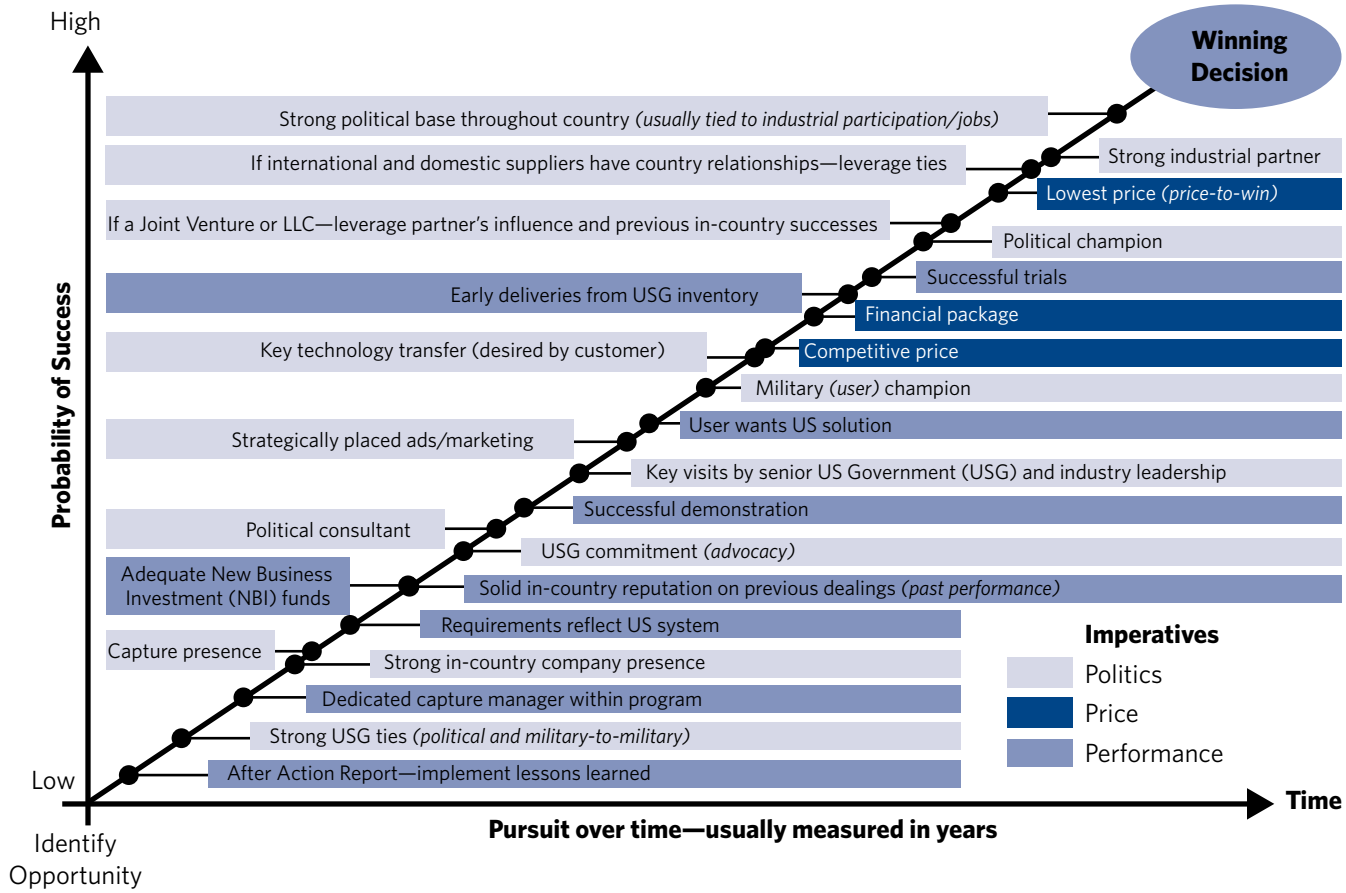
Politics

Politics can be a critical aspect of a pursuit and in some cases can be the most important of the three Ps. I have experienced competitions in which a higher-priced and or lesser-performing system was selected, based largely on politics. The political objective is to inform and persuade the customer directly and indirectly through the United State and host country's governments and militaries, international and local industries, consultants and representatives, media and anyone else who can help convey and advocate strategic competitive messaging. Such messaging can be conveyed through many sources, but it must be consistent and explain how the proffered solution best meets the end user's requirements and the host government's political needs.

Government-to-government relationships, U.S. Government advocacy, industry presence, political insight, an effective information campaign, strategically timed visits by senior government and industry executives, technology transfer and job creation all contribute to achieving the political objective.

Strong political and military ties between the procuring country and the United States can increase the chances of success. Countries with shared geopolitical objectives are more likely to leverage each other to gain favor, thereby providing the proposed defense systems solution opportunity for preferential consideration. Additionally, militaries frequently seek complementary systems and capabilities with their allies and

Figure 1. Components of a Successful Pursuit



coalition partners, often leading to a preference for U.S. weapons. If government-to-government relations are strained, the solution may fall victim to political discord.

It is critical that the industry capture manager leverage the company's in-country presence and that of any relevant business partners and/or international and domestic suppliers. The capture manager, who is responsible for the success of the company's in-country pursuit, often focuses narrowly on the program's pursuit and overlooks his or her own company's presence and influence in the country, especially in larger organizations with multiple and diverse business units. Every in-country relationship and resource should be engaged, energized and exploited.

It may be necessary to hire a political consultant in the host country to aid in the development of the political component of the capture strategy. Additionally, the consultant often can help navigate the political landscape and better enable strategic messaging to key elected and appointed officials.

Timely placed ads, articles and editorials in targeted publications are essential in the information campaign, along with securing advocates in the host nation's political and military hierarchy. Influential, respected people in the government and military who champion the U.S. solution can sometimes tip the balance.

It also is important throughout the pursuit to schedule visits by senior U.S. Government and industry leaders. These visits must be linked to strategic program and decision milestones in order to gain maximum effect. Visits by senior leadership send a message that the United States and its industry are serious competitors, and this reinforces the country's importance to them. A comprehensive contact plan facilitates synchronizing visits and managing leadership priorities.

Industrial participation often is an integral part of a successful capture strategy and must be considered early in the process, even if not necessarily required by the customer. Teaming with a strong in-country industry partner puts a local face on the defense system and may be able to accomplish many of the political actions vital to the capture strategy. Teaming and job creation can build a strong political base throughout the country. A study of compatible industries located in key political districts will provide a blueprint for industrial participation and, by extension, political engagement. The objective is jobs and local economic benefits, from which political support normally flows.

In addition to job creation, technology transfer also can be a critical competitive source-selection criterion as countries often view it as a building block for industrial growth and economic security. Technology transfer is not always easy and requires U.S. Government approval and support. Additionally, it can have strategic competitive implications, for it may mean creating a possible future competitor using the technology transferred. Implementing technology transfer should be addressed early in the capture strategy process.

If the company's solution is the only U.S. system in the competition, it can also be helpful to seek advocacy from the Department of Commerce. This requires a formal request which, when approved, will ensure the full backing of the U.S. Government. It is especially important when soliciting support from the local U.S. ambassador and the U.S. Embassy team. The request also should be initiated early in the capture process.

Each international defense system pursuit is unique, and each country's industrial base and acquisition process can vary from simple to sophisticated, from opaque to transparent, all of which can influence the breadth and depth of necessary political engagement.

Price

Price and affordability are key considerations in balancing requirements and budgets. Arriving at a competitive, winning price can be complex and involves strategic business and competitive factors.

One of the most challenging aspects of pricing is determining the price-to-win. It is complicated and requires assumptions regarding what competitors may propose and the customer is willing to accept. Price-to-win provides the basis for the pricing strategy and involves sound intelligence, realistic assumptions, accurate estimating and, at times, even a bit of luck.

Marine Lance Cpl. David Fuertes fires the Javelin missile near Al Asad Air Base, Iraq, Dec. 8, 2014.
Photo by Capt. Paul Greenberg

Gaining visibility into the customer's program acquisition budget is a good price-to-win starting point, but also can be difficult as funding levels are not always available through open-source means. Unlike the United States, which openly publishes its procurement budget, many countries consider such information to be sensitive and restrict access accordingly. Sometimes the customer requests rough order of magnitude pricing for the defense item, from which a program budget might be estimated.

After industry proposals are submitted, which may be as complicated as three separate bids (one technical, one for price and an industrial participation or offset bid), there often is a subsequent customer request for a best and final offer. Attempts to convince company management to lower the price frequently are challenged and therefore require a compelling business-case argument. Pricing strategies may involve reducing company margins, U.S. Government fees, in-country local representative commissions, proposing early system deliveries, increasing host country work share, enhancing system warranties, and similar value propositions. The best and final offer is an opportunity for innovation with both the price and the offer, as it is the final chance to secure a favorable decision.

Offering the customer a financing package occasionally may provide competitive advantage. This approach is uncommon, customer dependent and likelier in countries with smaller defense procurement budgets. Loans and creative payment schedules normally are limited to Direct Commercial Sales (DCS) or to the DCS portion of a hybrid Foreign Military Sales/Direct Commercial Sales case. If envisioned, a financing package should be considered early when the pricing strategy is developed.

Finally, because a defense systems pursuit is protracted, often lasting several years, pricing is updated routinely. Determining a winning price is a fluid process predicated on sound strategy. Pricing is more complex than addressed in this article. But despite the limitations of this discussion, it is important for a successful outcome. In the end, a procurement decision often comes down to customer affordability.

Performance

Although counterintuitive, system performance may sometimes be less important than politics or price, assuming the customer minimum essential requirements are met.

Performance encompasses both program execution and system operation. Shortcomings, real or perceived, in program management or system performance can have far-reaching implications. Program management and system operation must therefore be seen to perform consistently and at expected levels.

Identifying and funding a capture manager, meeting technical and operational requirements, demonstrating system performance, meeting delivery dates, managing expectations and outperforming the competition during customer trials all contribute to the performance imperative.

Industry often does not assign a single point of contact for a pursuit; there is no "one person" accountable, other than the program director, to win the contract. It is essential that industry early in the pursuit identifies and resources a capture manager. Resourcing may involve contracting a local representative or consultant to lead the in-country effort if local procurement laws permit. Ensuring that the pursuit is funded adequately with new business investment is crucial

and requires constant vigilance by the capture manager to retain and maintain funding throughout the pursuit.

Yet funding is irrelevant if the system offered does not meet the customer's stated requirements. Conversely, a significant competitive advantage is possible if the user's requirements mirror the proposed solution. I recall reading a country's "futures" white paper discussing the concept of a man-portable anti-armor missile system. The paper proposed specifications identical to the American Javelin anti-armor system. The paper was published a full year before the competition was announced and, needless to say, years later the Javelin system was selected. On the other hand, I have experienced competitive requests for proposal that reflect the competitors' specifications verbatim.

Laying the foundation for a successful pursuit begins well before a competition is announced and a specific pursuit is identified. Marketing the system early, quickly responding to a potential buyer's requests for information and aiding the prospective customer in developing system requirements before an official program is announced normally ensure development of a friendly specifications document. It is a major advantage if the customer wants your system, yet this is seldom publicized and that preference can be trumped by price or politics.

A system demonstration can increase the probability of success significantly, yet it also can consume limited new business investment funds, especially if conducted in the host country. Often it is mandated by the customer—but if it is not, a demonstration should still be considered. Like any high-payoff event, there is risk in such demonstrations. A technical problem or system failure can haunt the remainder of the pursuit.

Performance also is the credible capability to deliver the system on schedule and within budget. In collaboration with the U.S. Government and the lead Service, an early delivery from the U.S. inventory sometimes may influence the procurement decision positively. This is not easily obtained and is authorized by exception.

Finally, formal customer system trials, which are usually scored, must be executed as flawlessly as possible. These are graded exercises and must be accomplished without a hitch. Here a company's technical and engineering support must be resourced with priority.

In the end, program management and system performance are critical determinants of success.

Conclusion

International defense system sales are governed strictly by a number of U.S. laws and regulations, most notably the Arms Export Control Act, the Foreign Corrupt Practices Act and the International Traffic in Arms Regulations. It is essential that every action and conduct in a pursuit complies fully with all such legal and regulatory requirements. There can be no exceptions.

The in-country campaign always will be defined by some combination of politics, price and performance. Regardless of how these "three Ps" imperatives are approached, or how the components are accomplished, two fundamentals will always prevail: listening to the customer and both building and maintaining professional relationships. Both must be done well.

Additionally, a successful sale requires U.S. Government and industry collaboration. If the two entities work as a well-coordinated team, the probability of success is significantly enhanced.

An international defense system sale can be a complex and lengthy process. The capture manager and his or her team must be persistent, patient and diligent, as the journey in pursuit of a contract often is littered with frustration and disappointment.

Finally, the value of international defense system sales can range from hundreds of thousands of dollars to billions of dollars. Some are sole-source procurements while others are competitive, and the purchase may be a Foreign Military Sale, a Direct Commercial Sale or a combination of the two. Yet regardless of contract value or procurement method, successfully addressing all components of a pursuit strategy provides the best path to a winning decision.

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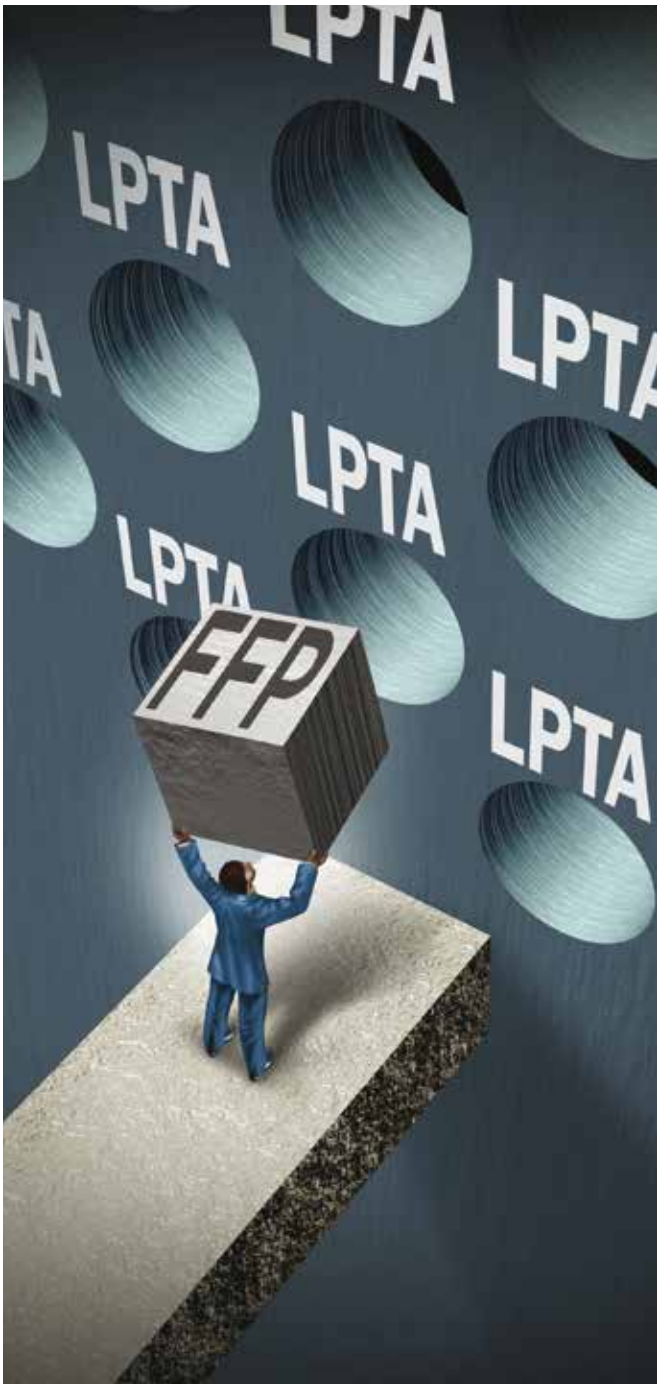
Lowest Price Technically Acceptable

Overrated, Overused?

Will Goodman



The Lowest Price, Technically Acceptable (LPTA) source-selection method is overused, and that overuse harms the products and services that our warfighters rely on. While LPTA has a proper function in the acquisition of commodities and commoditized services, the increased use of the LPTA in recent years means that the tool has expanded into other areas where it does not belong.

