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Defense AT&L

Acquisition, Technology and Logistics

A PUBLICATION OF THE DEFENSE ACQUISITION UNIVERSITY

Boosting Access

to Government Rocket Science

Ethics and Acquisition Professionalism:
It is All About Trust
by the Under Secretary of Defense for Acquisition, Technology, and Logistics

International Arms Sales
An Industry Perspective

Critical Thinking
A Missing Ingredient in DoD's Acquisition (Education) System

2014 Winner APEX Award for Excellence

CONTENTS

2 *From the Under Secretary of Defense for Acquisition, Technology, and Logistics*
Ethics and Acquisition Professionalism:
It is All About Trust
Frank Kendall

6

Boosting Access
to Government Rocket Science
John F. Rice
DAU's South Region leads a study for a joint DoD-NASA organization to develop a strategy for reinvigorating the propulsion industrial base.

13

International Arms Sales
An Industry Perspective
Lawrence E. Casper
Most national governments give defense a top priority, but what they ultimately procure in weapons systems may reveal further underlying motives and priorities.

16

Critical Thinking
A Missing Ingredient in DoD's Acquisition (Education) System
Sean M. Frisbee and Scott Reynolds
The complex and unstable environment surrounding federal procurement makes thorough preparation of the acquisition workforce particularly difficult but also more important than ever.

23

What the Acquisition Workforce Knows
Stephen V. Reeves
Outcomes ultimately matter, but calls for reforming "the process" run into difficulty given greater emphasis "on things not going wrong than on assuring most things go right."

27

Acquisition Challenges of a Lethal Virus
Col. Russell E. Coleman, USA
The Ebola virus outbreak in Africa presents a challenge—and a real learning experience—for the Defense Department's Chemical and Biological Defense program.

32

Tiny Nanoparticles
—A Big Battlefield Impact?
Donald Kennedy
Tiny metallic nanoparticles can change the landscape of defense technology—from helping conceal the location of warfighters to providing transparent displays in vehicles.

36

Army Acquisition Lessons Learned
Jill Iracki
A center established within the last four years collects, analyzes and disseminates the U.S. Army's acquisition experience and includes a knowledge management portal for program executive offices.

41

Cybersecurity Challenges
for Program Managers
Steve Mills and Rob Goldsmith
Program managers need the right policies, processes, people and tools to counter cybersecurity threats in Defense Department acquisition programs.

44

Accounting for Every Kilowatt
Maj. Mark Gillman, USA, William M. Singleton, Robert A. Wilson, William Cotta, John Donnal, James Paris and Steven Leeb
Field tests of a load monitor being developed at MIT promise improved management of electricity use by forward-deployed soldiers.

50

More Time Management Tips for Busy People
Roy Wood, Ph.D.
Sometimes you just have to tear into time-consuming items and tasks.

ALSO

25 MDAP/MAIS Program Manager Changes

30 *Defense AT&L* Wins 2014 APEX Award for Excellence

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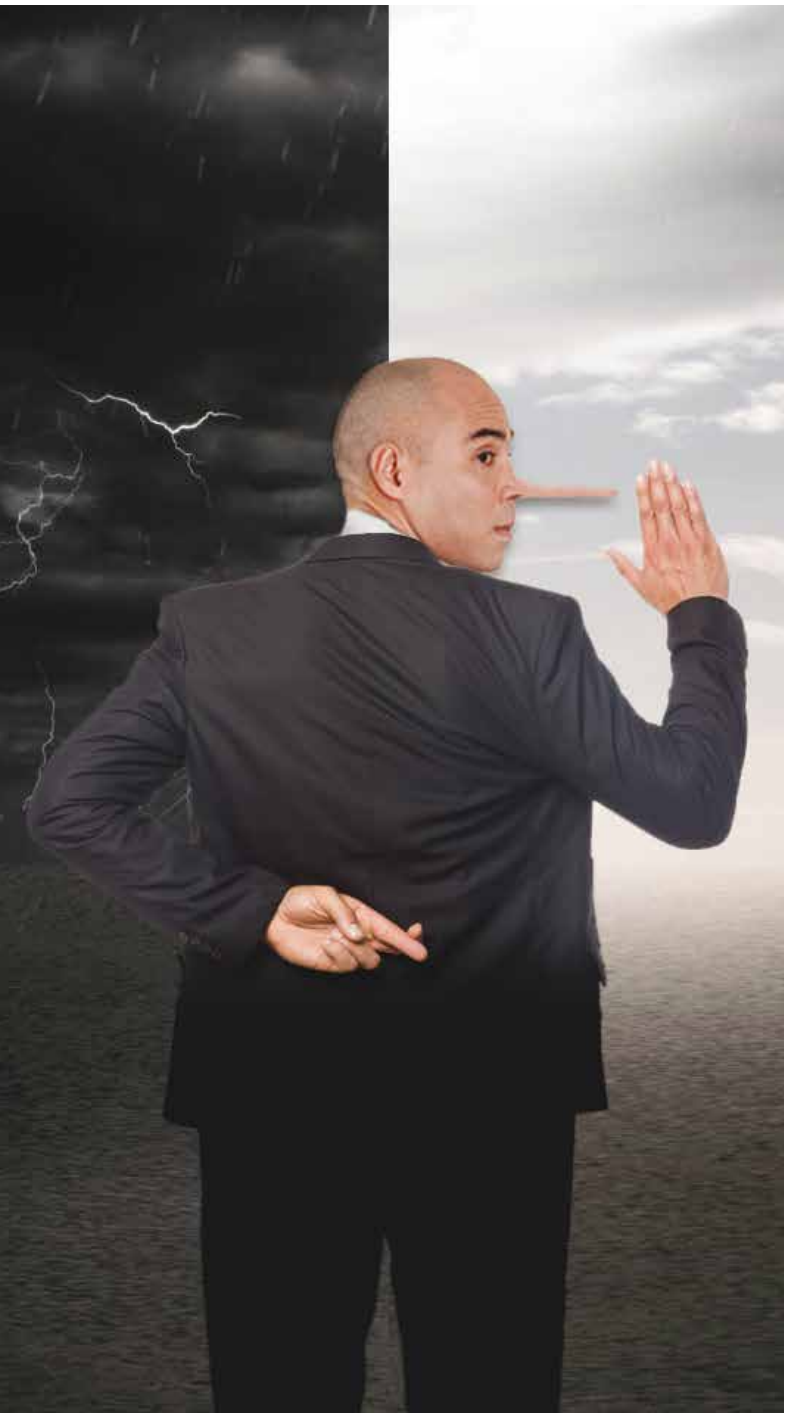
Ethics and Acquisition Professionalism:

It is All About Trust

Frank Kendall



One of my predecessors as Under Secretary for Acquisition, Technology, and Logistics, and my former boss, John Betti, once commented to me, "The most valuable thing any one of us has is our credibility; once credibility is gone, it can never be recovered." Credibility, or our capacity to have other people trust what we say, is essential to any successful acquisition professional. Trust in our credibility matters when we interact with our supervisors, subordinates, customers (military operators), the media, Congress and industry—in other words with everyone we encounter. Once we lose credibility with any one of these groups, we aren't far from losing it—and our effectiveness—with all of them.

There are a lot of ethics-related topics I could write about. I've chosen this one partly because of its importance, but also because of the frequency with which I've seen problems in this area and finally because it takes us into an area where there are a lot of shades of gray.

I won't say much about the basic rules we are required to follow as a matter of integrity and public confidence, but I will mention them briefly. If you are a dishonest person who would violate fundamental ethical requirements, say by accepting a bribe in some form, then there probably isn't anything I can write that would change that fact. If you are likely to yield to that sort of temptation, we will do all that we can to catch you and put you in jail. If that doesn't deter you, I don't think an article will have much effect.

Sustaining trust in our integrity as public servants also demands that we be very careful about avoiding any appearance of unethical conduct. We are reminded of these requirements frequently and all of us should follow them. The ethical problems I'd like to address instead involve times when one of us might be tempted to do something wrong

in our professional lives because of a goal we believe has real merit; in other words, to rationalize that good ends justify unethical means. In my experience, those unethical means often involve misleading a decision maker, authority or stakeholder in some manner. People generally don't go to jail for this type of behavior and we aren't talking about appearances only. The people who commit these ethical lapses do, however, sacrifice their credibility—and sometimes their careers.

I'm sometimes asked about why the government or, more specifically, the Office of the Secretary of Defense, doesn't trust one party or another more—or even why I personally do not do so. When I'm asked this, it is usually in the context of someone asking for a decision such as a business commitment, or reducing the oversight used, or a milestone delegation, or agreement to limit risk mitigation activities and expenses. The party asking can be someone from industry or a military department program manager or another senior leader. The answer, I'm afraid, is simple enough: experience. My life in the military, government and industry taught me that it isn't wise to give trust away for free; it should be earned. We are all involved in situations where we are trying to persuade someone to accept our point of view. It can be for approval of a milestone or authorization of funding or continuation of a program. There can be strong temptations in these cases to be something less than fully honest. This is the gray area I want to discuss.

I'll start with what I consider unethical attempts to influence decision makers or stakeholders. The extreme form of this is simply lying. I have very rarely, as far as I know, been directly lied to by a government acquisition professional. I did have one well-reported occasion when direct lying was practiced. It originated in a program executive office associated with the infamous Navy A-12 program. That individual was relieved and forced to retire when it was revealed that he had directed his subordinates to report lies about the program. It shouldn't be necessary for me to exhort anyone in defense acquisition not to cover up problems in a program by actively lying about them. If you are doing that, my advice to you is to get out of our profession. The rest of us do not want to work with you.

The form of ethical lapse I have seen too often consists of more subtle attempts to mislead decision makers in order to obtain a desired result. There are two forms of conduct that in my experience are much more common. The first is simply omitting information that would support a conclusion that is different from the desired one. The second one I'll refer to as "marketing," which falls short of direct lying but not by a wide margin.

I think I'm a realist, and I know that when a Military Department asks me for a decision when it has already decided what

We are all involved in situations where we are trying to persuade someone to accept our point of view. ... There can be strong temptations in these cases to be something less than fully honest.

that decision should be. As the Defense Acquisition Executive (DAE), I'm not being asked by the Service to figure out the right decision; I'm being asked to ratify the one the Service believes it has already effectively made. Going back to John Betti for a moment, John came into the Department of Defense (DoD) from a nondefense company where he was a senior executive. Originally, John approached his job as DAE as being similar to a corporate chief executive officer being asked to make a decision about an investment for a company. I explained to John that DoD worked a little differently. I told him he should think of it more as if he were a banker being asked to approve a loan. The applicant (Service) already knows it should get the loan; its only interest is in getting the loan approved. There is no incentive for a loan applicant to explain in detail all the reasons his credit rating is overstated or to emphasize risks that the business plan might not be successful. Despite this disincentive, we do have an ethical obligation to provide senior decision makers with all the relevant information they should have before they can make an informed decision, whether or not it supports the decision we would prefer.

In this regard, the best way to ensure credibility is to tell the whole story. It's fine to make recommendations, and even to advocate for a decision you support, but it is not fine to omit important facts of which the decision maker should be aware before he or she makes the decision. Another of my bosses was Dr. John Deutch, also a former Under Secretary for Acquisition. John is one of the smartest people I've ever met. When I worked for him, John had a habit, however, of leaping ahead on a subject and reaching a conclusion before I could give him all the information he needed. On more than one occasion, I had to physically grab him and insist that he have the patience to wait for some more information from me before making a decision. Even if I thought he was right and making the decision I supported, I still wanted him to have all the relevant information. This was partly out of self-interest as well as a sense of the duty I owed to my boss. If I didn't give him the full story and his decision was later proven wrong by events, I didn't want to be in the position of not having given him all the relevant data—my future credibility with him was at stake.

For supervisors especially, please note that when we do any of the things I have described we are effectively training our workforce that these practices are "OK." One reaps what one sows.

The second type of behavior I see fairly often can be described as "marketing." A friend of mine in business was once appalled at the lies her associate was telling a prospective client. When challenged, the sales person responded, "That wasn't lying; it was marketing." In this case, what I'm referring to is a little more of a gray area; it consists of claims about judgments, such as risk levels, or future implications of decisions that stretch the truth instead of breaking it. More extreme versions of "marketing," as opposed to objective presentation, are easy to spot. It doesn't take too many questions to find out whether there is real substance behind an assertion or, to use a phrase from the legal world, to discover that the claim being made is "mere puffery."

I've found it to be an important practice to try to find out if a program manager (PM) is trying to "sell" me, or if he or she is really on top of the program and has a real basis for the assertions made. (As a style comment a "just the facts ma'am" delivery works a lot better with me than that of a used car salesman.) Most PMs are very professional about this; some are not. Once a PM told me his optimistic schedule projection was made because he planned to do things "differently." Unfortunately, when I probed a little more deeply, he had no specifics whatsoever about what he was going to do "differently." In short, we shouldn't make claims we can't back up just to get someone's approval.

In another instance, a PM told me the new design turbine engine for his UAV program was low-risk because it had over 100 hours of testing on a prototype. I asked him based on past experience how many hours of testing a new engine should have before it is ready to enter serial production. He had no idea. (Hint: It's a lot more than 100.) It doesn't take too many questions to find out if a PM, or anyone else, knows his business and has done his or her homework. If you haven't done your homework and get caught trying to fake it, you can forget about trust or credibility as an asset.

I'll also mention similar behaviors that don't occur as often, but which I have seen, including relatively recently. One that particularly galls me is the "let's hope he doesn't read it" approach to getting something approved. Occasionally people will insert an action that they know I'm likely to disagree with into a document in the apparent hope I will miss it and grant approval. Even if I discover what I've done later, I would be in the unfortunate position of having to reverse myself. This doesn't happen often, but when it does the major impact is that I will read all the documents from the same organization very carefully in the future. A variation on this approach is to insert elements into a program option the Service or the PM doesn't support largely to make that option look less attractive from a cost or schedule perspective. I've seen this done to try to prevent congressional action that was opposed by the Service, and I've seen it done to try to dissuade me from a course of action I as the DAE thought was worth considering. When I see such actions, the organization does not earn my trust, nor do the responsible individuals.

One other behavior I see on occasion is what lawyers call "the parade of horribles." (Although I'm about 80 percent engineer, legal training provides some useful insights.) The phrase "parade of horribles" refers to the use in legal argument of a long list of all the really bad things that will happen if the judge makes a ruling the party opposes. These lists tend to be very speculative and inflated but not entirely fanciful. I do find it amusing when I'm told that any decision to change a requested program, in any direction other than precisely the requested one, will have equally negative consequences for cost or risk. In short, adding a lot of weak or speculative arguments to a recommendation can have the opposite of the desired effect.

While I've focused on some gray areas within my own interactions in the Department, the points I'm trying to make about earning and sustaining credibility apply equally well when we deal with outside stakeholders, especially Congress, industry and the media. For supervisors especially, please note that when we do any of the things I have described we are effectively training our workforce that these practices are "OK." One reaps what one sows.

The bottom line is that we should not let advocacy for a position, no matter how sure we are that it is correct, push us outside of ethical constraints. We don't just need to tell the people we are responsible to the truth, we need to tell them the whole truth. We need to be clear about what we know and what we don't know. We need to clearly distinguish between things we know and things we have informed opinions about. We must be able to back up our assertions with facts and sound logic or we shouldn't make them. We certainly should not try to sneak anything by the people or institutions that make decisions we are bound by. Building our credibility as defense acquisition professionals is a career-long effort. Destroying it only takes a moment. John Betti was right; our credibility is our most valuable possession.

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Boosting Access

to Government Rocket Science

John F. Rice

Retirement of the Space Shuttle and Constellation programs has created significant ripple effects in Department of Defense (DoD) missile and rocket acquisition. Notably, the decline in propulsion system skills and capabilities has led to a decrease in technology advances. This is exemplified by DoD's reliance on Russia for Atlas V rocket engines to launch military payloads. Enter the Defense Acquisition University (DAU) and its Mission Assistance for the National Institute for Rocket Propulsion Systems (NIRPS). DAU's South Region led a study for NIRPS, a joint DoD-NASA virtual organization, to assess issues relating to the propulsion industrial base. The results include an innovative framework for developing flexible, yet binding, agreements that promote commercial access to government resources.

NIRPS was established by NASA as a forum to address Section 1095 of the 2012 National Defense Authorization Act (NDAA). The Act directed development of a national rocket propulsion strategy to foster collaboration and coordination among multiple DoD components and NASA to reinvigorate the propulsion industrial base. Systems potentially benefitting include Atlas and Delta launch vehicles, the Space Launch System (SLS), the Theater High Altitude Air Defense system, Patriot Advanced Capability–3, Helicopter Launched Fire-and-Forget Missile System, Advanced Medium-Range Air-to-Air Missile, and Javelin.

A recent example of public-private collaboration is NASA's use of a Space Act Agreement (SAA) to enable Sierra Nevada Corporation (SNC) access to the Agency's expertise. Specifically, the Marshall Space Flight Center (MSFC) in Huntsville, Ala., will support SNC in its development of the Dream Chaser spacecraft. SNC has had a relationship

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with MSFC, through an SAA signed in 2012, using Marshall's expertise and resources to perform wind tunnel testing on various configurations of the Dream Chaser.

SAAs are flexible partnerships that allow NASA to work cooperatively with industry to develop and transfer technology in support of national priorities and NASA's mission. They are derived from the Space Act of 1958, which authorizes NASA to enter into "other transactions" outside of contracts, leases and cooperative agreements. These agreements are collaborative research and development efforts that provide for an ongoing exchange of NASA assets—personnel, use of facilities, expertise, equipment and technology—to private partners. Federal Acquisition Regulation (FAR) compliance is waived for SAAs.

Similar laws and regulations led to DoD agreements with commercial users of its resources. For example, Title 10 of U.S. Code § 2539b addresses Public-Private Partnering Authorities to make available U.S. Army facilities, equipment and personnel for private users. The 2539b-derived requirements, unlike those of the SAAs, require FAR compliance.

The U.S. Army Aviation and Missile Research Development and Engineering Center (AMRDEC) at Redstone Arsenal, Ala., has developed a § 2539b-derived Test Agreement for propulsion testing at its ranges. Industrial partners taking advantage of this approach at AMRDEC include small-to-large aerospace and defense firms. Range assets include solid rocket stands, liquid rocket stands and an explosives test range.

While these statutes and associated agreements have been employed effectively, they were not universally designed for efficiency. As a result, DAU was approached by NIRPS to conduct experimental development and to review such acts/agreements—specifically for the U.S. rocket propulsion industry—and recommend a streamlined framework. NIRPS is especially interested in simplifying agreements since the retirement of the Space Shuttle has led to deterioration of the national propulsion industrial base. Streamlined government-industry agreements enable both new entrants and existing suppliers to access valuable government resources in a timely, coordinated manner so as to expedite the development of new technologies.

Approach

DAU completed systematic interviews in 2013 to identify and assess public-private partnerships established by the DoD and NASA. Such partnerships enable the propulsion industry to access U.S. government facilities and expertise. Given the scope of this task, the study was limited to propulsion test activities. However, extension to propulsion research, development, manufacturing and operations is possible with the framework.