The downward pressure on price reduces industry's incentive to innovate and may drive quality suppliers entirely out of the defense marketplace as they look for more lucrative opportunities. Without updating the guidance for LPTA and narrowing the range of solicitations for which it is used, contracting officers will continue to misuse LPTA, harming both acquisition outcomes and our industrial base in the process.

Reports demonstrate that the use of LPTA has increased significantly in recent years. According to the Government Accountability Office (GAO), between fiscal years 2009 and 2013, the Department of Defense (DoD) use of LPTA in solicitations rose 10 percentage points, from 26 percent to 36 percent of solicitations, a relative increase in use of 38 percent. Over the same period, the Tradeoff process declined 11 percentage points, from 69 percent to 58 percent. Bloomberg reported a government-wide increase in the use of LPTA, from 55.7 percent of solicitations in 2010 to 61.4 percent in 2014. Over the same period, growth in the use of LPTA was most significant in the Navy, with the number of LPTA solicitations in 2014 outstripping the total number of all Best Value Continuum solicitations in 2010, 2011, or 2012.

To be fair, there are four possible explanations for the rising use of LPTA. First, we may have significantly changed the profile of items we are buying, necessitating a change in our

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Lowest Price Technically Acceptable

Why All the Debate?

Scott R. Calisti

Industry continues to raise concerns about the perceived overuse by the Department of Defense (DoD) of the Lowest Priced Technically Acceptable (LPTA) source-selection process.

In appropriate circumstances, combined with effective competition and proper contract type, LPTA can drive down costs and provide the government with a best-value solution. Using LPTA can also simplify and streamline the selection process and deliver precisely the product or service required by the warfighter. Detractors argue LPTA drives us to only a "low cost, low quality" solution, stifles innovation and squeezes corporate margins due to downward pressure on price. Furthermore, industry contends, overusing LPTA in the long haul will erode the DoD technological edge through low-cost/low-performance solutions; cause performance innovators to depart the market and reduce the quality of goods and services provided.

Industry has a point. However, I would offer that the real issue is the inappropriate use of LPTA, which does adversely affect both industry and DoD. LPTA has a place in the "best value" continuum when applied correctly. This article will discuss the appropriate use of LPTA, how our regulations, policy, guidance and training have driven the appropriate behavior in its use, and the progress made by DoD thus far. I will then discuss some of industry concerns and believe that these concerns can be resolved by applying LPTA correctly.

Used appropriately, LPTA has value to DoD. But improper use of LPTA for complex products and services can rob DoD of innovations needed to maintain our technological advantage and meet the warfighter's needs. Ultimately, it is in our best interest to make sure we use LPTA for the right requirements and under the right circumstances. We must ensure we continue to promote innovation *and* maintain our technological

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source-selection methods. Second, we may have overused Tradeoff or other Best Value processes in the past. Third, we may now be overusing LPTA. Last, it could be some combination of the other three possibilities.

Fairness notwithstanding, the most obvious explanation is an overuse of LPTA due to downward pressure on costs. Although I cannot offer evidence of a causal relationship between the two, the increased use of LPTA correlates in time to overall budget pressures created by DoD efficiency initiatives, the Budget Control Act, and budget sequestration. Better Buying Power 1.0's emphasis on cost reductions likely reinforced the tendency.

The overuse of LPTA is an effort to receive more than what we pay for. The Center for Strategic and International Studies' annual contracting report demonstrates that the pain of sequestration has fallen disproportionately on modernization accounts, while the demands made of the DoD, including demands on its materiel, continue without significant reductions. A sustained demand signal coupled with reduced resources prompts the acquisition workforce to look for new ways to save money—including LPTA—even if, under normal circumstances, LPTA would not be the ideal source-selection method. While asking industry and our acquisition workforce to do more without more funding can temporarily produce good outcomes, it is not a sustainable approach in the long run unless it is coupled with technology-enabled productivity increases. Without real productivity gains, "do more without more" becomes magical thinking enabled by short-term needs borrowing against long-term investments. That is a recipe for hollowing out our long-term technology superiority.

For that reason, the tendency to overuse LPTA leads to very worrisome anecdotal examples. In my own experience, I have witnessed LPTA used to purchase personal protective equipment for soldiers and Marines headed for combat. I have heard stories of LPTA used to purchase pilot training services. National Defense Industrial Association members could likely fill the remainder of this allotted space just with examples of the inappropriate use of LPTA. Suffice it to say that if I or one of my loved ones is heading into harm's way, I want the very best, not the lowest-priced, body armor or flight training. I prefer a solicitation that gives due consideration to quality distinctions above the threshold of technical acceptability.

We rightly talk a great deal about competition among suppliers for government contracts, but we often fail to remember that the government also is in competition with other marketplaces for the very best suppliers. Like water seeking its own level, capital flows to those places where it can most efficiently deliver returns at an acceptable risk. For quite some time, the defense marketplace has offered reasonable returns with low risk. That has made our marketplace desirable for investment.

But times are changing, and not for the better. What once was a very stable and predictable market has been roiled by budget uncertainty, government shutdowns, topline reductions, and sequestration. At the same time, sourcing strategies that employ LPTA put increasing pressure on already limited returns. Coupling an unpredictable market with unattractive returns is no incentive for new capital and is a disincentive for existing capital. Becoming a less-desirable customer will inevitably mean losing good suppliers in exchange for bad ones.

LPTA actually conditions the market to favor less-desirable suppliers, since it reverses the standard incentive structure of product and service competitions. Under generalized Best Value and Tradeoff sourcing processes, industry has incentives to make the best product possible and offer it at its best price. But under LPTA, the incentive structure is for companies to reduce the price point no matter what, as long as they can remain above the threshold of technical acceptability. LPTA actually incentivizes contractors to worsen their product offerings, provided doing so will reduce price and remain above the technically acceptable threshold.

Along with a desire to make a profit, most contractors take great pride in their work—they entered defense contracting out of a sense of patriotism and desire to help warfighters. Many contractors are former warfighters or government employees. Under LPTA, they are in effect told, "Make this product as cheaply as you can and, if need be, as badly as you can as long as it meets minimum requirements. If you refuse, we will punish you by awarding the contract to someone else."

Contractors are caught on the horns of a dilemma. They want to provide a high-quality product or service that they themselves would be glad to use. At the same time, if they do not bleed out every last cost, they will never have the chance to provide anything at all. The message is simple: Bid a cheap product or service, or leave the government market.

Ironically, one effect of LPTA is of benefit to industry. Under the Federal Acquisition Regulation (FAR) Part 15, all negotiated source selections, including lowest-price source selections, could be made without using LPTA. With the exception of LPTA, the Best Value Continuum is highly flexible and allows contracting officers to review all bids, weigh their different characteristics, and use judgment to accept the best overall value—and that could include choosing the lowest-price bid.

Since LPTA circumscribes the judgment of a contracting officer in what would otherwise be a very flexible post-bidding source-selection environment, LPTA exists to provide an advance signal to industry about what the government will weight most heavily in bids. Providing that information to industry in advance, at the expense of ex post facto government flexibility, actually is the most welcome aspect of LPTA—worse than LPTA would be a stream of non-LPTA solicitations that still consistently chose the lowest-priced offerings without advance warning.

Therefore, industry eschews the reflexive preference for the lowest-priced bid without regard to other factors, not the LPTA tool itself. The United States enjoys its military advantage for three reasons: quality people, realistic and continuous training, and cutting-edge equipment. In the area of equipment, the United States for the last half-century has enjoyed a technological advantage that is all too quickly slipping away. Better Buying Power 3.0, with its emphasis on technology innovation, is a clear recognition of the need to reassert and maintain U.S. technological superiority, as are the Defense Innovation Initiative and the Offset Strategy. But telling companies to aim for a highly specific target of technical acceptability and an ever-diminishing price point directs their innovative energies toward price reductions alone without regard to quality.

In fact, LPTA incentivizes industry to be innovative about quality reductions, provided those reductions in quality also will reduce price. Is that really the kind of innovation we are looking for?

Driving toward the lowest possible price does not always make sense. For products, logic suggests that capability areas that are regularly subject to LPTA solicitations over time will see flat-lining or even reduced capabilities, as LPTA incentive structures punish companies when they independently attempt innovations in quality that may cost more to develop or produce. Therefore, if the DoD hopes to see independently developed, defense-unique current or future innovations in a product area, it needs to reward and not punish industry for making innovations, and that means avoiding the use of LPTA.

Any service that requires skill or experience is unlikely to fare well under the LPTA source selection method. Unrealistically low bids can reflect carelessness in bidding, an attempt to undercut the competition, or a misunderstanding of the solicitation. Whatever the reason, the winning bidder still will seek to make a profit on the work and therefore will look for any and all ways to cut costs. That is not a recipe for high-quality services.

If a company offers a high-value product or service at the lowest price, that source selection is a no-brainer. In circumstances where that is not the case, choosing the lowest-price option makes sense when the government wants industry to apply its innovative energies to price reduction at the expense of value creation. That outcome is most preferable in areas where there are no meaningful distinctions in value above the threshold of technical acceptability—which means, for the most part, commodities and commoditized services. So long as we establish a minimal quality threshold, the DoD does not need more innovation in its No. 2 pencils or lawn mowing.

In this regard, the current FAR guidance for LPTA misleads contracting officers. That is how the GAO can observe a significant increase in the prevalence of LPTA and yet conclude that LPTA is used in accordance with guidance. The guidance itself is too narrow and focused on individual transactions rather than on capability area outcomes over the course of multiple solicitations. To address the deficiency, the FAR should point out that LPTA is ideal for commodities and commoditized services and note that contracting officers should consider the possible and probable long-term impacts of an LPTA source selection on the capability area addressed by the solicitation.

While the technical acceptability standard is sufficient for a single purchase, the broader view of overall capability area goals deserves consideration before committing to the lowest-price option. Likewise, guidance should stipulate that complex services requiring highly technical knowledge and experience only rarely will be suitable for an LPTA source-selection method. This guidance gives pause but does not prohibit contracting officers from using LPTA in such circumstances.

Over time, customer behavior shapes the market. Following a decade of investment in warfighter technology, we have high-quality contractors making high-quality products. But the market will not provide something in exchange for nothing for very long. If we allow current trends to continue, what will we have after a decade of prevalent LPTA solicitations?

Industry and government agree that LPTA is a proper tool when used properly. To argue that point is to blow over a straw man. If the government contends that LPTA is used properly, policy makers should account for the recent and dramatic increase in its use. Otherwise they argue against a point that no one in industry is making.

LPTA is a highly limited tool. The trick for policy makers and contracting officers is to find a purpose for the tool as limited as the tool itself.

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advantage when our requirements dictate the need for a trade-off process, while directly improving our acquisition system efficiencies. The proper application of both the LPTA and the trade-off process can support that end game.

LPTA is a useful source-selection process when we have well-defined requirements, when the risk of unsuccessful contract performance is minimal, when we determine price should play a dominant role in the source selection and when we neither value nor are willing to pay for higher performance. Simply put, its use is most appropriate when best value is expected to result from the selection of the technically acceptable proposal with the lowest evaluated price. In some cases, LPTA makes sense—but it does not if we are willing to pay more for objective performance, resulting in a trade-off between cost or price and non-cost factors. If there is no value to the government in performance beyond well-defined thresholds, an LPTA approach is an appropriate tool for source selections.

We continue to concentrate on LPTA's appropriate use and on how we define and apply "technical acceptability." From my perspective, the key to effective LPTA use is first to determine our needs through robust market research, good acquisition planning and careful development of our requirements. Through this process, we need to be able to firmly define our requirements and the "technically acceptable" criteria within the request for proposals, know the vendor-base products and services available to meet our needs, and be assured no value or benefit will accrue from a proposal exceeding minimum technical and performance requirements. With firm requirements that are clearly understood by both parties, a thorough knowledge of the marketplace and the conviction that the readily available products and services will meet our stated needs, LPTA is the appropriate choice.

Our regulations, policies, guidance—specifically, the *DoD Source Selection Procedures*—and workforce training outline the appropriate use of LPTA in making a "best value" determination. Published in 2011, the *DoD Source Selection Procedures* has a dedicated appendix for LPTA, which currently is being updated. The Defense Acquisition University (DAU) offers five courses for both contracting and noncontracting acquisition personnel that discuss LPTA policy and implementation. Additionally, the military Services, the Defense Logistics Agency and other DoD agencies offer their own training on source selection that includes the appropriate application of LPTA. These efforts are enhancing the contracting workforce skills and contributing to decisions to use LPTA appropriately.

The July 14 Government Accountability Office (GAO) report, "Factors DoD Considers When Choosing Best Value Processes Are Consistent with Guidance for Selected Acquisitions," found our efforts were getting results. After numerous interviews, review of our acquisition training and case studies of randomly selected Fiscal Year 2013 competitive awards of more than $1 million each, GAO reported: "DoD's reasons for choosing LPTA or trade-off were generally consistent with guidance in the FAR [Federal Acquisition Regulation] and DoD's source selection procedures ... and its decision making regarding which source selection process to use did not appear ill-advised." They further reported that for contracts with higher obligations, the DoD used the LPTA process primarily to acquire commercial products, such as fuel, which is in line with our regulations.

For the requirements lending themselves to LPTA, we should not apologize for being concerned with price when several sources offer quality commercial and non-complex products and services that meet our stated requirements.

Given this background of our intended application of LPTA and our policies, guidance and training to support the proper use of LPTA, let us examine the industry concerns.

Industry contends that quality solutions and LPTA are mutually exclusive and we cannot buy quality goods and services. LPTA will result in only the "low cost, low quality" solution, stifling innovation and eroding our technological advantage. I believe industry concerns are more about promoting the importance of price under LPTA than our ability to attain quality goods and services for the right requirements and under the right circumstances. After all, as individuals we use virtually the same process every day to buy the products and services we need: We decide what we need, compare the price among

the various firms offering that specific solution and pick the low-cost product that meets our stated needs.

We also understand that industry, especially vendors that rely on offering technical performance and service-level enhancements at higher pricing for products and services readily available in the market, are concerned about the use of LPTA and the importance placed on price. Their value proposition and the ability to offer their technical or performance solutions depend on the DoD's use of the trade-off process. Therefore, we expect our industry partners to advocate against the use of LPTA when they believe the government would benefit from the higher performance levels they offer. Moreover, the emphasis on price, after meeting minimum technical requirements, drives industry to reduce costs in order to remain competitive for the classes of goods and services using LPTA, and this puts pressure on profit margins. Again, for the requirements lending themselves to LPTA, we should not apologize for being concerned with price when several sources offer quality commercial and non-complex products and services that meet our stated requirements.

Industry also is concerned that DoD selects LPTA, not when the requirements and situation clearly dictate, but for reasons of acquisition efficiency and convenience. When our acquisition team selects LPTA based on market research, careful requirements development, thorough knowledge of the vendor base and its products and services, and when DoD will receive no benefit from performance above the threshold or minimum technical needs, we are on solid ground. If our DoD team selects LPTA for convenience, expediency or because of schedule pressures, we do a disservice to both the warfighter that required a trade-off process to secure the higher performance and to the industry partner that had the innovation needed to maintain our technological edge. Leadership at all levels within our acquisition system must prevent use of LPTA under these circumstances.

We recognize that despite our best efforts, in some cases LPTA will be used inappropriately and will fail to deliver the desired results and outcomes. As discussed, the incorrect application of LPTA has adverse impacts for both parties and we have a common interest to see LPTA used correctly.

This is exactly why we should only use LPTA when our requirements are clear, our knowledge of the vendor base is thorough and the risk of unsuccessful performance is low. In these cases, LPTA and effective competition will deliver the low-cost solution that meets the technical and performance needs. When these conditions are not present, we need to use a trade-off process because we should be concerned about securing innovative solutions for the warfighter that would maintain our technological edge, support the industrial base to deliver these needs and provide industry a reasonable profit to support a lean, competitive and productive defense industry.

Under Better Buying Power 3.0's initiative to incentivize innovation in industry and government when the acquisition situation dictates a trade-off approach, we are driving our people to share clear "best value" definitions that outline the value, in monetary terms, for that higher performance. We want to provide access to draft technical requirements early so industry can plan for and offer innovative solutions. This will enable industry to propose higher levels of performance, within cost and affordability caps, because industry now is keenly aware of the value we place on performance above minimum or threshold requirements. In this case, our efforts are intended to deliver a "best value" selection that includes our need for innovative solutions that maintain our technological edge and at affordable and sustainable cost and requires a trade-off source-selection process.

In my opinion, the discussion on LPTA should not be about the mechanics of the process or whether LPTA inhibits innovation, results in a "low-cost, low-quality" solution or reduces corporate margins, but about the proper use of LPTA. If LPTA is used correctly, the DoD will acquire the specific class of commercial and non-complex products and services at the best available commercial price, and faster and more efficiently for the warfighter. Conversely, when our product and service requirements demand innovative solutions that we are willing to pay for, a trade-off process must be used. In those situations, we should share technical requirements in advance, communicate the monetary value of performance above the threshold or minimum performance standards so industry can understand the value proposition and can offer us a proposal to meet our needs with cost-effective, innovation solutions.

In the final analysis, both DoD and industry have a joint interest in the appropriate use of LPTA. For DoD, there is real value in using LPTA when the circumstances support a quick procurement of well-defined goods and services at the best pricing. This improves the efficiency of the acquisition process, thereby cutting costs and speeding solutions to the warfighter. Unjustified use, however, can prevent the warfighter from taking advantage of the higher performance level and innovation needed to maintain our technological edge and can deter industry from offering its most creative work in support of national security. The correct selection and application of the LPTA or trade-off source-selection process based on carefully developed requirements, thorough market research and solid acquisition planning will support our collective goal to ensure that the DoD provides effective incentives to industry promoting innovation and acquires what it needs without paying more than is necessary or required.

The author can be contacted at **scott.r.calisti.civ@mail.mil**.

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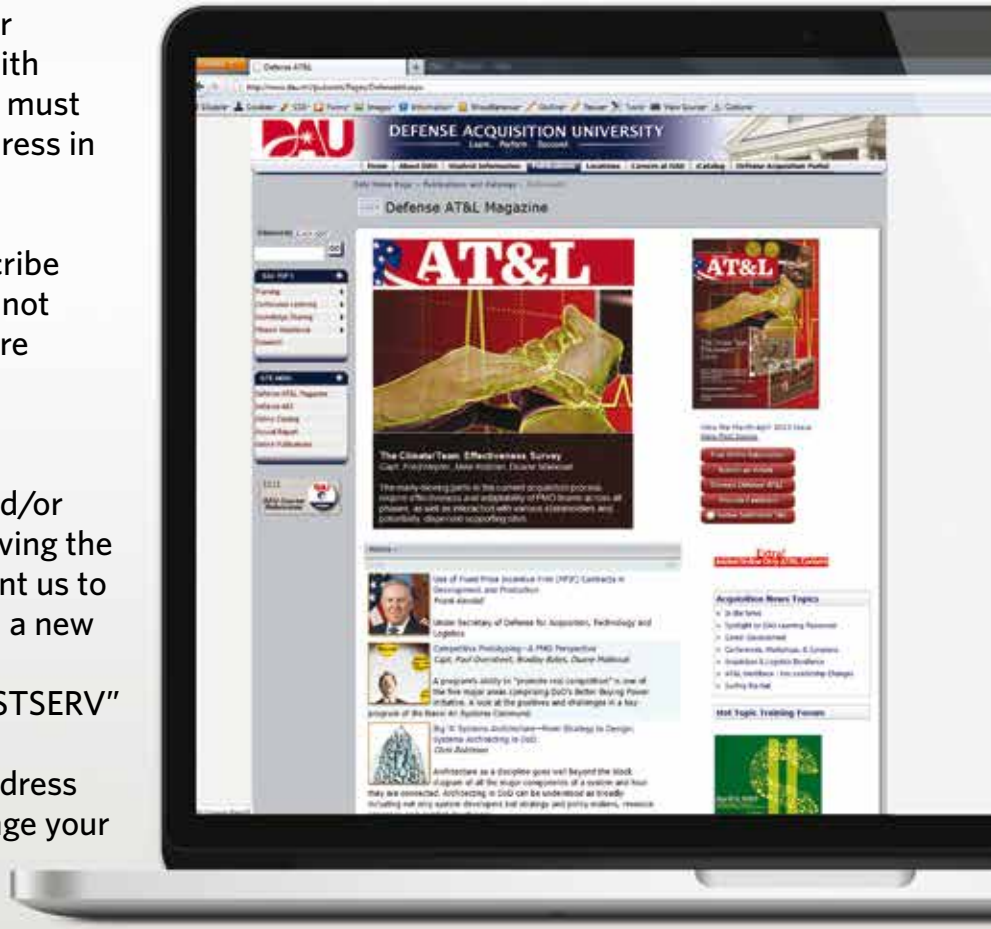

2014 Defense Acquisition WORKFORCE AWARDS

WORKFORCE ACHIEVEMENT AWARDS

The Defense Acquisition Workforce Individual Achievement Awards were established to recognize and motivate individuals who have demonstrated excellent performance in the acquisition of products and services for the Department of Defense (DoD). This program recognizes DoD military members and civilian personnel who represent the best in the acquisition workforce.

The primary judging criteria include one or more of the following:

- Specific achievements within the functional area/category during the period of July 1, 2013, to June 30, 2014.
- The value of the nominee's contributions during the award period to the mission of the organization and to outstanding development, acquisition, and/or sustainment of products and services for DoD.
- Leadership, by example and through mentoring, provided to others in the organization and toward achievement of organizational objectives.

WORKFORCE INDIVIDUAL ACHIEVEMENT AWARDS

Requirements Management
Ms. Diane Baker, U.S. Air Force
(Left to Right): Vice Admiral James A. Winnefeld, Jr., Ms. Diane Baker, Under Secretary of Defense for Acquisition, Technology, and Logistics the Hon. Frank Kendall, Jr.

Acquisition in an Expeditionary Environment
Mr. Matthew A. McLean, U.S. Air Force
(Left to Right): The Hon. Frank Kendall, Jr., Mr. Matthew McLean, the Hon. Richard Lombardi

Auditing
Mr. Robert F. LeJeune, Defense Contract Audit Agency
(Left to Right): The Hon. Frank Kendall, Jr., Mr. Robert LeJeune, Ms. Anita Bales

Business
Ms. Maryellen Lukac, U.S. Army
(Left to Right): The Hon. Frank Kendall, Jr., Ms. Maryellen Lukac, the Hon. Gabriel Camarillo, Mr. Peter Burke

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Contracting and Procurement
Ms. Patricia A. Watson, Washington Headquarters Services
(Left to Right):
The Hon. Frank Kendall, Jr.,
Ms. Patricia Watson,
Ms. Linda Allen,
Mr. William E. Brazis

Earned Value Management
Mr. David Kester, Defense Contract Management Agency
(Left to Right):
The Hon. Frank Kendall, Jr.,
Mr. David Kester, Mr. Joe Sweeney

Engineering
Mr. Daniel Dittenber, U.S. Army
(Left to Right):
The Hon. Frank Kendall, Jr.,
Mr. Daniel Dittenber,
the Hon. Gabriel Camarillo,
Col. Courtney P. Cote

Facilities Engineering
Mr. Leland "Allen" Fincham, U.S. Army
(Left to Right):
The Hon. Frank Kendall, Jr.,
Mr. Leland "Allen" Fincham, the Hon. Gabriel Camarillo,
Col. Lee G. Hudson

Life Cycle Logistics
Mr. Kevin M. Cormier, U.S. Navy
(Left to Right): The Hon. James E. Thomsen, the Hon. Frank Kendall, Jr., Mr. Kevin Cormier, Rear Adm. Thomas J. Moore, Mr. Mike Cornwell

Production, Quality, and Manufacturing
Mr. John P. Graham, Defense Contract Management Agency
(Left to Right): The Hon. Frank Kendall, Jr., Mr. John Graham, Lt. Col. Robert Rugg, Mr. Joe Sweeney

Information Technology,
Mr. Edward Lane, National Reconnaissance Office
(Left to Right) The Hon. Frank Kendall, Jr., Mr. Edward Lane, Mr. Kevin West

Program Management
Ms. Thu Van Hendrey, U.S. Navy
(Left to Right): The Hon. Frank Kendall, Jr., Ms. Thu Van Hendrey, Mr. Bill Bray, the Hon. James E. Thomsen

Photos by Leroy Council Jr., Department of Defense.

Science and Technology Manager
Major Christopher C. Schlagheck, U.S. Air Force
(Left to Right): The Hon. Frank Kendall, Jr., Maj. Christopher Schlagheck, the Hon. Richard Lombardi

Services Acquisition
Mr. Steven R. Lahr, U.S. Air Force
(Left to Right): The Hon. Frank Kendall, Jr., Mr. Steven Lahr, Mr. Randall Culpeper, the Hon. Richard Lombardi

Small Business
Ms. Crystal Ober, Defense Logistics Agency
(Left to Right): The Hon. Frank Kendall, Jr., Ms. Crystal Ober, Mr. John Henley, Mr. Matthew Beebe

Test & Evaluation
Mr. Steven D. Schroeder, U.S. Navy
(Left to Right): The Hon. Frank Kendall, Jr., Mr. Steven D. Schroeder, Ms. Amber Huffman, Mr. Frederick Stefany, the Hon. James Thomsen

2014 Defense Acquisition WORKFORCE AWARDS

WORKFORCE DEVELOPMENT AWARDS

The Defense Acquisition Workforce Development Awards were established to recognize those organizations that are achieving excellence in developing their employees as acquisition professionals, leaders, and our future acquisition workforce. Additionally, the award serves our community by identifying best practices for other organizations to adopt.

The 2014 Defense Acquisition Workforce Development Awards Program focused on three major contribution areas: (1) Talent Management; (2) Knowledge Transfer, Partnering, and Sharing of Workforce Best Practices; and (3) Workforce Development and Recognition Initiatives.

WORKFORCE DEVELOPMENT AWARDS

Gold Award, Large Category: U.S. Navy—Naval Undersea Warfare Center Division, Newport, Rhode Island
(Left to Right):
The Hon. James Thomsen, the Hon. Frank Kendall, Jr., Ms. Vicki Comeau, Capt. Howard Goldman, Mr. Donald McCormick

Gold Award, Small Category: U.S. Navy—Space and Naval Warfare Systems Command—Business Financial Management Competency (SPAWAR)
(Left to Right):
The Hon. Frank Kendall, Jr., Ms. Patricia Ashenfelter, the Hon. James Thomsen

Silver Award, Large Category: U.S. Air Force—448th Supply Chain Management Wing/431st Supply Chain Management Squadron, Tinker Air Force Base, Oklahoma
(Left to Right):
The Hon. Frank Kendall, Jr., Mr. John Sirmon, Ms. Elizabeth Windsor, the Hon. Richard Lombardi

Photos by Leroy Council Jr., Department of Defense.

Silver Award, Small Category: USSOCOM—Special Operations Research, Development, and Acquisition Center, United States Special Operations Command (SOCOM-SORDAC)
(Left to Right):
The Hon. Frank Kendall, Jr.,
Mr. James F. Geurts,
Mr. James H. Smith,
Lt. Gen. Thomas J. Trask

Bronze Award, Large Category: Army Contracting Command—Rock Island, Illinois
(Left to Right):
The Hon. Frank Kendall, Jr.,
Ms. Melanie Johnson,
Ms. Michelle Breitbach,
Ms. Amy Hayden,
the Hon. Gabriel Camarillo

Bronze Award, Small Category: U.S. Air Force—Acquisition Excellence & Program Execution Directorate (AFLCMC/AQ-AZ), Wright-Patterson Air Force Base, Ohio
(Left to Right):
The Hon. Frank Kendall, Jr.,
Ms. Jill Willingham-Allen,
Mr. Donald Hofele,
Mrs. Patsy Reeves,
the Hon. Richard Lombardi

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Communities of Interest

Collaborating on Technology Challenges

Alan Shaffer

The technological superiority that we and our partners and allies have enjoyed for the past 50 years can no longer be assured, and recognition of this requires a new approach to research and engineering. We must open our science and technology aperture and employ much greater collaboration in making our technology investment decisions. Simply, the Department of Defense (DoD) Research and Engineering (R&E) Enterprise (Table 1) must deliver a more coordinated and coherent R&E program, across all components—reaching beyond the DoD to include our National Laboratories, colleges and universities, our national industrial base and our global partners and allies. Data may move at the speed of light, but decisions move at the speed of trust. Guiding DoD's approach are three foundational documents designed to build the trust to enhance the speed and quality of our decisions, development and deployment, provide strategic direction to the DoD R&E Enterprise and outline the framework for achieving our objectives.

The DoD R&E Enterprise Strategic Guidance outlines "Three Enduring Principles" for the purpose and conduct of DoD R&E efforts: (1) to mitigate or eliminate existing and emerging technology-based threats to national security; (2) to affordably enable new or extended military capabilities; and (3) to create technology surprise through science and engineering. Our goal is to ensure that our R&E efforts align to these principles.

Shaffer *is the Principal Deputy Assistant Secretary of Defense for Research and Engineering (OASD[R&E]).*

"We want to tell industry more clearly what has value to us so they'll be able to bid more intelligently, so they'll be able to make their own technology investment decisions more intelligently."

—Frank Kendall, Under Secretary of Defense for Acquisition, Technology, and Logistics, *Defense News,* Sept. 22, 2014.

Table 1. DoD Research and Engineering Enterprise

- Military Departments
- Service Laboratories
- DoD Laboratories and Product Centers
- Defense Agencies:
- Defense Advanced Research Projects Agency
- Defense Threat Reduction Agency
- Missile Defense Agency (MDA)
- Other Federal Government Laboratories
- Federally Funded Research and Development Centers (FFRDCs)
- University Affiliated Research Centers
- United States and allied universities
- Allied and partner government laboratories
- Industrial Base
-

The DoD R&E International Science and Technology (S&T) Engagement Strategy was a collaboration between the Offices of the Under Secretary of Defense for Acquisition, Technology, and Logistics Office of International Cooperation and the Assistant Secretary of Defense for Research and Evaluation (ASD[R&E]). With this as our guide for achieving global interoperability, we will strengthen and expand existing relationships and initiate new relationships with our international partners, allies and friends. Real collaboration, including real-time information and data exchanges between the members of our R&E Enterprise, will allow us to better leverage emerging global opportunities, accelerate the pace of change, create technological surprise and mitigate the global threats to our capabilities—and to those of our allies and partners.

The Reliance 21-Operating Principles constitute a portfolio management approach that provides the framework for executing both the DoD R&E and International Engagement Strategies. The outcome of this approach will impact the development of the DoD-wide Research, Development, Test and Evaluation (RDT&E) budget and allows us to deliver an integrated, cohesive voice across the R&E Enterprise enabling:

- Information sharing
- Alignment of effort against capability gaps
- Coordination of priorities and investments
- Exploitation of synergies and development of new opportunities
- Support for scientists and engineers across the DoD R&E Enterprise

Done correctly, Reliance 21 will provide more focused output for every RDT&E dollar.

Communities of Interest

Under Reliance 21, the Science and Technology Executive Committee (S&T ExCom) has divided the DoD R&E Portfolio into 17 Communities of Interest (COIs) that reach across all components (Table 2). These technical communities are reviewing and assessing the alignment of current and planned R&E programs, identifying gaps, and helping to prioritize R&E funding efforts to meet the technical challenges of the DoD in their respective focus area, or portfolio (Figure 1). Each COI represents specific cross-domain technology areas where there is substantial investment across multiple components. The COIs do not replace service-specific technology areas—those will continue to be worked by the Services. Each COI has a rotating Steering Group Lead assigned (at the Senior Executive Service/GS-15 level) and supporting subject-matter experts (SMEs) participating from each of the military Services and component agencies. Each COI draws representation from across the echelons of DoD people working in a technology area.

The COIs are collecting, coordinating and aligning the technical capabilities, requirements, gaps, opportunities and priorities for their respective technology areas or portfolios. This information forms the basis for a detailed COI Technology Roadmap. The Technology Roadmaps include a desired end state, described in terms of technology-based military capabilities. The roadmaps then will incorporate all existing and planned investments in that focus area being funded by any or all of the Services, Office of the Secretary of Defense (OSD), agencies or laboratories. The Technology Roadmaps are presented to the DoD S&T ExCom during COI Portfolio Reviews, which are used to build the DoD Program Objective Memorandum (POM) and Budget Estimate Submission (BES).