Examples of agreements in use by contacted organizations (see Table 1) are provided below. These existing mechanisms and their guiding statutes accommodate a variety of scenarios for engaging industry.

DoD:

- Test Service Agreement (U.S. Army)
- Test Agreement and Cooperative Agreement (AMRDEC)
- Department of Transportation/Federal Aviation Administration Launch Act (WSMR)
- Cooperative Research and Development Agreement (NAWC, WSMR)
- Commercial Service Agreement (NAWC)
- Test Requirements Document (RTC)
- Test Use Agreement (RTC)
- Other transactions (U.S. Army) (10 U.S.C 2371)
- Letter of Agreement (WSMR/WSTC)

NASA:

- Space Act Agreement
- Enhanced Use Agreement
- Commercial Space Launch Act Agreement
- Cooperative Research and Development Agreement
- Exclusive Use Agreement (permit, lease)
- Request for Information
- Transfer ownership via General Services Administration
- Shared use with other customer or government

Table 1. Government Propulsion Organizations Contacted

- U.S. Army, White Sands Missile Range/White Sands Test Center (WSMR/WSTC)
- U.S. Army, Program Executive Office Missiles and Space (PEO M&S)
- Missile Defense Agency (MDA)
- NASA, Stennis Space Center (SSC)
- NASA, Marshall Space Flight Center (MSFC)
- U.S. Navy, Naval Air Warfare Center Weapons Division (NAWCWD)
- NASA, Michoud Assembly Facility (MAF)
- U.S. Army, Aviation and Missile Research Development and Engineering Center (AMRDEC)
- U.S. Army, Redstone Test Center (RTC)
- U.S. Air Force, Arnold Engineering Development Complex (AEDC)
- Federal Aviation Administration (FAA), Office of Commercial Space Transportation
- DAU Contracting Department and Engineering Department
- U.S. Army Corps of Engineers, Engineering and Support Center
- NASA Glenn Research Center, NASA Plum Brook Station
- U.S. Army, Army Materiel Command (AMC), Office of the Command Counsel

Atlas V launches third Advanced Extremely High Frequency Satellite for the U.S. Air Force in September 2013.
United Launch Alliance photo.

Initial Findings

Templates for a subset of these agreements were provided as best practices by NASA and DoD organizations contacted. The samples demonstrated the practical tailoring of agreements that can be conducted specifically under the Space Act and U.S.C. 2539b. The AMRDEC Test Agreement is an example of a streamlined 2539b agreement through which the Army provides facilities and expertise. The agreement is typically shorter than five pages and has been used for laboratory demonstrations tied to testing. The industry user simply provides a statement of work (SOW) with expected level of effort to the test organization. This is then reviewed and approved or disapproved by an Army legal representative. The company president and AMRDEC Center Director co-sign the approved agreement, and work commences. The industrial partner then provides reimbursement to AMRDEC. Rates are determined at AMRDEC's leadership level. The simplified Test Agreement workflow is depicted in Figure 1.

Another noteworthy example, a 2539b-derived Commercial Services Agreement (CSA), was provided by the U.S. Navy's Naval Air Warfare Center Weapons Division (NAWCWD). Table 2 provides a description of the features and requirements of the CSA. These are common to most public-private agreements utilized by the federal government.

Analysis and Recommendations

The structured interviews and example agreements revealed that NASA and DoD have significant experience with industry engagement and are making strides through use of the Space Act, Public-Private Partnering Authorities, the Commercial Space Launch Amendments Act of 2004 (49 U.S.C. § 70101) and implementations of such statutes. However,

Figure 1. AMRDEC Test Agreement Process

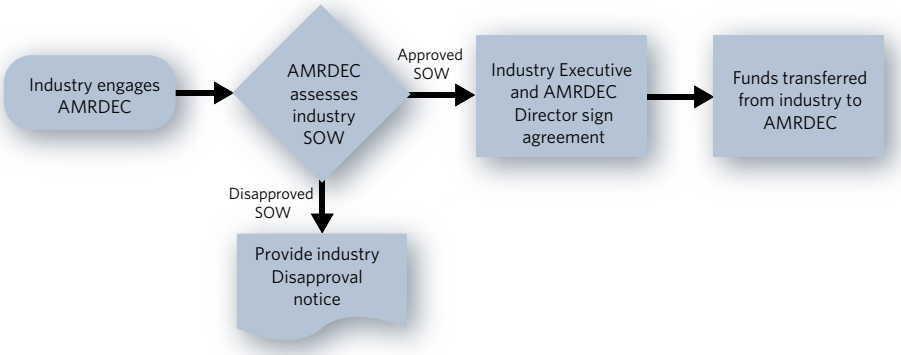


Table 2. NAWCWD CSA Features

Common features—From NAWCWD Web site

Commercial Services Agreements (CSAs) Purpose and Benefit

A variety of vehicles encourage working relationships between federal laboratories and non-federal, U.S.-based commercial entities (e.g., private companies, state and local governments, and academic institutions). These agreements allow federal organizations to work with commercial customers to perform laboratory and range test events at DoD installations. The arrangement is win-win for government and industry.

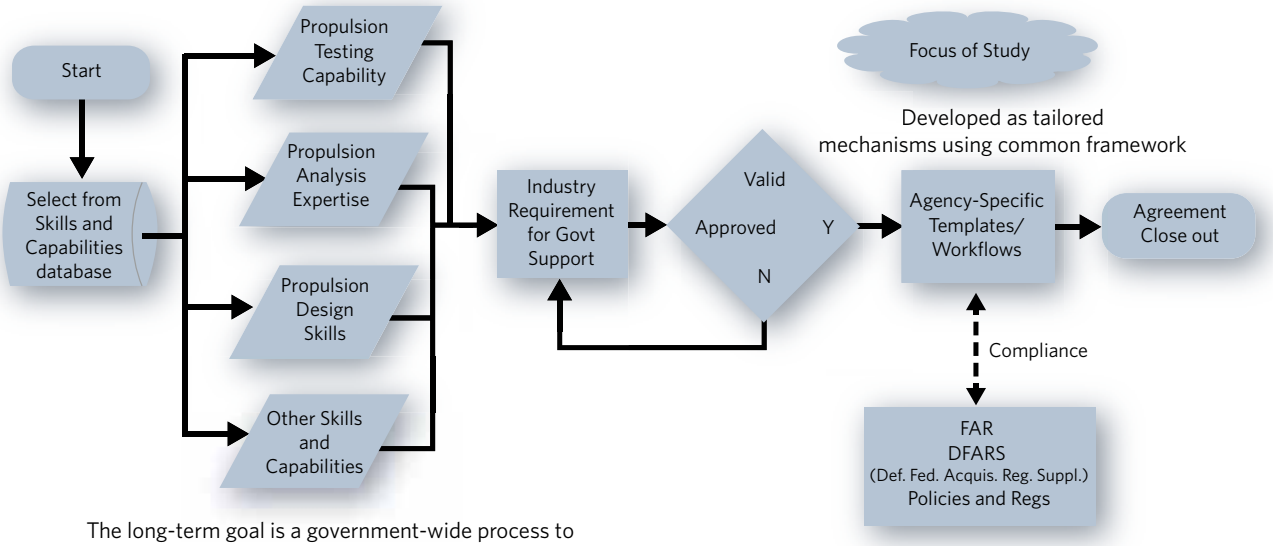
General Requirements for CSAs

- Must be in the best interest of the U.S. government
- Must be on a non-interference basis
- Must be cost-reimbursable with funding received in advance. Payments may be incremental
- Work cannot be guaranteed or warranted
- U.S. government must be held harmless against all claims
- U.S. government may not compete with private industry
- No other similar capability exists
  - Or the capability exists, but other sources cannot meet time requirements
    - Or other sources cannot provide adequate security or safety
    - Or other sources do not want the specific work
    - Or the only available U.S. businesses that can provide the needed services are also competitors
    - Or other sources cannot provide a unique combination of integrated products/services

the interviews yielded inconsistencies in the streamlining of government-industry agreements. The problem areas included both the formation and the execution of agreements—hence, the structure of the agreement and the workflow in getting agreements approved were identified as issues.

DAU explored a more adaptable solution to ensure binding mechanisms enable, rather than impede, utilization of infrastructure, expertise, equipment and support services. As a result, the following study question was posed: "Can a novel framework be devised to streamline binding mechanisms for industry's use of government rocket propulsion resources?" Initial study guidance from NIRPS was to explore a cross-governmental solution given the diversity of governmental agencies and activities across the propulsion sector. Since 2539b is DoD-specific and the Space Act is NASA-specific, the solution would need to accommodate a variety of scenarios while adhering to federal acquisition