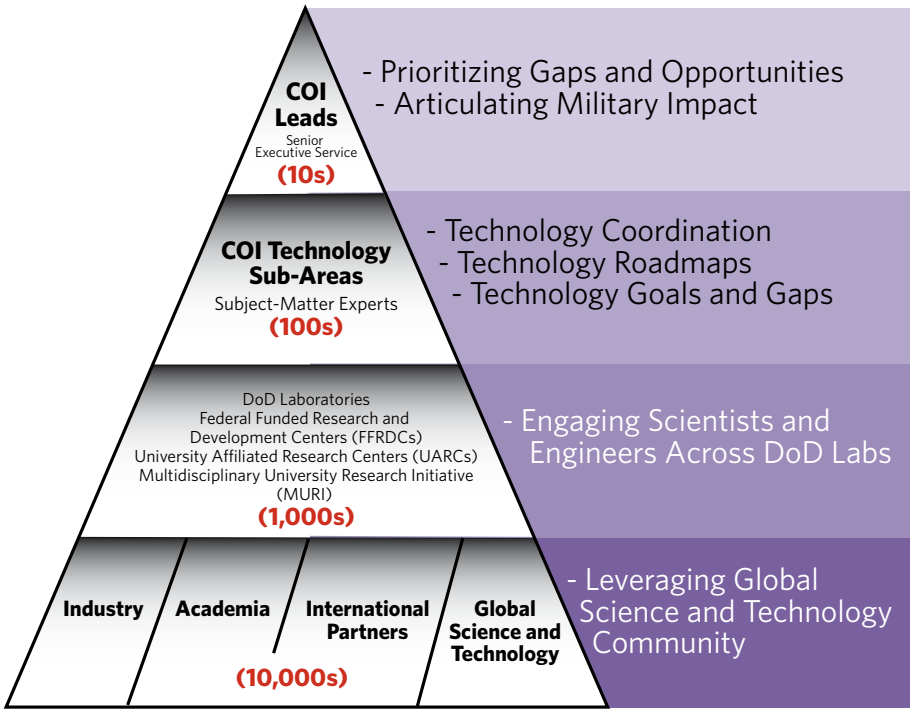
Table 2. Communities of Interest

Advanced Electronics	Energy & Power Technologies
Air Platforms	Engineered Resilient Systems
Autonomy	Ground and Sea Platforms
BioMedical (Armed Services Research Evaluation and Management [ASBREM])	Human Systems
Command, Control, Communications, Computers and Intelligence	Materials and Manufacturing Processes
Counter Improvised Explosive Devices	Sensors and Processing
Counter Weapons of Mass Destruction	Space
Cyber	Weapons Technologies
Electronic Warfare / Electronic Protect	

The COI Technology Roadmaps are valuable tools that help leadership identify and understand areas of over- (or under-) investment, unproductive duplication and any technology gaps that need to be addressed.

Additionally, the COI Technology Roadmaps will highlight research efforts by industry, universities, allies or partner nations—whether or not funded by the DoD—to identify new technologies that could mitigate or eliminate existing and emerging threats, affordably enable new or extended capabilities or create technology surprise to give DoD a disruptive advantage.

Figure 1. Communities of Interest Roles



Once completed with all existing and planned programs, and annotated with related projects drawn from the other R&E efforts such as Independent Research and Development (IR&D), Multidisciplinary University Research Initiatives (MURIs), Laboratories (Unified Research and Engineering Database), Small Business Innovation Research (SBIRs) and Rapid Innovation Fund (RIF), the Roadmaps will identify:

- Opportunities to either combine, limit or discontinue R&E efforts that demonstrate unnecessary, or unintentional, duplication of efforts or funding.
- Technology gaps or challenges still facing the DoD that are not being adequately addressed and the potential military impact of not addressing these gaps.
- Investments that are not on the critical or disruptive path.

We expect COIs to use any of these opportunities in their areas of interest to improve delivery of capability against strategic goals. The Technology Roadmaps will allow the breadth of the R&E Enterprise, and not just to leadership, to identify promising investments—constrained by limited resources and any R&E programmatic or funding inefficiencies, technical gaps or challenges—and their relative priorities. The strength of the COI Roadmaps will go a long way toward aligning R&E efforts and funding with risk and urgency to address technology gaps.

The Technology Roadmaps are updated every two years, and serve as the foundation for the annual COI Portfolio Reviews, which include the following:

- **Portfolio Overview**: Topics, scope and approximate investment by subtopics
- **Major Goals**: Technical challenges, opportunities and desired outcomes—aligned with operational capabilities and needs
- **Investment Plans**: All current and planned programs/projects, transition opportunities, key performers, critical capabilities and gaps prioritized
- **Portfolio Health Assessment**: Strengths, weaknesses, risks and mitigation strategies

The COI Portfolio Reviews serve to inform DoD R&E/S&T leadership and will assist in the development of the DoD RDT&E POM, BES and the Program and Budget Review (PBR).

The DoD R&E/S&T Leadership is drawn from across the DoD R&E Enterprise. The COIs are led and guided by two groups with DoD R&E budgetary responsibilities:

The R&E Executive Committee (R&E ExCom), the most senior-level group, is comprised of the ASD(R&E), Service Acquisition Executives (SAEs) and the Deputy Director of the Defense Advanced Research Projects Agency (DARPA). This group convenes as required to address cross-service issues that cannot be resolved by the DoD Science and Technology Executive Committee (S&T ExCom).

The DoD S&T ExCom has membership from OSD, the military departments and other DoD agencies (Table 3). This group meets monthly and as required. The S&T ExCom has responsibility for the coordination and management of DoD R&E/S&T funding efforts. The S&T ExCom is assisted by the S&T deputies, who meet weekly. The S&T ExCom also meets annually in a two-day event to review the Roadmaps of multiple COIs. The Chairman's Risk Assessment, Joint Staff risks and requirements, and Service Initiatives and Priorities are also

The COIs are collecting, coordinating and aligning the technical capabilities, requirements, gaps, opportunities and priorities for their respective technology areas or portfolios. This information forms the basis for a detailed COI Technology Roadmap. The Technology Roadmaps are presented to the DoD S&T ExCom during COI Portfolio Reviews, which are used to build the DoD Program Objective Memorandum and Budget Estimate Submission.

presented. The COIs have a direct impact on future DoD R&E funding decisions through their Technology Roadmaps and Portfolio Review by helping the S&T ExCom identify areas of investment and new technology efforts able to address the needs of the DoD.

Resources for the COIs

The COIs can draw from many new resources to inform and populate their respective Technology Roadmaps. The ASD(R&E) hosts a COI Collaboration workspace on TechSpace, (www.dtic.mil/dtic/) accessible to all DoD government and military personnel, and to support contractors (with the approval of their government sponsors). TechSpace is home to the ASD(R&E) COI Wiki, which contains a collaboration workspace for each of the COIs with copies of their presentations, unclassified versions of their Technology Roadmaps, Weekly Status Reports and other important documents. The COI Wiki also has links to the International Agreements Database, and the *S&T News Bulletin*. The Wiki is available at www.dodtechipedia.mil/dodc/x/1gO0.

There is a communications resource (www.DefenseInnovationMarketplace.mil) containing DoD and Service investment strategies and priorities, documents and events intended to provide the DoD R&E Enterprise with information regarding technical challenges facing the DoD. All the DoD R&E Strategic Guidance documents are available on the Marketplace. The Marketplace also houses the Independent Research and Development (IR&D) Secure Portal, into which industry/academia submit project summaries of their IR&D efforts. Because the summaries contain company proprietary data, access to them is restricted to registered and approved DoD government civilians and military personnel with R&E, S&T or acquisition responsibilities. Members of the COI can request access and use this information for roadmap development activities.

To date, more than 18,000 IR&D Project Summaries have been submitted to the portal, and each is aligned to the most relevant COI and Sub-Area. All summaries include company and technical points of contact (POCs) enabling an interested DoD user to reach out and discuss the effort with the IR&D participant to determine if the effort might address a particular technical challenge of the COI. This resource helps COI members review and assess the type and maturity of industry and academia IR&D efforts in their challenge areas, bringing them to the attention of those working to address those challenges.

Above; Screen shot of the online Defense Innovation Marketplace. Left: Communities of Interest page at Techspace.

Table 3. Science and Technology Executive Committee Membership, OSD

- ASD(R&E)
- Deputy Assistant Secretary of Defense (DASD) Research
- DASD Emerging Capabilities & Prototyping
- DASD Force Health Protection and Readiness
- DASD Manufacturing and Industrial Base Policy
- DASD Chemical and Biological Defense
- Director International Cooperation

Military Departments

- Deputy Assistant Secretary of the Air Force for Science, Technology and Engineering
- Deputy Assistant Secretary of the Army for Research and Technology
- Chief of Naval Research
- Joint Chiefs of Staff, Deputy Director for Resources and Acquisition

Agencies

- Deputy Director, Defense Advanced Research Projects Agency
- Program Executive for Advanced Technology, Missile Defense Agency
- Joint Improvised Explosive Device Defeat Organization, Deputy Director for Rapid Capability Delivery
- Defense Threat Reduction Agency, Associate Director for R&D

Also, COIs can host Virtual Technology Interchanges to align DoD, industry and global partners and allies on very specific, high-priority or game-changing technology challenges. Technology needs and background details are posted on the Defense Innovation Marketplace, and organizations submit their potential solutions into the IR&D Secure Portal. Once reviewed by the COI SMEs, organizations then are invited to provide more detailed briefings on select efforts to the government host's (COI) representatives. Previous Virtual Technology Interchanges have resulted in new relationships, partnerships and Cooperative Research and Development Agreements (CRADAs) between IR&D participants and the DoD hosts.

Reliance 21 and the DoD Communities of Interest

Collaboration between and among the members of Global R&E Enterprise, through the COIs, helps the DoD more effectively identify and react to emerging opportunities. Information—formed through collaboration, collected by the COIs, embedded into the Technology Roadmaps, and shared among the R&E Enterprise—provides the insight needed to inform for the R&D investment decisions that will guide the scientists, engineers, researchers and acquisition professionals working across the Enterprise to meet the current and future technical needs of the DoD, its allies and partners.

Join us in meeting these challenges. Visit DoD Techspace and the DefenseInnovationMarketplace.mil to look for opportunities to learn more, share information and get engaged.

The author can be contacted at **osd.pentagon.ousd-atl.mbx.asd-r-e@mail.mil**.

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

- BBP Gateway (**https://dap.dau.mil/bbp**) is your source for the latest information, guidance, and directives on better buying power in defense acquisition
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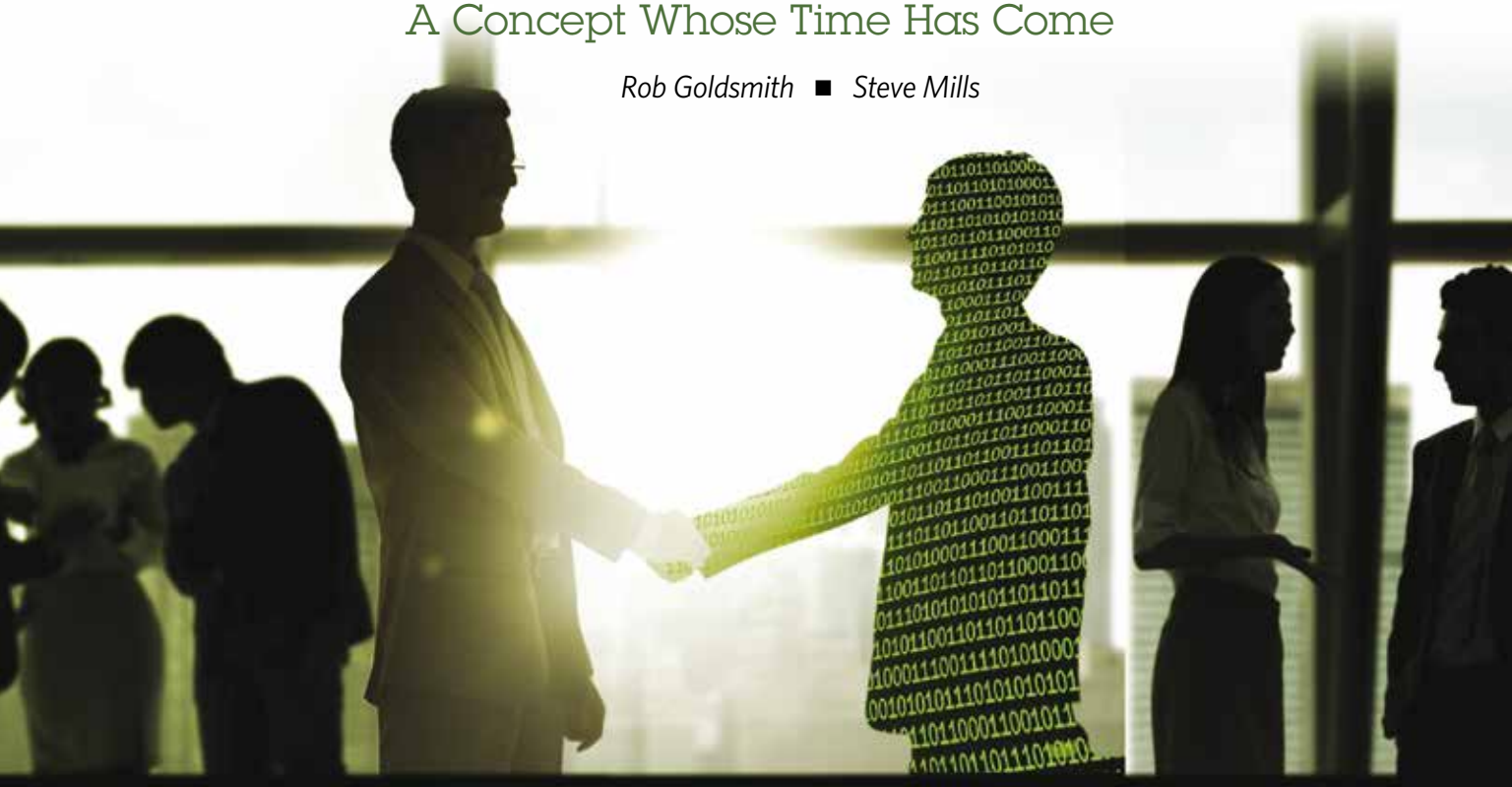
Cyber Integrator

A Concept Whose Time Has Come

Rob Goldsmith ■ *Steve Mills*



Effective cybersecurity in Department of Defense (DoD) acquisition programs is a top concern for both DoD program managers (PMs) and the DoD as a whole. What can be done to help DoD PMs meet this challenge? An emerging concept is the establishment of a "Cyber Integrator" (CI) at the Program Executive Office (PEO)/Major Defense Acquisition Program (MDAP) level, to help address cybersecurity risk in DoD acquisition programs. The purpose of the CI is to lead the cybersecurity efforts within the PEO/MDAP, and that role includes effectively integrating cybersecurity across all functional domains and acting as principal advisor to the PM on all cybersecurity matters. A CI by itself will not mitigate all the cybersecurity challenges faced by DoD PMs, but based on the emerging results of an ongoing Aviation and Missile Research, Development, and Engineering Center (AMRDEC) pilot program, the CI concept appears to be a step in the right direction.

Making a Case for the Cyber Integrator

To appreciate the potential value of the CI concept, consider a comparison between the impact of sustainment on the DoD acquisition life cycle and that of cybersecurity. Such a comparison brings to light common themes that strongly suggest lessons learned about sustainment in the acquisition life cycle are applicable to cybersecurity.

Goldsmith *is a systems engineer and currently the Aviation and Missile Research, Development and Engineering Center Cybersecurity Lead at Redstone Arsenal, Alabama.* **Mills** *is a former program manager from Northrop Grumman Inc. He currently is a professor of program management and information technology at the Defense Acquisition University.*

Sustainment has always been an important component of the DoD acquisition life cycle, but all too often has not been recognized as such. Diminishing sustainment to an afterthought in the engineering process can have significant negative impacts on the viability, performance and overall success of our DoD weapon systems. Sustainment now is a recognized activity spanning the entire life cycle. The concept of sustainment as a design consideration is validated when reviewing the DoD Integrated Product Support Elements. The elements of Design Interface and Sustainment Engineering support this assertion. Sustainment in acquisition programs is proactive. The clear goal for sustainment is to "Bake in sustainment, don't bolt it on." Is cybersecurity any different? Shouldn't our goal for cybersecurity be the same? Should cybersecurity be treated as a design consideration? Should cybersecurity be considered "upfront and early" rather than later in the acquisition life cycle?

Such a comparison brings to light common themes that strongly suggest lessons learned about sustainment in the acquisition life cycle are applicable to cybersecurity.