Figure 2. Selection and Template Generation for Government Resources



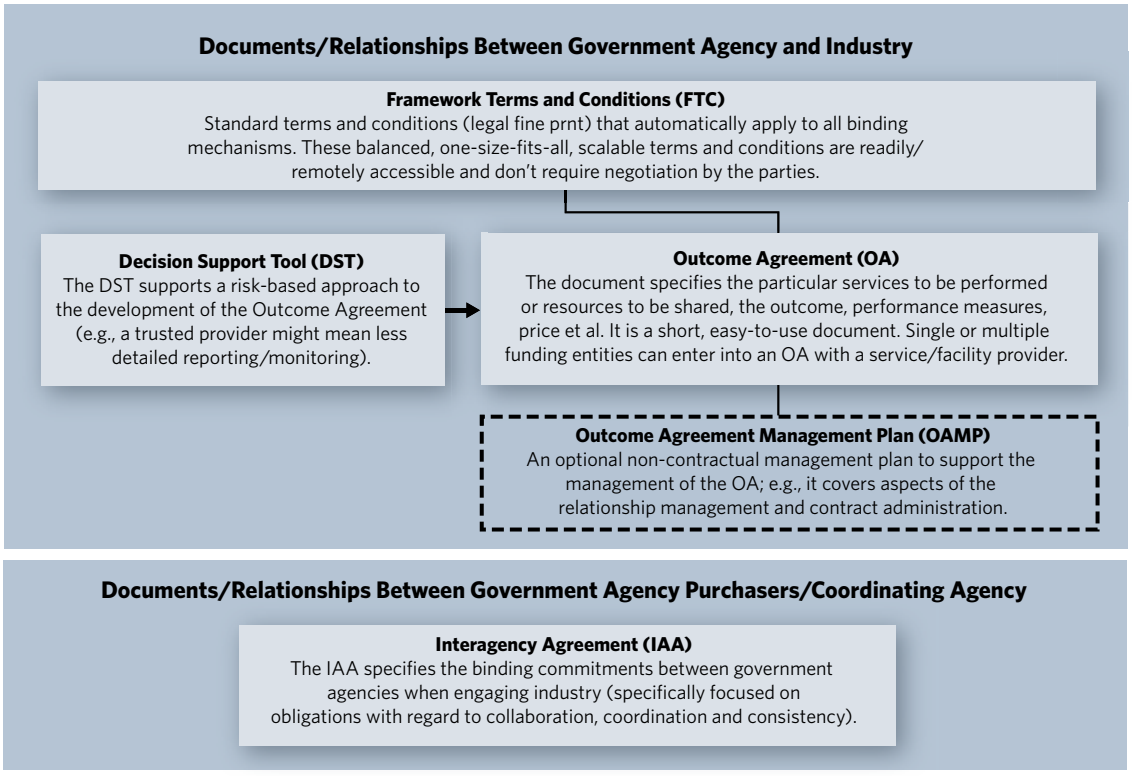
The long-term goal is a government-wide process to streamline industry access to federal propulsion assets.

Sierra Nevada Corp. recently announced the expansion of its Dream Chaser program team and scope of work in Huntsville, Ala., with the signing of an SAA Annex with NASA's Marshall Space Flight Center.
NASA photo.

requirements. A novel approach has been developed whereby capabilities- and skills-based templates could be chosen from a database (see Figure 2).

Using this process, a skill/capability could be chosen from a central repository and the "if-then" conditions that follow would be agency-specific or interagency-based. In Figure 2, various propulsion skills are depicted from an interagency database. The industry user could select the government resource needed to assist in product development. The requirement(s) for government support would then be proposed and subsequently validated by the government resource provider. Templates and workflows based on the Space Act, 2539b and related policies would be generated to yield a government-industry agreement.

Figure 3. Outcome Agreement Framework



The U.S. Army utilizes Test Service Agreements to provide industry users with services for conducting tactical missile research, development and technology demonstrations.
U.S. Army photo.

The templates could then be structured using the Outcome Agreement Framework in Figure 3. This framework was derived from a model utilized by the government of New Zealand (www.procurement.govt.nz) for its private-public partnerships. The model was discovered during an extensive literature search and could be repurposed for this effort. It would yield generic mechanisms to accommodate a diversity of life-cycle activities, organizations and legal/contractual scenarios. As depicted, an Outcome Agreement (OA) would be the core product with Framework Terms and Conditions providing the legal bounds of the mechanism. A Decision Support Tool (DST) would enable a risk-based development by identifying preferred industry users. An Outcome Agreement Management Plan would support the management of the OA. An Interagency Agreement would provide the binding commitments among government entities with respect to industry engagement.

The features of this framework are explained in the diagram in Figure 3. Of note is the DST, which would base the tailoring of agreements on risk and the notion of a trusted provider. Risk management is commonly practiced across government agencies with supplier risk management a subset of the practice. Given a risk model and a set of parameters to assess potential issues, the DST would be a useful tool to streamline the approval process for propulsion industry users.

The creation of this framework is a step toward answering the question of whether such a model can be developed and effectively applied. A follow-on study is planned to apply the framework in a pilot scenario such as a rocket component test at a DoD or NASA test facility.

Planned Study

During the Phase Two study for NIRPS, DAU-South plans to assess both the resource selection process and the agreement framework and collaborate on their usage in a typical scenario. Government policies will be explored further to determine whether additional streamlining is allowable and how industry innovation can be accommodated through such efficiencies.

The product of this effort will be a decision methodology that allows adaptive, streamlined commercial use of government propulsion resources.

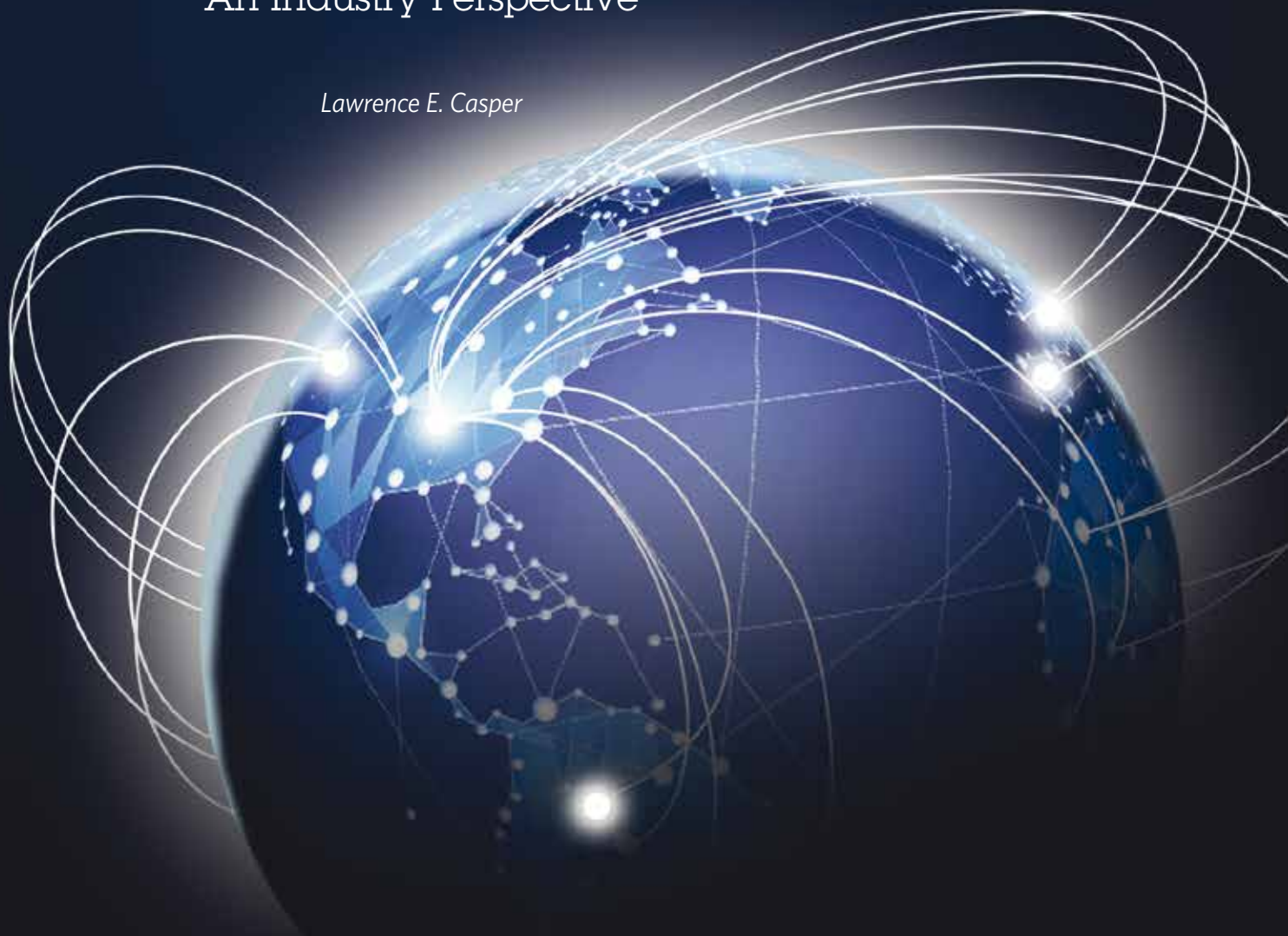
A contractual framework, intended to reduce bureaucracy and serve the taxpayer and national interests while adhering to legal requirements, is the expected result of this consulting effort. Through continued studies, it is expected DAU will provide a significantly improved method to enable industry access to government propulsion resources.

The author can be contacted at **john.rice@dau.mil**.

International Arms Sales

An Industry Perspective

Lawrence E. Casper



I have spent a number of years selling sophisticated defense items to countries around the world, representing both a large U.S. defense contractor and the U.S. government. It was fascinating work and brought me in direct contact with some of the brightest and most influential people in many countries.

This article addresses some of the motives for procuring defense items, the effort involved in pursuing international weapons sales, and key elements of success. The article is based on personal experience and provides but a brief overview of what is in reality a very complex process. The opinions expressed are mine alone.

The Motive

Over the years, I have observed that while governments ostensibly procure for the purposes of military defense and national security, their purchases can also reflect contrary or unrelated considerations. Most governments give the defense of the nation a top priority, yet for some that is not always as evident as one might intuitively think. Critically examining what countries ultimately procure may reveal other underlying motives and priorities.

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Technology transfer interests, domestic industrial policies and political alliances can influence national procurement decisions, as can internal/domestic prestige and credibility and high-profile jobs programs. Additionally, defense projects often stir nationalist pride and are frequently more politically appealing than domestic acquisitions. Although these are all valid considerations, I believe governments generally purchase defense items for one of three fundamental purposes.

First, governments seek to equip their militaries to participate in international or coalition operations. They do this for multiple reasons (e.g., international prestige, justification of military force structures, contributing to alliance and coalition requirements, etc.). As an example, New Zealand has no significant military threat to its borders and national integrity. However, because concern over illegal immigration is a national priority, the government has eliminated Royal New Zealand Air Force fighter and strike requirements in favor of transport and surveillance aircraft.

Yet New Zealand also participates with its Army in places like Afghanistan, in the Multinational Forces Observers (MFO) on the Sinai Peninsula, and in other peacekeeping operations throughout the world. This has led to a well-equipped Army outfitted with modern and effective soldier kit, communication systems, vehicles and anti-tank and air defense missiles for the deployed forces. Ireland and Canada are also countries with defense procurement policies focused on commitments and operations both at home and abroad and not driven primarily by direct threats to their individual sovereignty.

Second, some countries face external threats, yet for various reasons are unlikely to participate in external international or coalition operations. Taiwan is an example of such a country, given its proximity to the Peoples' Republic of China and the inherent geopolitical limitations of the role of Taiwan Armed Forces. In a report for the U.S.-China Economic and Security Review Commission on Taiwan's declining defense spending, Craig Murray wrote that, in 2013, Taiwan spent 2.1 percent of its GDP on military equipment modernization, focusing on island defense and not on force projection.

Third, the majority of nations are found between these two ends of this military-priorities spectrum. These countries, depending on where they fall on such a continuum, equip their armed forces both to defend their borders and to participate in United Nations and coalition operations. The United States is positioned about in the middle of the spectrum, with a force structured to defeat enemies both at home and abroad.

There are a number of ways to categorize or differentiate between customers and the strategy to conclude a sale, but understanding the procurement motive provides a basis for the pursuit.

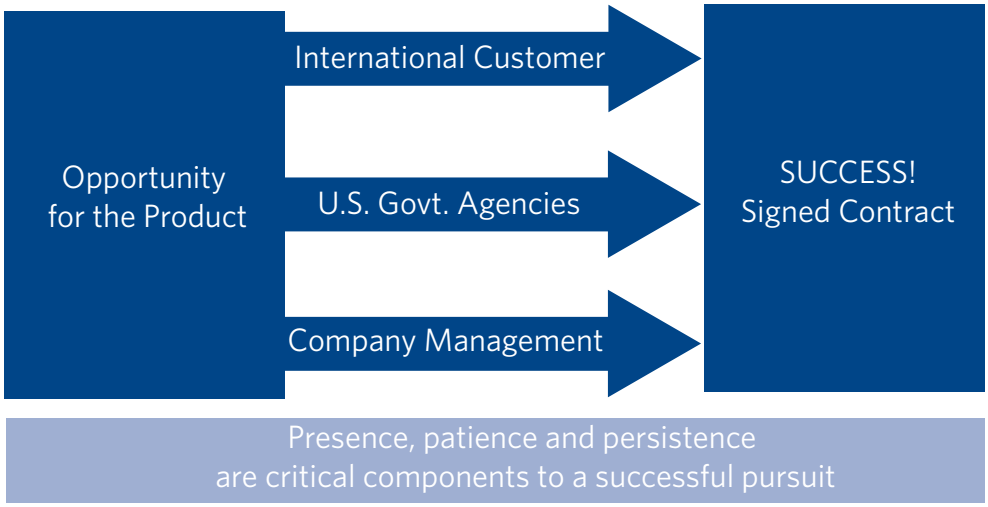
The Pursuit

While each international pursuit is unique, pursuits can share some similar attributes. It can often take five years or more to close a sale, and during a given country pursuit typically three "campaigns" must be executed simultaneously to complete the sale (Figure 1).

The three campaigns are: (1) convincing the international customer that your product is the best solution; (2) aligning the pursuit with the U.S. government's national security policy objectives and requirements; and (3) selling the effort to your company management to ensure priority and funding for the pursuit.

Convincing the international customer that you have the best solution is not always a quick or easy task. The campaign must be aggressively worked at the political, governmental, industrial and public levels. It involves seeking out indigenous

Figure 1. Three Simultaneous Campaigns Lead to a Successful Sale



- The three campaigns must be initiated and maintained from the time the opportunity is identified throughout the pursuit to contract signing—Foreign Military Sales or Direct Commercial Sale.
- Each campaign is consistent in a theme and overall goal (successful sale), but each campaign is crafted to meet the individual stakeholder's objective.
- No single campaign is more important than the other—a failure in one means a failure of the entire pursuit.
-

Some countries are understandably concerned about attacks from other nations, yet for various reasons are unlikely to participate in external international or coalition operations.

champions in the military, political and industrial communities that believe your product best meets their stated and implied needs. Domestic and international business alliances must be established, marketing and communication campaigns developed and relationships solidified with all customers. Your efforts can be complemented by your domestic and international suppliers if they possess relationships in the target country. This campaign can be complex and may require a presence in the country where the business is sought, as well as an abundance of patience and persistence.

In the international defense sales business, it is imperative to partner with the U.S. government. Although selling military systems to international customers is an extension of our government's foreign policy, this support is not provided automatically. A separate campaign must be waged with the government, extending from the military component's program office, throughout the Service agencies to the Departments of Defense, State, and Commerce. This initiative encompasses education about the international customer, prompting action when and where needed, and, in some cases, assisting and supporting the government with communications, briefings, visits and the like. At times, the U.S. defense contractor may initially have more insight than the U.S. government officials into the international customer and the competitive environment involved in its purchase of arms.

International pursuits can be expensive and over time can consume considerable resources before achieving discernible results. This drives the third campaign, which is keeping company management informed, involved and convinced that the effort is buttressed by a compelling business case. The success rate of international pursuits is not high, and other company programs often compete for limited new business funding. The challenge is to keep program momentum moving forward with senior management over the length of the pursuit as they prioritize bookings growth, predictable revenue, solid margins and a sound cash position.

The theme of the three campaigns must be consistent (best solution, best value), yet each of these campaigns must also be crafted to accommodate individual stakeholder objectives. For the international customer, the objectives are performance, price and politics (although performance is often trumped by politics or price). For the U.S. government, the objective is to provide equipment that is compatible with our own military, thereby strengthening ties between the United States and the customer nation. And for the defense contractor, the objective is a capable and dependable product with a compelling business case. The campaigns must be executed in parallel, with no single campaign necessarily more important than another.

In some cases, objectives overlap. Both the U.S. government and the contractor have an interest in maintaining the industrial base. And both may want to attain interoperability.

Finally, do not underestimate the power of relationships when executing the campaigns. Maintaining close professional relationships with all parties is essential for success.

In the end, a successful international arms pursuit is the culmination of efforts by the U.S. government and industry teams stationed in the customer countries and the support of countless U.S. government and industry employees occupying their offices back in the United States.

The Business

International arms sales can be complex and lengthy regardless of a country's procurement motive. An exception is when a country is in conflict directly supporting U.S. government efforts and objectives. Under these circumstances, arms are often purchased quickly, cutting through government bureaucrat red tape. An example occurred shortly after the Sept. 11, 2001, terrorist attacks on the Pentagon and New York City's Twin Towers. A U.S. government foreign military sales case for a small quantity of Javelin handheld launchers and missiles was processed in fewer than 30 days, followed by training and initial delivery in under 45 days. This herculean effort by government and industry was in support of a coalition partner deploying to Operation Enduring Freedom in Afghanistan.

International arms sales are highly regulated, demanding strict compliance with U.S. laws, policies and procedures, as well as those of the procuring country. Additionally, the business can be unpredictable, as an ally today may not be an ally tomorrow, thereby negating years of effort and investment. Selling weapon systems in the international market takes continued presence, abundant patience and steadfast persistence.

Despite the challenges, selling defense systems internationally strengthens the U.S. industrial base and helps sustain technological and operational advantages, while supplying our allies and coalition partners with the best weapon systems in the world.

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INNOVATE
INSPIRATION
IDEAS

Critical Thinking

A Missing Ingredient in DoD's Acquisition (Education) System

Sean M. Frisbee ■ *Scott Reynolds*

... [T]he procurement process itself is a weapon of war no less significant than the guns, the airplanes, and the rockets turned out by the arsenals of democracy.

—I. B. Holley

In his review of the industrial buildup for World War II, renowned historian I. B. Holley eloquently highlighted the importance of acquisition to our country's overall defense posture. The role of advanced technology and weapon systems to successful World War II outcomes is widely recognized. From a fiscal perspective, acquisition professionals historically spend over half of Department of Defense (DoD) annual expenditures. In FY2013, that dollar amount topped $400 billion.

The organization with the formidable task of training and educating this workforce is the Defense Acquisition University (DAU). Headquartered near Washington, D.C., DAU has 500 instructors in five regional campuses across the country. These instructors train all of DoD's 152,110 program managers (PMs), financial managers, contracting officers, engineers and logisticians. Each year, DAU receives many accolades for the excellent job it does in educating the acquisition workforce. In 2013, KnowledgeAdvisors recognized DAU as the top overall corporate university.

Yet it is the graduates of this award-winning university who are responsible for and lead the multitude of failed acquisition programs. Certainly, one cannot hold DAU accountable for failed acquisition programs, but this apparent dichotomy points to

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an important question: Are the Department's personnel adequately prepared to lead the highly complex programs of today and tomorrow?