Sustainment is recognized as a critical component of DoD acquisition programs. With that distinction come requirements to develop a plan, measure its overall effectiveness and have accountability to ensure its overall success. Sustainment for DoD acquisition programs is defined in a statutory Life Cycle Sustainment Plan (LCSP). The LCSP describes the resources and approach for achieving effective sustainment of the program throughout the entire life cycle of the program. The LCSP is a key component of the Acquisition Strategy. The Cybersecurity Strategy provides a similar opportunity to tell the cybersecurity "story" for an acquisition program. How effective is the newly mandated Cybersecurity Strategy in addressing cybersecurity risks in DoD acquisition programs?

Effective management and leadership of the sustainment effort on DoD programs is performed by the Product Support Manager (PSM). The PSM is a statutorily designated position for DoD acquisition programs. The PSM primarily focuses on development and execution of the LCSP. The PSM is the primary advisor to the PM on all sustainment issues. This critical position within the Program Management Office (PMO) provides the PM with a "sustainment champion" who can mitigate sustainment risk to the program across the life cycle. Is the impact and scope of cybersecurity on DoD acquisition programs significant enough to warrant a Cybersecurity champion within the PEO/PMO? If not, how can cybersecurity risks best be mitigated?

The AMRDEC CI Pilot program provides some insight into the overall effectiveness of incorporating a CI into an MDAP. This effort will continue, but initial results are enlightening!

Cyber Integrator Lessons Learned

After a yearlong pilot of the CI concept in an Acquisition Category (ACAT) ID Army Acquisition Program, the AMRDEC has learned a lot of valuable lessons. The CI concept, highlighted in an article by the authors in the September–October 2014 issue of *Defense AT&L* magazine, is an innovative approach that can assist PMs in making better investment decisions about cybersecurity. The Cyber Dashboard is a program management tool that uses program specific cybersecurity metrics to assess the effectiveness of cybersecurity across the acquisition program and life cycle. The Cyber Dashboard provides the PM with a holistic view of cybersecurity risks. The following are some key takeaways for anyone who may consider implementing the CI concept in an organization.

"I would never have given you that resumé." These were the words of the hiring manager after I recommended the individual who now successfully performs the role of CI in the AMRDEC pilot. The hiring manager was perplexed about which attributes he had missed in his screening criteria. So what makes a good CI? Hiring the CI is the single most important decision you will make when employing this concept. The natural tendency will be to look for someone with a traditional Information Technology (IT), Cybersecurity or Information Assurance (IA) background. While a strong background in IA, IT, Blue or Red Team, Systems Engineering (SE) or Cyber Test and Evaluation (T&E) is attractive, I would consider those as desirable but not required qualifications. The two primary required qualifications I looked for were:

- A proven leader able to understand technical concepts and integrate diverse teams working complex projects
- A person having the ability to communicate effectively with technical people and senior leaders through both the spoken word and development of presentation material

The required attributes of an effective integrator and communicator far surpass the advantages that a specialist brings. In fact, specialists are at a disadvantage because they almost always tend to spend undue time and attention on their area

of expertise at the expense of the other important elements of cybersecurity within the office.

"Where the CI sits matters." To be effective in a PMO, the CI must be empowered. CI empowerment. This is achieved through both verbal/written direction by senior leadership to the entire team, as well as organizationally placing the CI under either the chief engineer in the PMO or the deputy PM (DPM). Placing the CI under the lead Systems Engineer or the Systems Engineering, Integration, and Test (SEIT) lead will not send the same message to the team as putting the CI in a position with ready access to program senior leadership. Empowerment is necessary for the CI to gain access to the information needed to develop the program's Cyber Dashboard. The PM must ensure that the CI is invited to key meetings and that he or she is not viewed as outside the PMO "family." Gaining that acceptance will depend in part on the CI's relationship-building skills—but, to succeed, the CI must also have the backing and endorsement of the PM.

"Why are you here? We handle cybersecurity!" Your IA staff is not "baking in" cybersecurity for your acquisition program. The staff is only handling a portion of your cybersecurity. It is a big mistake to believe that the DoD certification and accreditation (C&A) process and cybersecurity are synonymous. IA is an important component of the overall cybersecurity effort, but cybersecurity has many other facets not adequately addressed through C&A alone. These other facets include:

- Software assurance
- Supply chain security
- Vulnerability assessments/Blue Team testing
- Others

This misconception is illustrated by the success rate of the Red Teams during Operational Test and Evaluation (OT&E) against systems that have achieved Authorities to Operate (ATOs) through the C&A process. If you want to fail at OT&E, trust all of your cybersecurity to your IA team. The recent rebranding of IA as cybersecurity in DoD policy can prove misleading to members of the acquisition community, including the PM. Currently AMRDEC has more than 30 full-time IA personnel supporting PMOs and is one of the 11 accredited Army Agents of the Certification Authority (ACAs). AMRDEC clearly understands the importance of IA as a part of cybersecurity, but AMRDEC also understands its limitations.

"Up Front, Early and Continuous." This phrase applies in two ways. First, it is best to get your CI on board as early as possible in the life cycle. The CI can make sure critical contract language is put in place, architectural decisions are made with all facets of cybersecurity in mind and can help steer limited resources to the right places at the right time in the program. The phrase "upfront and early" also applies to educating members of the PMO early. As soon as possible once the CI is on board, the PM, DPM or chief engineer should assemble subordinate leaders, engineers and staff to introduce the CI and explain why the CI has been brought onboard. The team needs to walk away understanding what cybersecurity is, how it differs from IA, who the CI is and what the CI will be doing for the PM. These actions will establish the CI as truly empowered and as a crucial member of the PMO team.

The team needs to walk away understanding what cybersecurity is, how it differs from IA, who is the CI and what the CI will be doing for the PM. These actions will establish the CI as truly empowered and a crucial member of the PMO team.

PMO employees need to know the CI is not an "extra hand" for the IA team, to be saddled with milestone documentation or C&A work. The CI's input is necessary for such tasks, but the CI must avoid the trap of going too deeply into one aspect of cybersecurity and not fulfilling the CI's mission to the PM of capturing the big picture. The CI must be able to work effectively with the team to gather the details from the experts and provide an integrated risk perspective to the PM.

The purpose of this article was to describe an emerging concept of integrating a new role into the DoD acquisition process—the CI. When implemented, the CI provides the PM a cybersecurity champion who can develop and implement an effective cybersecurity solution across the acquisition life cycle of a program or programs. This role may be best suited for only larger programs or implementation at the PEO level with one CI supporting multiple programs. The key point of this article is to present the CI concept, provide insights to date on the AMRDEC CI Pilot effort and to generate discussion on the CI concept. A key question to address is, "What is the risk of not implementing the CI Concept for select PEOs and large acquisition programs?" Please submit your questions and comments to the authors of this article. We welcome them!

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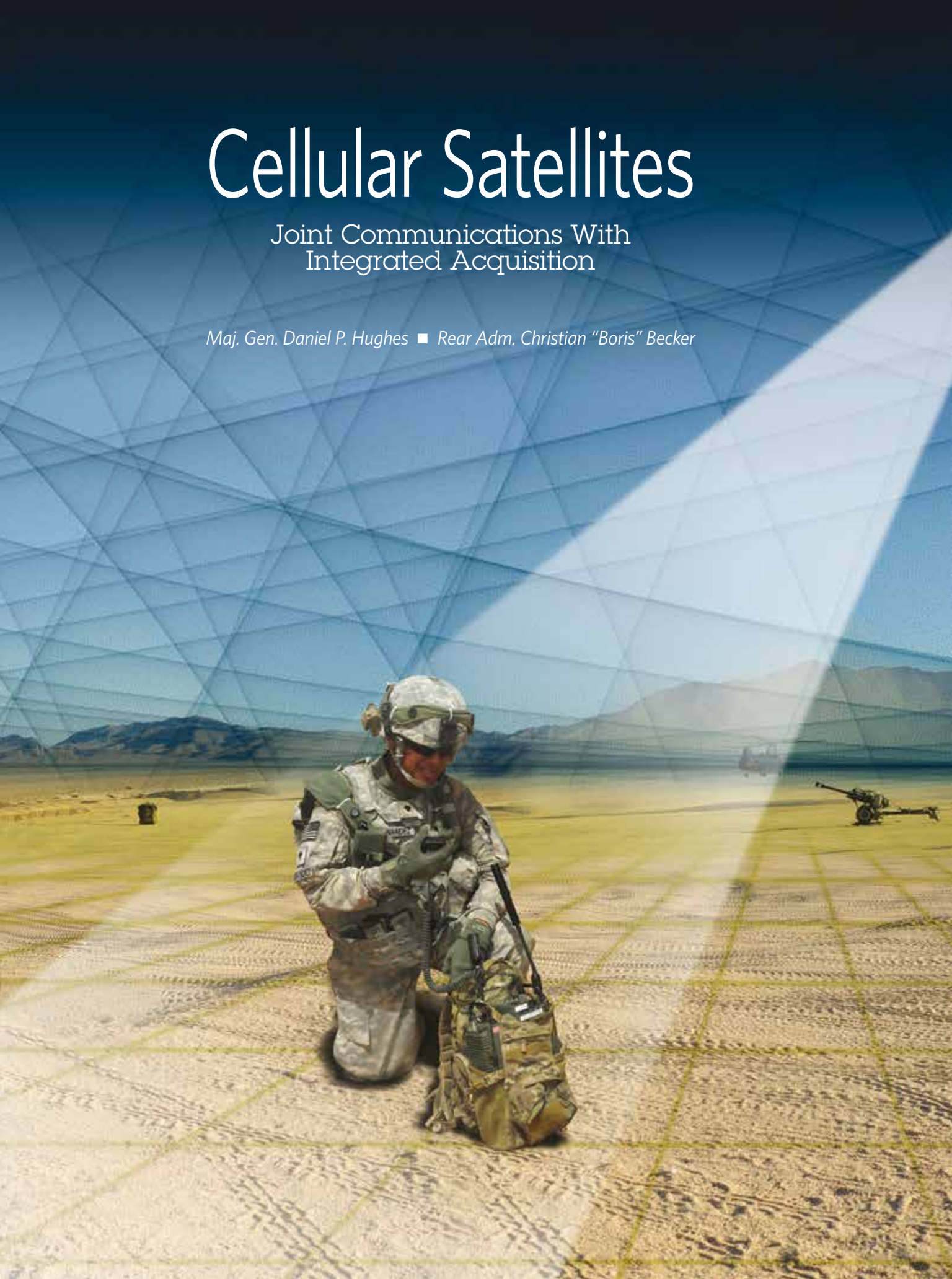
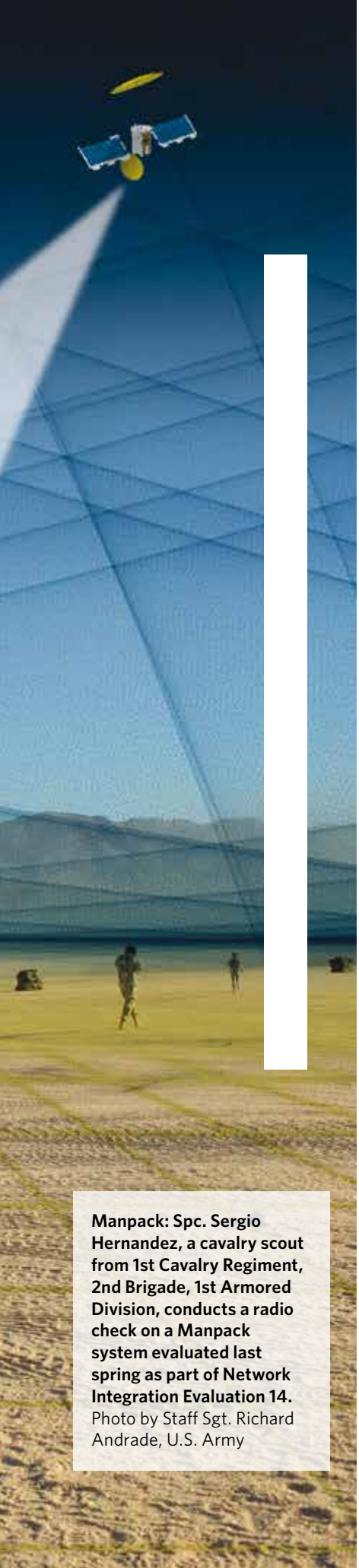
Cellular Satellites

Joint Communications With Integrated Acquisition

Maj. Gen. Daniel P. Hughes ■ Rear Adm. Christian "Boris" Becker





Manpack: Spc. Sergio Hernandez, a cavalry scout from 1st Cavalry Regiment, 2nd Brigade, 1st Armored Division, conducts a radio check on a Manpack system evaluated last spring as part of Network Integration Evaluation 14. Photo by Staff Sgt. Richard Andrade, U.S. Army

It's a familiar image: a Soldier crouching with a radio, next to a spidery antenna pointing skyward to reach a distant satellite. But that view of military communications is on the verge of change—being replaced by troops rapidly exchanging data while moving seamlessly around the battlespace.

This progress is possible due to the Mobile User Objective System (MUOS), the next-generation narrowband military satellite communication system that will support worldwide, multi-Service users in the Ultra-High Frequency (UHF) band. MUOS will use Earth-orbiting satellites as the equivalent of cellphone towers in space, providing smartphone-like service that keeps users connected while on the move and in challenging urban, jungle or mountainous terrain. As the current UHF satellite constellation reaches the end of its life, MUOS will replace it with a communications capacity that is more than 10 times greater.

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Through this improved connectivity, MUOS will provide military radios with a secure version of what users would expect from commercial cellular service: mission voice, data and video on demand. It will connect warfighters on ships; in submarines, aircraft and vehicles; and while dismounted and on the move—providing the vital link between troops in advanced positions or remote areas and the rest of the Department of Defense (DoD) military global network. Using MUOS will allow troops to stay in communications beyond line of sight, whether they are on the other side of a mountain or the other side of the world, thereby enabling a more agile and expeditionary force.

This exponential increase in capability also brings a significant value proposition. MUOS supports all Service branches and interfaces with Defense Information Systems Network (DISN) capabilities, reducing duplication and providing improved joint communications across the tactical and strategic environments. MUOS will function on numerous new or modified radios that industry is developing, supporting a competitive radio marketplace that will drive innovation and lower costs.

More than just satellites, MUOS is a complex DoD orchestra comprised of a five-satellite constellation, four ground stations across the globe, an integrated waveform, the radios, and a complex software to manage the network. It also requires that all these individual segments of the system work together seamlessly and reliably, which requires close coordination and teamwork across the programs delivering these capabilities. The acquisition warfighters of the Army Program Executive Office (PEO) for Command, Control and Communications-Tactical and of the Navy PEO Space Systems have come together to meet this challenge and are on track to achieve MUOS Full Operational Capability in 2017.

Capability Progress

MUOS satellites carry two distinct payloads. The legacy UHF payload provides the capability of the UHF Follow-On satellite constellation, while a new UHF MUOS waveform payload will significantly increase availability and throughput to the user. The dual-payload design supports a gradual transition to MUOS capability, allowing backward compatibility with legacy UHF terminals while providing a next-generation waveform to support communications on the move and higher data rates for dismounted users. The new MUOS waveform leverages widely used commercial Wideband Code Division Multiple Access (WCDMA) cellphone technology.

The first satellite, MUOS-1, was launched from Cape Canaveral, Fla., in February 2012 aboard an Atlas rocket, and transitioned into operational use for legacy terminal users in November of that year. MUOS-2 launched in July 2013 and relocated to its operational slot more than 22,000 miles above the Earth in January 2014, where it also provides legacy UHF communications. MUOS-3 was launched in January 2015 and will be followed by MUOS-4, currently on the launch schedule for this summer.

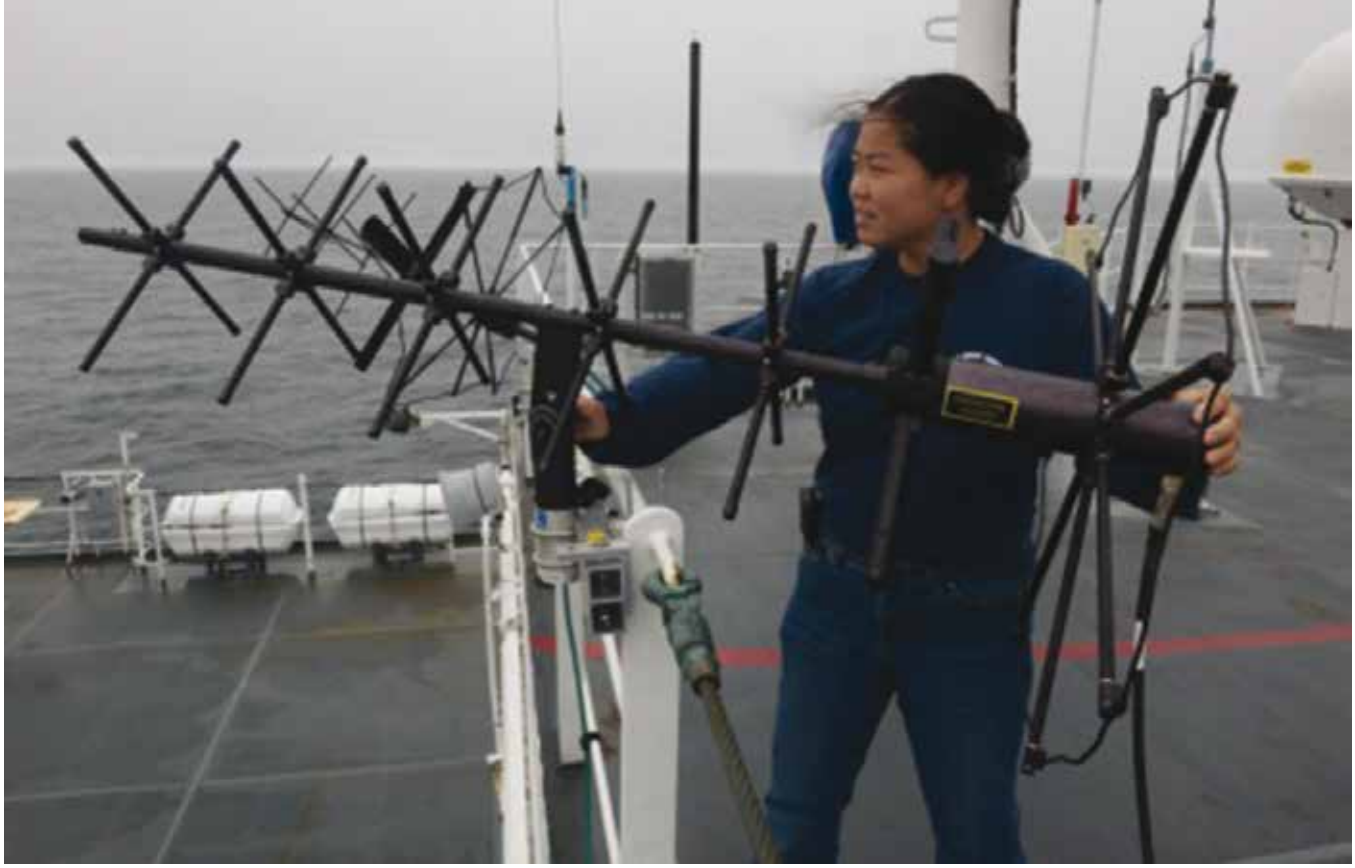
Operationally, user information will flow to the satellites via UHF WCDMA links, and the satellites will relay that information to one of four interconnected ground sites in Hawaii, Virginia, Italy and Australia via a Ka-band feeder link. These facilities identify the destination of the communications and route the information to the appropriate ground site for Ka-band uplink to the satellite and UHF WCDMA downlink to the correct users—a rapid, behind-the-scenes process that is transparent to the warfighter.

To prove these capabilities, MUOS is progressing through a series of rigorous developmental and operational tests, while simultaneously leaning forward with select capability demonstrations in a variety of challenging environments. A major step took place in March 2013 with the first end-to-end system test, and testing has continued with progressively more complex integration and scenario-based events. While each piece of the program conducted earlier laboratory evaluations to ensure they were meeting their individual requirements, the end-to-end tests bring all of the components from multiple programs together and demonstrate secure voice and data calls through MUOS-1 and the ground network. Utilizing the Army's Handheld, Manpack and Small Form Fit Manpack Radios, testers have completed a series of different call types, lasting from 3 minutes to 24 hours, with data rates up to 64 kilobytes per second. The test results have shown increased stability of the system, while allowing engineers to reduce risk by addressing integration issues that had not arisen during individual component tests.

In conjunction with the ongoing end-to-end tests, the team has supported several demonstrations to gauge MUOS potential in different operational scenarios while reducing risk for future record testing. One such demonstration was performed at the Arctic Circle in October 2013, where very high latitudes pose a challenge because the satellite is in geosynchronous orbit above the equator, and therefore harder to see. The MUOS team tested the ability of the Manpack Radio to reach the MUOS satellite communications network at latitudes up to 89.5 degrees north. The demo included both fixed-site locations around Anchorage and Barrow, Alaska, and aboard an aircraft operating above the Arctic Circle. The Manpack Radio successfully completed multiple point-to-point voice and data calls, as well as group calls connecting more than five radios.

Another demonstration, the Navy Submarine Ice Exercise, was conducted in March 2014. MUOS was operational for 15 days at Ice Camp Nautilus, a temporary research facility set up on the ice for Arctic submarine exercises, where operators successfully demonstrated long-term connections across multiple enclaves in a challenging environment.

In August 2014, the Air Force Research Laboratory conducted an airborne MUOS risk-reduction event featuring the in-flight demonstration of the MUOS waveform ported onto two different radios developed by two vendors—the PRC-155 HMS Manpack and the ARC-210—on a C-17 aircraft. Both radios



An advanced program lead for Lockheed Martin adjusts a UHF antenna aboard the Coast Guard Cutter Healy while under way near Alaska last August. The program lead works with narrowband military satellite systems and was onboard the Healy to test the capabilities of the Mobile User Objective System in the Arctic.
U.S. Coast Guard photo by Petty Officer 1st Class Shawn Eggbert

performed well, transmitting and receiving over the air while the aircraft was on the ground and while airborne, and recording progress in voice quality, data exchange and airborne call completion rates.

The MUOS team further stressed the system during North American Aerospace Defense Command/Northern Command Arctic Shield and ICE CUBE in August 2014 and Pacific Command Operation Deep Freeze in November 2014, where they demonstrated MUOS network performance through multiple nodes in extreme latitudes. Other demonstrations continue, including assessments of communications performance with different applications and antenna configurations including the Joint Strike Fighter and a scenario-based integration event with Naval Special Forces.

The demonstrations have produced a wealth of valuable information. Of primary focus and importance is the Multiservice Operational Test and Evaluation (MOT&E) Phase Two scheduled for December 2015. The scope of the MOT&E is significantly expanded from the initial end-to-end tests and will use two satellites, route calls through at least two ground stations instead of a single location, and involve larger quantities of radios and Defense Information Systems Agency (DISA) teleports. To prepare for the MOT&E, the Navy and Army team have developed a 10-step approach designed to increase reliability and validate integration of the waveform, and ground and terminal software configurations heading into the test. Although this plan required delaying the MOT&E, it will not affect the satellite launch schedule or the timeframe for achieving Full Operational Capability (FOC). The MUOS team will continue to conduct disciplined preparation and risk-reduction activities on the path to the MOT&E and FOC.

Joint Acquisition Approach

The acquisition of this complex system across several program offices has not been without its challenges. A Red Team Assessment of the technical viability and probability of success offered lessons learned and recommended way ahead for MUOS. In May 2012, Under Secretary of Defense for Acquisition, Technology, and Logistics Frank Kendall signed an Acquisition Decision Memorandum that clearly defined roles and responsibilities and that continues to drive the program's success.

The Navy's Communications Satellite Program Office has overall responsibility to deliver MUOS end-to-end capability. It is supported by the Army's Project Manager for Tactical Radios, which supplies the Manpack Radio, and Project Manager Joint Tactical Networks (JTN), which provides the MUOS waveform along with the network management system that provisions the radios and displays network information such as phone numbers and call groups. The Joint Tactical Networking Center maintains an information repository of

secure networking waveforms and applications for the DoD, which allows for interoperability across the Joint Services and continuous upgrades to waveform capability.

The MUOS waveform is part of that repository and available to industry, enabling a competitive environment where different vendors can develop terminals and radios that support MUOS. Six vendors have already evaluated their hardware's connectivity with MUOS by using three laboratories that opened in 2014—a Lockheed Martin facility in Sunnyvale, California; a General Dynamics facility in Scottsdale, Arizona; and a JTNC facility in San Diego. By realistically simulating the MUOS satellite network and various challenging environmental conditions, the laboratories support the integration of new and existing terminals with MUOS capability. A Memorandum of Agreement between the Navy, Army and DISA will define the roles and responsibilities to bring to operational status the recently released MUOS Military Standard (MIL-STD), which defines the process and criteria by which the government will certify terminals as they meet qualification standards.

For the Manpack Radio, which will be the primary MUOS terminal for ground users, the Army is moving forward with a competitive procurement of approximately 70,000 radios through the program's Full Rate Production (FRP) phase. The Manpack, delivered in vehicle-mounted and dismounted configurations, is the Army's first two-channel, software-defined radio capable of supporting advanced and current force waveforms. Under a full and open competition, Non-Developmental Item approach, the Army plans to award contracts to multiple vendors, creating a "radio marketplace" where vendors will compete for delivery orders as needed, after they achieve technical and operational requirements. The competition now is under way, with FRP scheduled to begin in Fiscal Year 2017.

To enable compatibility with MUOS, the Army developed the MUOS High Power Amplifier (MHPA) accessory to replace one of the Manpack's standard High Power Amplifiers. The MHPA includes special circuit boards and a full duplex modem that allow the MUOS waveform to run on the standard Manpack Radio. This technology, which eventually will become part of the radio itself, also is planned for use by the Navy, Marine Corps and Air Force.

The involvement of multiple Service branches and systems in MUOS has posed schedule challenges, such as the need to adjust acquisition and technology development timelines to account for other components. With such an integrated system, the status of each segment affects the others—requiring both a holistic approach to configuration management and certain inevitable trade-offs for the sake of a capability that ultimately will benefit thousands of joint users. What has kept the program moving forward is a solid foundation of defined responsibilities and areas of expertise, open communications, flexibility to adapt to unexpected contingencies, and, above all, the professionalism and commitment of the civilians and the Soldiers and Sailors dedicated to delivering this capability to the joint warfighter.

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Conclusion

Shoot, move and communicate—of these fundamental Soldier skills, the ability to do the latter is changing rapidly. With our adversaries taking full advantage of progress in the commercial communications market, continued modernization is essential for the U.S. military to maintain information dominance in the future.

MUOS is a critical piece of this plan, replacing the aging UHF satellite constellation with a significant increase in narrowband communication capability. Users will notice the difference: more bandwidth that is accessible on demand as opposed to preplanned channels; better voice quality; and reliable service, even in remote regions, urban environments or inclement weather. By combining satellites with cellular technology, MUOS will provide troops on the move with high-speed voice, data and network connectivity.

To deliver these improvements, the MUOS team must manage significant technical and programmatic complexity, as well as interface with multiple vendors in a competitive environment. While much work remains to be done, a disciplined yet flexible multi-Service acquisition approach, grounded in documentation and cooperation, has enabled the team to confront the challenges together as we work toward mission success.

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War Games

Do You Know Where Your Weapons Are?

Rosemary Johnston

President Obama recently authorized deployment of as many as 1,500 additional American troops to support Iraqi forces in the region in the continued resistance to the insurgent, self-proclaimed Islamic State in Iraq and Syria (ISIS), possibly raising the total U.S. troop numbers there to about 3,100, according to a Nov. 7, 2014, article in the *Wall Street Journal*. This will cost $5.6 billion as part of a long-term campaign to conduct counterterrorism operations across the Middle East and North Africa.

As the United States continues to help fight ISIS, American troops face the challenges of unreliable communications and attacks that disrupt the supply chain.

This raises the question: Is this outcome inevitable, or can it be prevented? Targeted attacks in the Middle East by ISIS and the conflict in Ukraine have drawn attention to the need for better tracking of high-value assets in these hot zones.

ISIS Crisis: Where's the Ammo?

A report by United Kingdom-based Conflict Armament Research on the origin of ISIS ammunition stated that, of the 1,700 ammunition cartridges the group studied, almost 20 percent was manufactured in the United States.

Johnston *oversees operations, sales operations, systems support and governance assistance for Savi Technology Inc. in Alexandria, Virginia. She supervises a team of sales operations, information systems, business systems and customer relationship managers. As the U.S. Air Force supply career field manager (1995-1999), she developed training, staffing and recruitment programs for 35,000 USAF and civilian personnel within the supply logistics career field. She chaired the USAF Supply Chiefs Advisory Board, the USAF Supply Training Team, and USAF Supply Wartime Requirements workgroups.*

The group documented more than 300 U.S.-manufactured cartridges, dating back more than a decade. It appeared that ISIS accumulated much of its arsenal from weapons seized or abandoned by Iraqi forces, meaning that the United States must fight foes armed with some of its own weapons. According to a Dec. 1, 2014, article on the *Inquisitr* news website, the United Nations warns that ISIS has enough weapons, artillery and vehicles to last between six months and two years. ISIS is able to move over a wide range with greater mobility. And even if the U.S.-led coalitions were to destroy the insurgents' vehicles and large weapons, ISIS still has a great many small weapons at its disposal. The article also says that the ISIS weapons include T-55 and T-72 tanks, Humvees, machine guns, short-range anti-aircraft artillery, and shoulder-mounted rockets seized from Iraq and Syrian forces during military raids.

According to the Conflict Armament Research report, U.S.-made materiel was documented in Iraq close to Syria about two weeks after the fall of Mosul to ISIS forces. The distance between the two regions is about 500 kilometers, or 311 miles, which demonstrates the logistical intelligence of ISIS forces.

But for abandoned and seized weapons from the United States and Iranian, Russian and Sudanese ammunition, ISIS wouldn't have nearly as many weapons and might not pose as much of a threat as it does now.

Ukraine: Russia Denies Supplying Arms

At the same time that the ISIS situation has been unfolding, turmoil in Ukraine has created ambiguity about the source of weapons entering the conflict region. Moscow has denied involvement in arming pro-Russian rebels, according to a Nov. 8, 2014, article in *The Washington Post*. Ukraine also has accused Russia of sending tanks and heavy weapons into rebel-controlled regions. *USA Today* reported on Nov. 7, 2014, that, although Russia continues to deny these accusations, Ukraine and the West continually have accused Moscow of deploying troops and weapons to help aid a pro-Russian rebellion in eastern Ukraine—a practice the United States does not accept.

According to a Dec. 2, 2014, *Reuters* article, looking for evidence of Russian-supplied guns in eastern Ukraine is harder than it has been in the past—for example, when Russian soldiers in Crimea wore camouflage uniforms and carried rifles that easily marked them as Russian. However, rebels began using tanks and sophisticated weapons normally issued only to the Russian armed forces. Russia produced these T-72B3 tanks but never determined their use.

This demonstrates why communications must be clear and efficient in order to maintain successful relationships and insights into where a country's (or its allies') high-value assets are sent. This added insight could help provide tracking and communication of operational data in real time, providing end-to-end visibility of goods and critical assets moving through the supply chain at any location and in any environment. The ability to track and secure the high-value assets to mitigate risk is a key to improving operational efficiency.

Solution: Sensor Technology to Track Assets

Historically, sensor technology has made it easier for the government to track high-value assets and identify the location of weapons, ammunition and other critical infrastructure and materiel to ensure that these assets are in the correct hands. This issue is not new; there was a similar development during Desert Shield and Desert Storm (the first Gulf War of the early 1990s), when tens of millions of dollars in abandoned shipping containers full of valuable goods and weapons (known as the Iron Mountains) were abandoned. As a result, the U.S. Government saw the need for improved monitoring of the location and movement of cargo and high-value resources in order to save time and money and secure its assets around the world. The Army's Project Directorate for Automated Movement and Identification Solutions (PD AMIS) set out to develop critical logistics infrastructure and a method for collecting data to provide in-transit visibility across its entire logistics chain, including high-risk areas where the assets otherwise would be invisible.

As materiel is sourced from multiple locations and through multiple depots, military supply chains bring added complexity and uncertainty to logistical operations. Systems that support the military supply chain—from the tags and readers, through the software and to the alerts and reports—need to seamlessly operate amid great complexity and harsh conditions.

The conflict in Ukraine and the threat from ISIS have further developed a well-known priority issue for the U.S. Government over the last two decades. This is given special emphasis by the Obama administration's increased spending on troops and the resulting need to track and secure cargo in the conflict region.