The complex and unstable environment surrounding federal procurement makes it particularly difficult to train and educate DoD acquisition leaders. Complexity comes in part from technological uncertainties found in weapon system programs as well as the bureaucratic organizational structure. Instability in funding, requirements, personnel and procurement philosophy is exacerbated by the increasingly long time it takes to procure high-tech weapon systems. To be successful, acquisition leaders must not only be technically savvy and capable of understanding the tradeoffs between scope, requirements, schedule, time and costs but must be business and politically savvy enough to coordinate, collaborate with and influence a wide variety of stakeholders such as Congress, the Office of the Secretary of Defense, and Service and industry leaders.

Unfortunately, the DoD acquisition education system is not designed to develop critical thinkers; it is designed to develop process experts.

Acquisition leaders must constantly adapt, motivate and lead their high-performing teams through inevitable change over the long haul. There is no checklist for success. One NASA study on government program management concluded that success depends on multiple external stakeholders, groundbreaking technology and innovation, unprecedented engineering concepts and the management of multiple systems of systems. Leadership and critical thinking skills are crucial in such an environment.

In a recent speech to West Point cadets, Yale University Professor William Deresiewicz argued that these exact skills—leadership and critical thinking—are missing in today's education system:

> We have a crisis of leadership in America because our overwhelming power and wealth, earned under earlier generations of leaders, made us complacent, and for too long we have been training leaders who only know how to keep the routine going. Who can answer questions, but don't know how to ask them. Who can fulfill goals, but don't know how to set them. Who think about how to get things done, but not whether they're worth doing in the first place. ...What we don't have are leaders. ...What we don't have, in other words, are thinkers.

According to Deresiewicz, the answer to overcoming this crisis is to develop leaders with the ability to *think critically*. Not the ability to memorize information, follow checklists or recall specific details at the right time, but the ability to develop their own ideas about a particular subject. He claims that spending enough time concentrating on a subject to develop one's own ideas about it is fundamental to becoming a thinker. Reading, discussing, writing, making connections across seemingly disparate concepts, mulling things over and refining one's thoughts all contribute to developing this skill.

Frank Kendall, Under Secretary of Defense for Acquisition, Technology, and Logistics, has come to similar conclusions. His No. 1 principle underlying his newest acquisition initiatives relates to critical thinking. According to his April 24, 2013, memorandum to the Department:

> The first responsibility of the acquisition workforce is to think. We need to be true professionals who apply our education, training, and experience through analysis and creative, informed thought to address our daily decisions. Our workforce should be encouraged by leaders to think and not to automatically default to a perceived "school solution" just because it is expected to be approved more easily. BBP [Better Buying Power] 2.0, like BBP 1.0 is not rigid dogma—it is guidance subject to professional judgment.

Unfortunately, the DoD acquisition education system is not designed to develop critical thinkers; it is designed to develop process experts: people who understand and can apply the Federal Acquisition Regulations (FAR); who understand the DoD 5000 series regulations, policies and processes; who understand the various stakeholders and their particular roles in the process. The acquisition education system instructs acquisition officials on how to build and present briefings, how to speak with the media, how to build budgets and track expenditures and on myriad other steps necessary to develop, acquire and sustain America's weapon systems. These are all necessary skills, but they are not sufficient.

At the beginning of an acquisition career, trainees face a battery of online courses designed to teach the DoD acquisition process. Students read various policies and regulations and demonstrate their knowledge through acquisition examples and multiple-choice tests. It is an exercise of reading, memorizing, understanding steps in a process, as well as multiple-choice test-taking skills. There is little to no instructor interaction, no feedback or assessment of the quality of thinking the student is exercising, and no opportunity to ask questions, debate or learn the reasons "why" a particular answer might be better than another. In short, critical thinking skills are neither taught nor required in these courses.

In 2002, Lisa Tsui—a researcher for the Education Policy Center at the Urban Institute in Washington, D.C.—published research in the *Journal of Higher Education* concluding that students experienced greatest growth in critical thinking through writing and rewriting with a focus on synthesis, analysis and refinement of ideas. High-quality online courses at major universities employ online course software designed to engage students in debate. Instructors pose a question and students answer the question via short essays. Writing an essay forces students to think hard about their answers and often requires that they do research to support their opinions. The instructor then facilitates a debate around the students' answers by asking each student to provide a response to several students' answers. This approach challenges students to dig deep into topics and extend their learning well past rote memorization.

DAU acquisition training does not include this method. As the acquisition leader gains experience, classroom courses are added to complement the online courses. The resident courses increase depth of knowledge by putting students through a variety of team exercises, allowing students to interact and learn from their colleagues' experiences. They provide students with opportunities to enhance their briefing and oral communication skills, examine past successes and failures via case studies, as well as interact with senior defense and industry leaders. While the classroom courses are a significant improvement to the online courses in terms of student interaction and participation, they fall short in providing an environment that encourages students to think and deeply understand the fundamentals of their profession.

Vern Edwards—author, lecturer and government contracting specialist—recently penned a thought piece related to acquisition professionals in which he argues that effective thinking must begin with contemplation and understanding simple things deeply. He asks his readers the following:

> If asked to explain cost, as used in cost estimate, cost analysis, and should cost, what would you say? If asked to define cost on the spot, could you do it? A cost estimate is an estimate of what, exactly? How much and how good of an explanation could you give to someone who doesn't know anything about it? How deeply could you go into that concept? Could you anticipate the inevitable questions? Could you answer them? ... How much do you know about, and how deeply do you understand, the thing in which you specialize?

One of the authors of this article works with more than 100 senior program managers annually and finds that critical thinking is a rarity. One recent exception was a Navy PM in charge of developing missiles launched from fighters. This PM constantly probed his staff by asking questions such as: Why are we doing this? What other options have you explored? How do we know this is a fair cost? Who did you involve in your decision making? What is our industry partner's stance on this issue? How did your solution resolve their concerns? Through this thinking process and probing, his team found an Air Force missile that met all Navy requirements but cost $400,000 less per missile than his Navy missile. One would think it would be an easy solution to simply acquire the Air Force missiles, saving the government, overall, more than $550 million. However, "old thinking" persisted as senior leadership resisted moving funds from the Navy to the Air Force. It took more than 18 months of marketing, educating and prodding to bring this new idea to fruition.

The authors find the failure to apply critical thinking to DoD procurement repeated day after day at all levels. And while it is easy to point a finger at DAU for failure to teach critical thinking, doing so is shortsighted. The individual shares in that responsibility, as do leaders across the Department who should be mentoring their subordinates in critical thinking. It's difficult, however, to mentor people to think critically if the leaders themselves have failed to learn to think critically. This failure of senior leaders to think critically was epitomized when Robert Gates, while Secretary of Defense, encouraged each Service to think harder and challenge present practices and beliefs to see whether they align with future Service needs and capabilities. His challenges to "think" were met with strong resistance and his motives were often questioned, so much so that he felt obligated to state the following at the Air Force Academy on March 4, 2011:

> My message to the services is being distorted by some and misunderstood by others. At the Navy League last year, I suggested that the Navy should *think* anew about the role of aircraft carriers and the size of amphibious modernization programs. The speech was characterized by some as my doubting the value of carriers and amphibious assault capabilities altogether. At West Point last week I questioned the wisdom of sending large land armies into major conflicts in Asia, Africa and the Middle East, and suggested the Army should *think* about the number and role of heavy armored formations for the future. That has been interpreted as my questioning the need for the Army at all, or at least one its present size, the value of heavy armor generally, and even the wisdom of our involvement in Afghanistan. I suspect my remarks today will be construed as an attack on bombers and fighters. [Emphasis added.]

The frustration experienced by Gates suggests that Kendall's goal of improving the thinking of acquisition professionals will

require much more than direction from above—it will require deep introspection by acquisition leaders on how their beliefs and actions have caused today's challenges. At a minimum, the Department will need to make significant changes to its education process and how leadership engages and mentors acquisition professionals. Perhaps the following recommendations for DAU will spur some thinking in the Department about how it might go about creating critical thinkers.

Recommendations

Recommendation 1: Understand that embedding good thinking habits cannot be surged at the senior-officer level. Revamp all entry- through senior-level training courses to engage students in critical thinking about the subjects being taught.

One reason change efforts fail is that 68 percent of the people involved in the change effort don't believe they need to change to fit within the new paradigm.

A systems approach should be taken, introducing critical thinking fundamentals such as standardized tools and language into entry-level courses and then building on that foundation as students advance. Faculty would make it explicit when they apply the terms and tools. As students advance, they would be expected to apply the intellectual standards and elements of reasoning and thought. At the most senior levels, the students would not only be expected to have embedded good thinking habits and superior content knowledge but be working on their ability to mentor their teams on sound critical, creative and analytical thinking techniques. Many of these changes counter DAU's cost-per-training-hour and seats-per-offering approach that has brought many accolades. As Deresiewicz suggested, the ability to think critically requires spending enough time concentrating on a subject to develop one's own ideas. It requires reading, writing, discussing and making connections across seemingly disparate concepts. It requires giving students time to stop and reflect. Metrics for success will have to measure not only the quantity of graduates but the quality.

Recommendation 2: Adjust DAU's instructor recruiting, training and certification process to include professionally qualified as well as academically qualified instructors and ensure all instructors are qualified to advance improved thinking skills.

The majority of faculty members arrive at DAU as retired practitioners from the civilian and active-duty DoD acquisition career field. Because of their many years of experience, these members are considered professionally qualified to instruct DoD acquisition courses. When entering DAU, these instructors complete a training program. The training program should be modified to include instruction on approaches to developing critical thinking skills.

Additionally, DAU should consider adjusting the mix of faculty to include academically qualified (AQ) instructors from major universities. They could be rotating positions where each faculty member spends two to four years at DAU. During their tenure, these AQ faculty members could advance their research in areas related to DoD procurement, research that may be difficult to accomplish in a civilian university. The DoD would benefit from an increased variety of instruction as well as the advancement of ideas specifically focused on DoD procurement. Finally, the mix of faculty would continually bring fresh thinking into DAU.