Evolving sensor technology and the rise of the internet of things (IoT) have led to additional tagging and deeper analysis of data, mostly through sensors and predictive and prescriptive technology. Sensors allow government agencies to track the departure and arrival of crucial materiel such as food, ammunition, medicine, etc., and to record arrival time, stops along a route, humidity and temperature levels of cargo and other key factors. The sensor and data now also provide an opportunity to reroute in high-risk areas and save lives.

Sensor technology can be used to increase safety, minimize risk and operationalize the supply channel in these dangerous areas by providing intelligence on where a cargo is at any moment, from any device—even in regions lacking modern infrastructure. The technology is used to identify troops and assets in the desert and to provide real-time visibility and operational intelligence on these otherwise invisible assets. It also can assist the identification of a breach, when and where it occurred and help adjust course to improve safety and reliability around global shipping operations for some of the highest-value assets. If U.S. weapons abandoned by Iraqi forces contained imbedded sensors, military personnel could track these abandoned weapons to keep them out of enemy hands and to provide the U.S. military more reliable communications and visibility across the full supply chain.

Conclusion

The United States and its allies should not have to worry about weapons falling into the wrong hands and can improve the tracking, securing and management of these assets. Providing service personnel with the location of their critical parts in very long and complex supply chains increases operational intelligence, safety and security in some of the most dangerous regions. Sensors can help detect deviation from an original planned route or ending point—and the future of sensors is to provide actionable intelligence through predictive scenarios.

Real-time visibility of supplies and planning system integration are just the starting point for military supply management and tracking. The supply chains require a global view in order to deploy unit equipment and sustainment supplies in real time. With sensors and data providing an integrated link between real-time asset information and planning systems, defense forces are in a much better position to execute logistical plans. To do so, data from every type of tracking device and reader will have to be monitored continually and compared to plan data and mission requirements.

The next step is for U.S. supply chains to continue tracking certain assets even after arrival and to move toward predictive analysis to ensure that weapons, tanks and ammunition all end up in the right hands and stay there. This will help ensure full visibility into the supply chain to see where high-value assets should go and where they should end up—saving time, money, and most important, securing and protecting our troops and the countries they are assisting.

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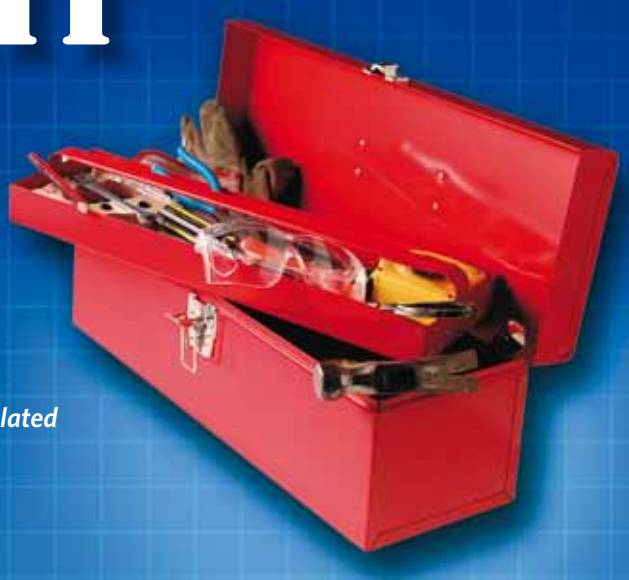

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Millennials at Work

The Advice of Great Leaders

Carol Axten

According to a recent U.S. Bureau of Labor Statistics forecast, by 2015 about 70 million members of the millennial generation will enter the workforce and by 2030 will make up 75 percent of all working professionals. As managers in the acquisition profession, are you ready to lead members of this generation who have been labeled "pampered," "nurtured" and kept busy with myriad activities since they were toddlers?

Born between 1980 and 2000, as the new millennium approached, millennials have a tendency to question the status quo and hold a different set of priorities than their parents. They put less priority on careers and, instead, seek flexibility and balance of work, family and personal time. This means they can be viewed as both high-performance and high-maintenance types. These characteristics can pose challenges to older leaders in the workforce. However, millennials' energy, enthusiasm, creativity and innovation are needed to make the acquisition community successful in a declining budget environment, while balancing developing and maintaining complex weapon and defense systems.

Let's look to the words and actions of great leaders of the past and present, from President George Washington to President Barack Obama, to provide guidance on leading millennials. These leadership skills are timeless and will benefit all leaders in any organization—military or civilian government employees or even those in the private sector.

Axten *has more than 30 years of experience in Defense Department engineering, program management, and policy development. She has graduate degrees in business, engineering, international relations, and national security resource strategy, and is a doctoral candidate at the University of Maryland.*

Abraham Lincoln on Preach a Vision

During the Civil War, through his speeches, writings and conversations, Lincoln preached the vision of America that he was shaping. No matter what vision an organization selects for itself, to apply Lincoln's advice the processes and policies need to align with that vision. Millennials need a vision and a plan to achieve the vision. Millennials were raised with structured schedules, hovering parents and hands-on teachers. Therefore, it is understandable that comments about millennials include their need for structure, supervision and a clear plan for accomplishing tasks. They will look to the leader to provide a vision and execution plan just as their parents provided a vision with direction and close oversight.

Millennials also need to understand how their jobs fit into the vision of their organizations. They will not merely follow directions but want to understand how their actions support a given purpose. Leaders need to eliminate the processes or steps that add "no value" and are found redundant. Lean Six Sigma method, a collaborative team initiative for defining and eliminating waste in processes, is one tool leaders can use to streamline processes and improve worker satisfaction while reducing costs. Like Lincoln, leaders need to develop effective vision and execution plans for their organizations and rally workers around those visions and plans.

President Obama's Values

In his book *The Audacity of Hope*, President Obama wrote, "Our individualism has always been bound by a set of communal values, the glue upon which every healthy society depends. ... We value community, the neighborliness that expresses itself through raising the barn or coaching the soccer team." Millennials are more attuned than some other generations to helping others and to community service, charitable activity, global politics and environmental issues. Many high schools require that students perform community service or be involved in social science activities in order to graduate, thereby increasing student awareness of those areas. Leaders must recognize that a job must provide workers with a sense of worth and fulfillment. Leaders need to convey the values of the organization by their leadership actions and not just their words. Leading by example will inspire millennials to embrace organizational values and provide a sense of community within the organization.

Initiatives are needed to provide a sense of community. For example, implementing environmentally "green" choices within the workplace will allow millennials to connect with the organization and to share a sense of responsibility.

Warren Buffet on Integrity

In the book, "*The Warren Buffet CEO: Secrets of the Berkshire Hathaway Managers*," financier Buffet recounts a memorandum he sent to all the Berkshire managers, stating, "We can afford to lose money—even a lot of money. We cannot afford to lose reputation—even a shred of reputation. Let's be sure that everything we do in business can be reported on the front page of a national newspaper in an article written by an unfriendly but intelligent reporter. In many areas, including acquisitions, Berkshire's results have benefited from its reputation, and we don't want to do anything that in any way can tarnish it."

Generating a stock price of more than $200,000 a share by the end of 2014, Berkshire Hathaway leadership has proven that integrity is not a tradeoff that works against maintaining a competitive advantage. Integrity needs to be a core value of the organization, clearly articulated from the top leadership and visibly practiced by all throughout the organization. A reputation lost is seldom recovered, and subordinates will quickly lose trust in leadership when ethics are compromised.

Millennials, more than previous generations, expect an environment of honesty, trust and integrity in the workplace and all organizational dealings.

Colin Powell on the Clash of Ideas

In the book, *Leadership Secrets of Colin Powell*, the former secretary of state said to his new staff at the State Department: "You will find an open style, you will find me bouncing in, you will find me wanting to talk to field officers. I want to hear the rough edges of all arguments. I don't want to concur things to death and coordinate things to death so I get a round pebble instead of a stone that has edges on it. I want to hear from you, I want to get all the great ideas that exist throughout the Department."

Millennials want to be heard. They want to know the reason for everything. They don't merely take direction but want to know the reason for the request and the ultimate goal. They tend to be outspoken since they were raised to be confident and to share their feelings and ideas. Leaders need to recognize that millennials may not have much experience but do have a great many opinions and expect to be able to voice those opinions. Powell encouraged employees to tell him the bad as well as the good news. Leaders need to express the desire for openness and an acceptance of opposing opinions. Don't underestimate the workforce members' ability to acquire knowledge based on experience. Millennials can use their tech savvy to very effectively chase down information. Although they may have little experience, they can prove very knowledgeable as a result of Internet surfing and an expanded social network.

George Washington and Walking Around

During the Revolutionary War, General George Washington was known to invite his officers to dine with him in order to maintain communication. Why? This practice made it possible for everyone to know each other better, to understand what they had in common and to discuss their differences. In this way, they built mutual trust, respect and confidence. As the top leader, Washington could assess his people's abilities—their strengths, skills and weaknesses. Leaders need to know their employees.

Millennials are social creatures, due to coming of age when cellphones were available. They have experienced constant interaction with their parents and will expect that connection with their workplace leaders. And their leaders will need to get out of their offices and spend time "with the troops," just as Washington did with the Continental Army. This interaction will improve rapport with and appreciation of each team member.

J.W. Marriott on Communication

In his book, *The Spirit to Serve the Marriott Way*, J.W. Marriott stated: "After more than forty years in business, I've concluded that listening is the single most important on-the-job skill that a good manager can cultivate. A leader who doesn't listen well risks missing critical information, losing (or never winning) the confidence of staff and peers, and forfeiting the opportunity to be a proactive, hands-on manager."

Leaders are expected to be good communicators but few realize the need to be good listeners. Leaders need to listen to their employees to gain a level of competence and experience that the leader acting alone may lack. In time, problems faced by organizations will become ever more challenging. The creativity of the millennials will bring a new perspective to resolving those problems.

Jack Welch on "Fail Your Way to Success"

Former General Electric Corp. Chairman and Chief Executive Officer Jack Welch survived a few failures, even blowing up a pilot plant in an incident involving a bad chemical reaction.

Welch likens himself to inventor Thomas Alva Edison, who failed his way to success. Unless one takes calculated risks, innovation will never happen. The millennial generation is willing to test the limits and needs leaders who will allow them to take risks. This generation needs to be taught how to take calculated risks and how to learn from their mistakes. Leaders can accomplish this by choosing tasks that are challenging yet within the employee's skill level, rewarding innovation while tolerating failures and encouraging people to see the possibilities inherent in change. Leaders need to be learners—learning new information and new skills and learning from their mistakes.

Winston Churchill on Innovation

Although known as a great leader, Britain's World War II prime minister also is considered a great innovator. He produced a constant stream of ideas for inventions. Although some were considered impractical, many were both useful and realistic. Millennials are tech savvy. They are tech gurus who can process information on the Internet with lightning speed. A 12-year-old can take a new, never-played video game out of the carton, pop it into the game box and operate it immediately. Previous generations would have read the manual page by page before pushing the first button. The younger generations acquire, retain and correlate information faster than the boomer generation can comprehend. The younger generations have developed electronic intuition and are screaming for opportunities to innovate. Leaders merely need to provide the environment for them to be creative.

Theodore Roosevelt on Fun at Work

President Theodore Roosevelt wrote in his autobiography that, "the joy of life is a very good thing, and while work is essential in it, play also has its place. ... I have enjoyed myself in the White House more than I have ever known any other President to enjoy himself." Roosevelt understood that the workplace should be fun, or one either is not doing it well or is not suited for the job. Leaders should find their jobs interesting and enjoyable, and they should convey this to their employees. Millennials want their jobs to be interesting—and fun. Most of all, they want an employer who puts these concerns first. Whereas baby boomers born after World War II and before the early 1960s and "generation X" employees born between 1960 and 1980 saw their goals in life as one of progressively improving in their jobs, millennials strive to learn the job quickly and then move on to learning something new. They will become bored by mundane jobs that previous generations accepted as part of life. Leaders need to strive to keep the job challenging and to provide opportunities to all for continuous learning.

Donald Rumsfeld on Bureaucracy and Pragmatic Leadership

No one better understands how difficult change is in a bureaucratic organization than does former Defense Secretary Donald Rumsfeld. A 2006 article in the journal *Strategic Forum* (Number 221) of the Institute for National Strategic Security Studies at the National Defense University, "Reforming Pentagon Strategic Decisionmaking" (Christoper J. Lam, Irving Lachow), summarized a Sept. 10, 2001, Rumsfeld speech. Rumsfeld described the Pentagon bureaucracy as the enemy, arguing that it disrupts the defense of the United States and risks the lives of servicemen and -women. In the 2002 book by Jeffrey Kramer, *The Rumsfeld Way*, the former defense secretary is quoted as saying, "It's been a process of trying to not change things for the sake of changing things, but to get a sense of what's coming down the track on the freight train. And trying to figure out a way in which you can affect that without waiting two years."

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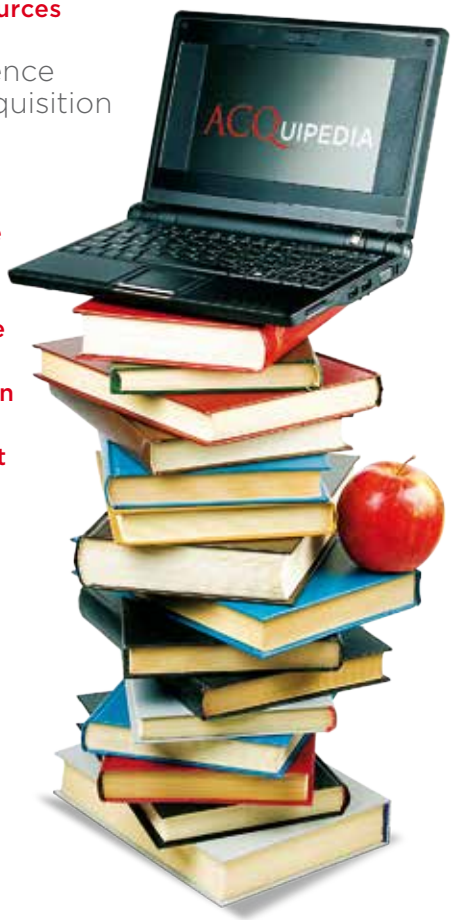

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Millennials emphasize earning respect based on skills, abilities and accomplishments. They look for jobs that provide opportunities to share ideas, accelerate advancement, learn continuously and allow alternate work schedules. Millennials are not conformists. They have high expectations of what the organization and its leadership should provide. They are perceived as requiring high maintenance, more than any other in workforce history. They want feedback now. They want training now. They want recognition now. And they want to create the lifestyle they desire—now. If managers can learn how to harness their energy and coach them effectively, these young employees have the potential to be the highest-producing generation ever.

Bureaucracy, which tends to be the norm in government and the military, will prove to be a demotivator for this generation. It will kill their enthusiasm. For a generation that asks why about everything, an answer of "because that's how we do it" will create frustration. Millennials believe life and work are about flexibility, individuality and creativity; therefore, they will expect considerable tailoring of policies and processes to achieve the greatest effectiveness. They will expect leadership and coworkers to think and not just follow the established procedures.

Leading Millennials

These timeless perspectives on leadership will "bring out the best" from the millennial generation and benefit every generation. Millennials are fluent in technology, possess great business acumen and have a firm grasp of money matters. Multitasking is second nature to them. They have been raised to juggle extracurricular activities, active social calendars, school and homework, part-time jobs and volunteer programs—and to do it all successfully. They manage social media circles around the world through community websites. Their sociability feeds a desire to support working as a group in order increase productivity. They are optimistic, confident and goal oriented. Millennials are not the problem; they are the solution.

The millennial generation will be the generation of change. The millennials' desire to break the stereotypical norms of the previous generations, and their energy to do so, will shake up business as well as government and the military. Their appreciation of flexibility, their tech savvy, their ability to learn quickly and their desire to serve and make the world a better place are qualities that should not be wasted by organizational rigidity. Organizations need to change to meet the challenges of the future, and millennials bring the skills and abilities to make the government and military successful. In Powell's words, "Leadership is the art of accomplishing more than the science of management says is possible." Millennials thrive on leadership. The organizations that figure this out will be very successful in the future.

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Dynamic Testing

Toward a Multiple Exciter Test

Michael T. Hale ■ William A. Barber

Ensuring that the warfighter is supplied with the safest and most reliable weapon systems is a challenging and often extremely varied process. One critical component in qualifying a system is developing and executing a thorough environmental test sequence representative of the anticipated life cycle of the item to be fielded. Effective development of such a test sequence requires clear communication between program office and test personnel.

This article concentrates on the critical vibration testing element. The field vibration environment may be described as the simultaneous vibration in three translational and three rotational degrees of freedom. Achieving an accurate 6 degree-of-freedom (6-DOF) replication of this environment in a controlled laboratory setting has taken decades of advancements in vibration control and exciter technology. Below are a short historical path of the evolution of the discipline toward multiple exciter/multiple degree-of-freedom (MDOF) testing, an example of an MDOF vibration system and a discussion of benefits of the technology advancements to the acquisition community.

Shock and Vibration—Pre-World War II

The first wide studies of shock and vibrations can be traced to the 1930s when the effects of earthquakes on buildings were being studied in order to improve the behavior of buildings. The work primarily was analytic, using the shock spectrum as defined in research by Belgian-American aeronautical engineer Maurice Anthony Biot. Instrumentation and signal conditioning equipment of the period were in their infancy and test equipment was limited.

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Wide-Ranging Interest in Vibration Testing

The rapid evolution of military hardware during World War II yielded many technological advances such as radar, high-performance vehicles (aircraft, ships, and ground vehicles) and early guided missiles. Coinciding with these advances were new structural and dynamic challenges that led directly to enhanced environmental testing. The combination of higher-performance vehicles generating more severe vibration environments and the use of complex electronics and munitions that are more susceptible to fatigue failure increased the potential for vibration to cause catastrophic failures. During this period, program managers began an initiative to address performance under shock and vibration loading in developing acceptance and qualification programs for increasingly complex products.

Mechanical Exciters

The World War II and early postwar dynamic test facility consisted largely of mechanical cam-driven excitation systems limited primarily to low-frequency cyclic motion of a circular or elliptical nature. These early mechanical systems were limited in bandwidth, for example a typical machine running circular motion at 300 revolutions per minute (RPM) would correlate to only 5 Hertz (Hz). The constant RPM rotational motion produced a fundamental motion of a periodic (sinusoidal) nature, but also tended to have very high uncontrolled harmonic distortions associated with the drive mechanisms. While they provided a rudimentary vibration environment, the technology was insufficient to address more complex and wider frequency ranges characteristic of the field environments of interest.

Electro-Dynamic and Servo-Hydraulic Exciters

Electro-dynamic exciters, first introduced in 1946, gradually began replacing mechanical exciters. The first generation of such equipment was very inefficient; however, it was quickly realized that such a device could address more complex random environments. Random vibration is defined as non-deterministic, which means that future behavior cannot be predicted precisely. However, it is possible to describe such motion in a statistical sense. Reference criteria for a random vibration environment are presented in the form of an Amplitude Spectral Density (ASD), which essentially is a statistical average of the distribution of energy as a function of frequency. Examples of environments that are characteristically random include a wheeled vehicle running over a rough road, turbulence around high-velocity exhausts or turbulence-induced vibration associated with aircraft or missile flight. Such environments have significant energy content through the 500- to 2,000-Hz range. Clearly, low-frequency sinusoidal motion is not sufficient to characterize such environments. Even though random vibration testing were then feasible, the initial limitation of the time was development of closed-loop control systems to create a controlled and repeatable motion. Also lacking were recognized standards for such tests, an obvious challenge to program managers of the day.

One limitation of electro-dynamic exciters, even those of the modern era, is that the high-force models have a significant footprint. Servo-hydraulic exciters, introduced in the late 1950s, are capable of producing a very high force in a much smaller footprint. While they lack the bandwidth potential of an electrodynamic exciter, development of dual-stage valves made it possible to achieve frequency response on the order of 500 Hz, which is acceptable for defining many environments.

With the onset of the space race and advancing missile technologies in the 1960s, a clear need became apparent to develop random vibration standards.

Vibration Standards

As development of electro-dynamic and servo-hydraulic exciters continued to mature and their potential became apparent, standards soon followed. Interestingly, early and modern vibration standards alike tend to be commodity and nationally or regionally based. The first standards were based on sinusoidal motion. The first widely disseminated U.S. military standard for environmental effects that included vibration was the 1962 release of U.S. Military Standard 810 (MIL-STD-810), under custody of the U.S. Air Force. MIL-STD-810, "Environmental Engineering Considerations and Laboratory Tests," is a Department of Defense (DoD) Test Method Standard approved for use by all DoD Service Departments and agencies.

With the onset of the space race and advancing missile technologies in the 1960s, a clear need became apparent to develop random vibration standards. Although random vibration was discussed in early releases of MIL-STD-810, definition of the environment was limited by the analog vibration control technologies then available. With the advent of digital control technologies in the late 1970s, more complex random profiles could be controlled. Techniques for developing fatigue equivalent laboratory vibration specifications based on measured field data were also advancing. This led to the inclusion of the first fatigue equivalent vibration profiles in the 1983 release of MIL-STD-810D.

Single-Exciter Excitation

Until recently, the vast majority of vibration testing has been conducted on a single exciter that would impart translational motion to the test payload in a single mechanical degree of freedom (1-DOF). It also is common practice to employ appropriately phased multiple exciters on large structures to obtain 1-DOF motion. Modern exciter systems and control-system combinations can address a wide range of environmental conditions beyond the classical sinusoidal tests of years past. Consider the following examples of various environments, all of which can be addressed by modern vibration-control systems: wheeled vehicles, which tend to be dominated by predominantly low-frequency random vibrations, and aircraft and space vehicles that tend to be dominated by higher-frequency random vibrations. Combined environments such as mixed sine on random, characteristic of rotor craft or propeller-driven aircraft, and mixed narrow-band random on random, which is characteristic of tracked vehicles. While the ability to address random and combined random environments was a giant leap forward, the limitation continued of conducting vibration tests in one mechanical DOF at a time.

The limitations of 1-DOF vibration testing essentially are twofold—one of test durations and one of test fidelity. As for test duration, laboratory test times are increased due to the serial nature of addressing one DOF at a time. This approach involves not only the time required to conduct the test serially but is exacerbated by the time required to reconfigure fixturing between axes—and, in the case of testing under temperature extremes, significant additional time is associated with temperature conditioning and reconditioning. Regarding test fidelity, a 1-DOF test configuration does not allow the natural mechanical coupling of energy into the test payload across mechanical DOFs as is characteristic of the field environment. Also, in most traditional 1-DOF tests, only the translational DOFs are considered. When conducting vibration tests on gimbaled devices such as gyroscopes, that by design are intended to remain on a horizontal plane, not including the rotational motion omits a major environmental feature necessary in evaluating the device's performance.

Multiple-Exciter Test Configurations

While researchers like David O. Smallwood proposed control algorithms for MDOF random vibration as far back as the late 1970s, MDOF vibration was not formally recognized in the MIL-STD-810 until the 2008 release of MIL-STD-810G. The inclusion of the multi-exciter test, method 527, in MIL-STD-810G established a standard set of techniques and terminology essential for users and developers to improve upon the MDOF vibration test technology. Most early MDOF systems were commodity specific and often operated in an open-loop fashion. The current trend in multiple-exciter test (MET) is to design the test platform so it is generic and control is closed loop. The ability to address a multitude of payload combinations and to deal with motion combinations ranging from 1 to 6 mechanical DOFs is critical due to the upfront costs associated with MET test platforms. This is made possible through a combination of vastly improved hardware used to couple the individual actuators to the table assembly—and as a result of modern vibration control systems that can address closed-loop MDOF excitation.

Multiple-Exciter Control Options

While modern MDOF excitation systems generally are designed to be multipurpose as discussed above, they are still found in various sizes ranging from table sizes of under 100 square inches with frequency response on the order of 5 khz to large earthquake systems capable of imparting motion on entire building assemblies with a frequency response generally below 100 hz. While the smaller systems tend to be electrodynamic, the larger systems are generally servo-hydraulic. In addressing the payload sizes and frequency bandwidth of interest to many DoD payloads, the optimal test platform characteristics will often fall in between the two extremes discussed above.

Clear communication between program office and test personnel in communicating OPM/MP details is critical in the development of MDOF vibration test criteria.

Redstone Test Center MDOF System

The Army's Redstone Test Center (RTC) in Huntsville, Alabama, a subordinate of the Army Test and Evaluation Command (ATEC), recently integrated a large capacity 6-DOF (LC6-DOF) system into its Dynamic Test Division. RTC has had several years' experience in operating a pair of Team Corporations Cube Model 3 6-DOF systems. These systems performed well. However, their force rating and limited surfaces (32 inches by 32 inches) restricted payload sizes. In addressing larger payloads, the design challenge of the new system was to maintain a 500-Hz frequency response for a system with a primary moving element (table) size of 8 feet by 8 feet. The over-actuated servo-hydraulic system consists of five vertical

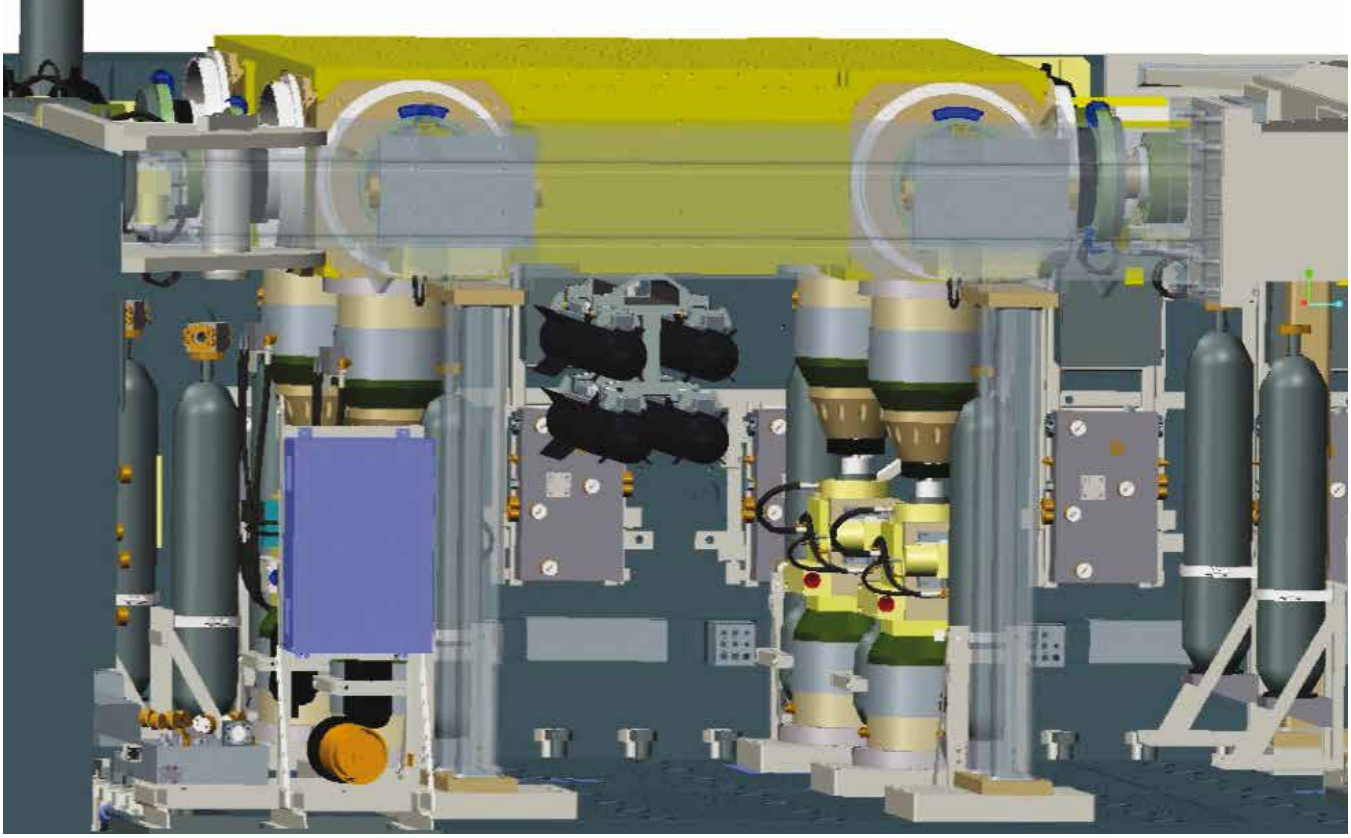
A Multiple Launch Rocket System pod mock-up illustrates a top-table mount with table extensions.
Photo by authors

and four horizontal actuators. When operating the hydraulic power supply at 3,000 pounds per square inch, the total vertical (z-axis) force rating is 225,000 pounds of force or 225 KlbF, and the horizontal (x and y axes) force ratings are 120 KlbF each. Use of high-performance pad bearing assemblies helps to minimalize the mass of the moving elements in the space-restrictive horizontal planes. Each translational DOF has a stroke capability of 3 inches double amplitude (DA) and the angular motion range is plus or minus 6 degrees about each translational axis. The first photograph is a top view of the table assembly in which 4 feet by 2.25 feet extensions have been added to the basic table assembly. Not shown in the current top-view photo is the work platform that will permit placement of a conditioning box that will encompass the table assembly and allow testing at extreme temperatures.

As described above, the LC6-DOF system is designed to be as adaptable as possible in order to address the testing needs of a wide range of military hardware, including ground and air vehicle payloads. For ground vehicle payloads, such as the Multiple Launch Rocket System pod shown in the first photo, all nine exciters are employed, with the item mounted to the top of the LC6-DOF table using tactical mounts and tiedowns to provide the most realistic vibration environment for the payload. However, for aircraft payloads suspended from a rotary wing aircraft, for example, the middle vertical actuator may be removed to enable use of a tactical launcher and bomb-rack mounted to the bottom of the LC6-DOF table for the most efficient and realistic test configuration. This option is illustrated in the second photograph. The LC6-DOF system's full performance ratings are based on a 5,000-pound payload and the ability to address multiple vibration environments. Examples of performance requirements for the LC6-DOF system at maximum load include simultaneous 3-DOF random motion as defined by the composite tactical wheeled and two-wheeled trailer environments in MIL-STD-810G-CN1, sine-on-random vibration for rotorcraft as defined in Table 514.7C-IX of 810G CN1 and various random-on-random-based tracked-vehicle environments.

MDOF Vibration Specification Development

Development of MDOF specific reference criteria and the inclusion of the MDOF criteria in military specifications are essential to the accuracy of an MDOF vibration test. As expected, this element of the MDOF vibration test lags behind the development of the laboratory test technology, but likely will see increased near-term activity. This topic is addressed in detail in the April 2014 release of MIL-STD-810G Change Notice 1. Specifically, Method 527.1—"Multiple Exciter Test," Annex E, "Laboratory Vibration Test Schedule Development for Multi-Exciter Applications"—provides the engineering and mathematical basis for establishing multiple exciter-test



Authors' model of a captive-carry payload in a bottom-table mount.
Photo by authors

reference criteria and an example for illustration purposes. As legacy programs are updated and new programs are developed, establishing well-defined laboratory vibration specifications based on the operational mode summary/mission profile (OMS/MP) is a key programmatic element. The OMS/MP is a quantitative depiction of the wartime and peacetime usage and environmental parameters anticipated during deployment. Clear communication between program office and test personnel in communicating OPM/MP details is critical in the development of MDOF vibration test criteria. Field data acquisition efforts should be coordinated carefully and transducer placements selected so they are acceptable for development of MDOF vibration reference criteria.

Conclusions

Laboratory 6-DOF vibration systems represent the latest chapter in a long history of refining the accuracy of laboratory vibration tests. MDOF excitation and control systems continue improving and are standard equipment in many vibration test facilities. Previously limited to small payloads and low-frequency test environments, the recently completed LC6-DOF system at the Army's Redstone Test Center provides the 6-DOF vibration test capability for large military payloads with a bandwidth of 500 Hz. Lagging in the process, but expected to see more near-term activity, is development of MDOF specific reference criteria. All mechanical and control aspects of MDOF testing continue to advance, offering the rare combination of reducing test costs while improving test fidelity.

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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 all such changes of leadership, for both civilian and military program managers in recent months.

Army

Michael R. Chandler relieved **Col. Robert A. Rasch** as project manager for the Integrated Air and Missile Defense (IAMD) Program on Nov. 24, 2014.

Navy/Marine Corps

Sean J. Burke relieved **Capt. James B. Hoke** as program manager for the MQ-4C Triton Program (PMA 262) on Dec. 18.

Air Force

Col. David M. Learned assumed the program manager position for the Joint Surveillance Target Attack Radar System Recapitalization (JSTARS Recap) program on Dec. 1.

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