Recommendation 3: The Department should consider developing a specialized program patterned after the Services' highly successful advanced strategy schools but with a bent toward weapon system procurement and the development of business-oriented strategists and critical thinkers.

The Services answer the need for developing the next generation of warfare strategists by creating specially designed advanced academic programs. The School of Advanced Military Studies (SAMS, Army), School of Advanced Air and Space Studies (SAASS, AF), Joint Advanced Warfighting School (JAWS, Marine) and the Advanced School of Air Mobility (ASAM) are examples of such programs. These schools are highly competitive, and only a select few Service members have the opportunity to attend. The graduates of the advanced schools are in extraordinarily high demand, experience 5 times the average success in promotion to flag rank and are considered the top strategic thinkers in the country.

An advanced acquisition school akin to this successful approach could create a cadre of highly skilled acquisition professionals ready to tackle the procurement of the most difficult acquisition programs. Each year, 12 to 20 carefully selected students from across the DoD would enter the yearlong school

taught by a cadre of hand-picked specialized faculty members with doctoral degrees or postdoctoral qualifications. As with the other advanced academic programs, the focus of the school would be on critical thinking, but business would be used as the medium to teach advanced thinking skills. Examples of courses to be taught might include business fundamentals, critical thinking and decision making, business strategy and theory, business and government relations, business operation simulation. Students would be required to complete a thesis and comprehensive oral exam. Eventually, this program would be certified to award a master's degree in business strategy.

In addition to creating a cadre of critical thinkers prepared to attack the most challenging weapon system procurement programs, the DoD would benefit from the thought and research resulting from students' theses.

Recommendation 4: Add more business education courses to the curriculum.

In general, DoD acquisition professionals are at a severe disadvantage each day as they find themselves on the opposite side of the table from business leaders who fully grasp business fundamentals. DoD acquisition education is heavy on DoD procurement processes, but very little is taught on business fundamentals. This is particularly troublesome, as DoD acquisition leaders are not required to have any formal business education. An understanding of business principles would provide government acquisition leaders with a better opportunity to structure business deals that create value for the Department and for industry. By combining instruction in the DoD procurement process (currently the entire curriculum) and business fundamentals in a manner that encourages critical thinking, DAU will significantly improve the skill set of the acquisition corps.

Recommendation 5: Improving the quality of thinking of the acquisition corps should begin at the leadership level.

While DAU can lead the educational elements of developing improved thinkers, senior leaders such as Service acquisition executives, program executive officers, program directors and other acquisition leaders down the line must follow Kendall's lead in driving this cultural change. One reason change efforts fail is that 68 percent of the people involved in the change effort don't believe they need to change to fit within the new paradigm. We feel DoD's senior acquisition leadership corps must first understand that it needs to change and then put in the work to do so. The leaders' interaction with the acquisition corps, the questions they ask, the work they drive, and the emphasis they place will ultimately determine whether the leadership corps applies critical thinking to its daily actions or continues to be process focused. Certainly cost, schedule and performance will continue to be stressed and evaluated. However, critical thinking questions such as why a particular strategy is selected, what behavior is expected, how a particular analysis tool is utilized and why the conclusions make sense will cause acquisition professionals to pause and consider the fundamentals of what they are considering.

The views presented in this article are those of the authors and do not necessarily represent the views of the Department of Defense or its Components.

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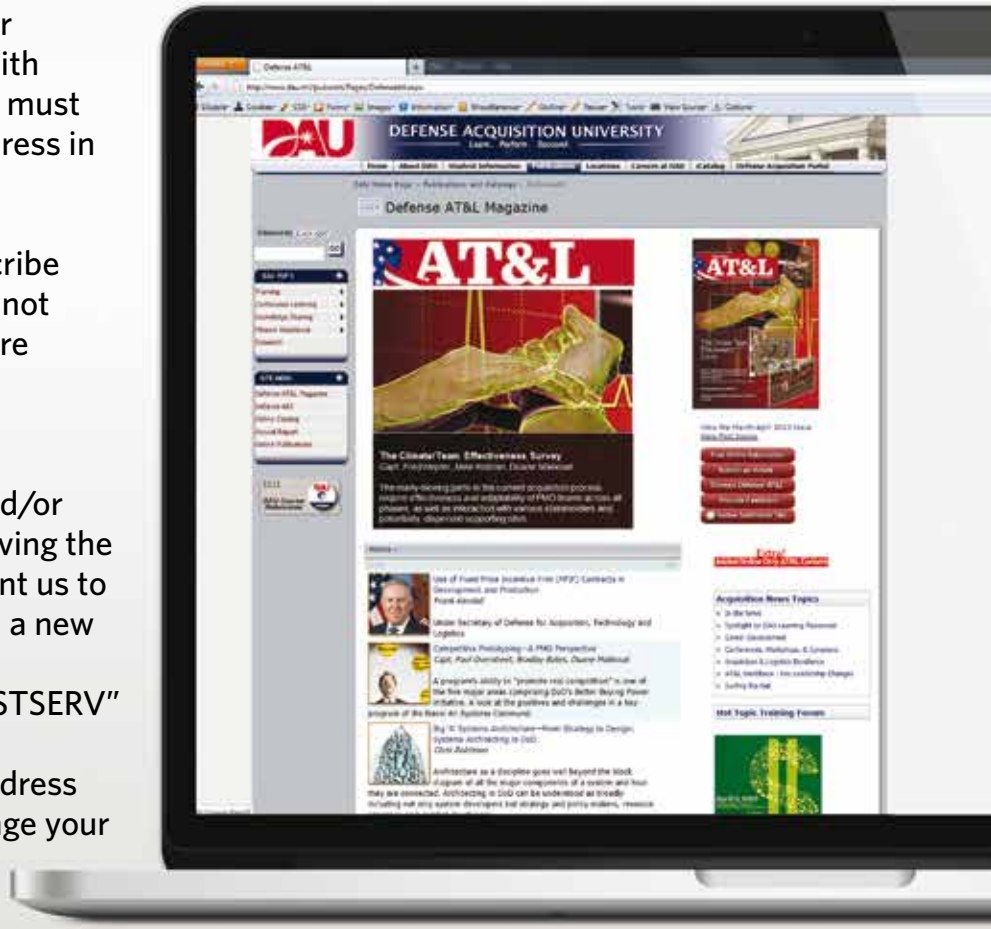
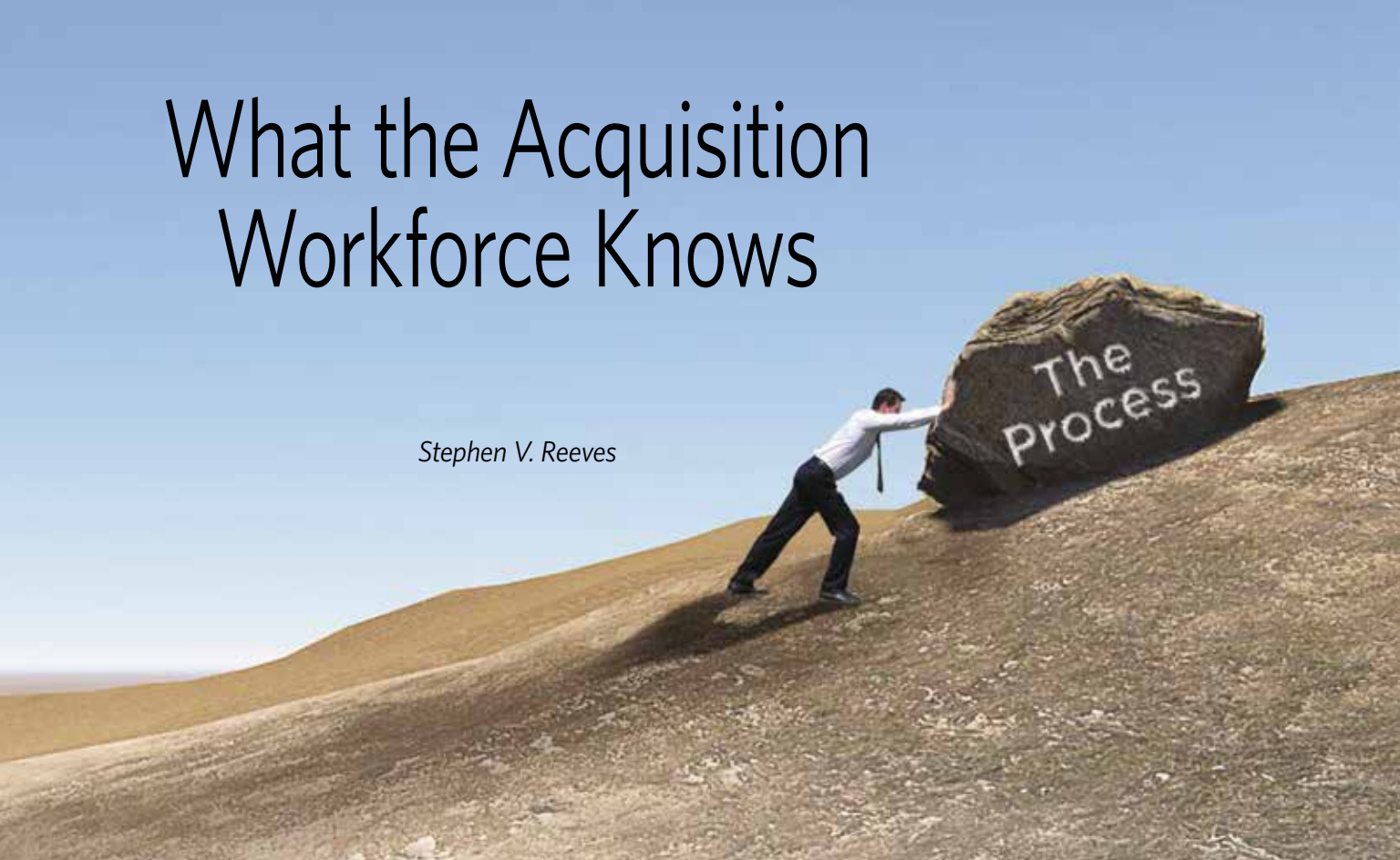


What the Acquisition Workforce Knows

Stephen V. Reeves



As a newly minted Defense Acquisition University graduate and board-selected product manager (PM), I was assigned a program that had, as we euphemistically like to say, some challenges. After a few months, it was clear, to me anyway, that the technology we were pursuing had either reached its limits or would take many more years to mature to a useful state. Before spending more time and money, it seemed prudent to form a team of in-house and outside experts to conduct an evaluation of the technology we were pursuing and if found deficient, an analysis of alternatives.

In a mere matter of days after this team was formed, my prime contractor came visiting, understandably concerned. It wasn't a happy conversation, but it was manageable. That was followed by a call to the deputy project manager's office. This, to a new product manager, was a much bigger deal. The deputy project manager was something of a legend in the business—a well-respected senior leader with more than 30 years' experience. Fully PowerPoint-laden, I made my case. He listened patiently for about 20 minutes, then leaned back in his chair, sighed, and said: "Don't stick your neck out too far. It may get cut off." The message could not have been clearer: Stay with the process.

Ah, process. It is at once a useful management tool, often maddening and the bureaucrats' comfort food. For defense acquisition, process reached its zenith in 1991 with 840 pages of instruction, regulation and policy in the Department of Defense (DoD) Instruction 5000 series, an attempt to anticipate and control every imaginable possibility. While defense acquisition is justifiably called "the most complex business process in the world," the simple fact is that many take comfort in "the process." Outcomes ultimately matter, but for too many it's all about "the process." The process provides management with a sense of control, the workforce with guidance, and a security blanket to those who simply want to get through the day and avoid any trouble.

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Calls to streamline, tailor and, of course, reform "the process" are legendary. In fact defense acquisition reform is something of a cottage industry with over 300 major and minor studies done since DoD's formation in 1947. The studies are all generally conducted by bright, experienced, well-intentioned and well-informed people. These studies' findings are also all remarkably similar: train the workforce; develop better leaders; control cost; cut the bureaucracy; scrub the accretion of laws, regulations and policies; streamline the process and so on. Acquisition reform studies' outcomes are likewise notable in that few, if any of the recommendations are ever actually implemented.

Why are all these studies generally ignored? There are certainly many reasons from the cynical to the practical. But the industry/government reform panel in 2011 perhaps best summed it up by pointing out the following: "Our System of Government—established on a foundation of checks and balances crucial to preserving our democratic political traditions—stumbles when the same principles are applied to business functions." The same panel went on to observe that, "There is more emphasis on things not going wrong than on assuring most things go right." This results in a process that is "agonizingly ponderous to manage and slow to produce."

There is also another reason. While most studies quite reasonably argue for "fixing the process," along with a host of recommendations, they barely mention, if at all, the challenge of cultural change and equally important, ways and means to achieve that cultural change. A notable exception is former Under Secretary of Defense for Acquisition, Technology, and Logistics (USD[AT&L]) Dr. Jacques Gansler. In his book, *Defense Conversation*, Gansler highlighted not only the need for cultural change but both the challenges and means for cultural change and change management.

So what? Consider some very recent history. In 2010, the acquisition community was given new direction in the DoD Better Buying Power initiatives. This was a set of best practices carefully crafted to improve processes and outcomes in defense acquisition. A key provision of Better Buying Power was its direction to use "lowest price, technically acceptable," or LPTA, as a source-selection criterion. There was also a key caveat to this guidance: Low price should be balanced against low technical risk.

But that is not what many in the acquisition workforce heard. What they heard was "low price." Why? First because it was the lowest-common-denominator solution. "Technically acceptable" required defining what was technically acceptable. Second, it required a judgment call. In a risk-averse culture, where penalties for failure far outweigh rewards for success, no one could argue when an award was based on the lowest price bid. "Technically acceptable" however, is a judgment call subject to definition, second guessing, bid protests and investigations.

So let's try this again. In 2013, Better Buying Power 2.0 and the new Interim DoD Instruction 5000.02, *Operation of the Defense Acquisition System*, were issued. Both exhort the defense acquisition community to use flexible processes, tailored strategies and above all, professional judgment. These documents provide suggested and preferred methods and models but ask the acquisition community to use professional judgment in their application. All excellent guidance.

"Technically acceptable" ... required a judgment call. In a risk-averse culture, where penalties for failure far outweigh rewards for success, no one could argue when an award was based on the lowest price bid.

Unfortunately, neither history nor culture is on the side of using judgment. Take, for example, bid protests. DoD contracts are less likely to be protested than contracts in the rest of the U.S. government. Why? The acquisition workforce knows that precisely following the process precludes or at least constrains most bid protests—and the DoD process is very successful when protested. According to the Congressional Research Service, from FY2008 to FY2012, DoD accounted for approximately 70 percent of government contract obligations but only 57 percent of protests filed against the federal government. Yet while contractor protests were sustained by the Government Accountability Office (GAO) at a rate of 17 percent across the government, protests against DoD were sustained at a much lower rate. In FY2008–FY2012, only 2.6 percent of protests filed against DoD were sustained by GAO. In FY2013, the Air Force reported only 1.4 percent of GAO protests were sustained.

The current fiscal environment doesn't help either. The workforce knows that as budgets go down, protests go up. Again from the Congressional Research Service, from FY2001 to FY2008, total government procurement spending, adjusted for inflation, increased faster (over 100 percent) than the number of protests filed (35 percent). This trend reversed itself in FY2008: In FY2008–FY2012, total government spending, adjusted for inflation, decreased more than 10 percent while total protests increased 45 percent. These data indicate that, when compared to the rate of government spending, bid protests decreased from FY2001 to FY2008, and increased from FY2008 to FY2012. Yet DoD, following a very defined process, won virtually all bid protests.

The workforce also knows that the smaller the contract, the more likely there will be a protest. For big companies bidding big contracts, a GAO protest is a business decision. For small companies, a decision to protest may mean the life of the company, a lack of understanding of the process, or simply an ego-driven decision. As the Naval Postgraduate School stated in a 2010 monograph, "Understanding and Mitigating Protests of Department of Defense Acquisition Contracts": "Most protests involve contracts with comparatively small value—under $100 million—where protestors are relatively small—fewer than 500 employees, and most protests are by small companies protesting awards to other small companies." For smaller contracts, abbreviated contracting procedures and tailored strategies would seem to make perfect sense. Yet in a highly risk-averse environment, small contracts can become every bit as complex as a major acquisition in terms of locally imposed process in an attempt to preclude or be fully prepared for a protest.

Process substituting for judgment is the unfortunate lesson well-learned. Look at any budget-driven acquisition strategy. The workforce knows that budget-driven programs result in underestimating the time, costs and risks of future actions while overestimating the benefits of those actions. This occurs even when they have experience with similar overrunning tasks. This is generally known as the "Planning Fallacy" and was first proposed in a 1979 paper by Daniel Kahneman and Amos Tversky. In a more humorous take, Bell Labs' Tom Cargill offered the 90–90 rule for software development: "The first 90 percent of the code accounts for the first 90 percent of the development time. The remaining 10 percent of the code accounts for the other 90 percent of the development time."

Yet even when independent observers review programs and offer more pessimistic views of cost, schedule or technical performance, programs frequently proceed, having checked all the blocks and followed the process. In March 2014, the GAO reported "Over the past year, the overall size of DoD's major defense acquisition program portfolio decreased, from 85 programs to 80, while the estimated cost has increased by $14.1 billion. The average time to deliver initial capability to the warfighter also increased by 2 months. ... In addition, many programs continue to commit to production before completing developmental testing."

So is "the process" the enemy? We certainly spend enormous resources both following it and suggesting ways to reform it. Yet process is also a fundamental management tool and mechanism for large groups of people to work collaboratively. Process also provides a mechanism for best practices and ensuring fairness in competition for defense procurements.

Process, however, is only a means to an end. Processes should be flexible and adaptable to the situation and allow for exceptions. The November 2013 Interim DoD Instruction 5000.02, Operation of the Defense Acquisition System,

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 that occurred in recent months.

Army

Col. James F. McNulty relieved **Col. Robert G. McVay** as project manager for Integrated Personnel and Pay System-Army (IPPS-A) in May.

Air Force

Col. Amanda G. Kato relieved **Col. Cordell A. DeLapena Jr.** as program manager for the Family of Advanced Beyond Line-of-Sight Terminals Increment 1 (FAB-T Inc 1) Program on March 17.

Col. Amy J. McCain relieved **Col. Ronald L. Jackson** as program manager for the Presidential Aircraft Recapitalization (PAR) program on April 10.

Col. Philip A. Garrant relieved **Col. Mark A. Baird** as program manager for the Joint Space Operations Center (JSpOC) Mission System Increment 2 (JMS Inc 2) program on May 1.

Linda W. Haines relieved **Thomas Davenport** as program manager for the Air Force Integrated Personnel and Pay System (AFFIPPS) program on May 4.

Col. Andrew J. Knoedler relieved **Col. Thomas J. Killeen** as program manager for the Mission Planning System Increment IV (MPS Inc IV) program on May 17.

certainly echoes this approach. The question remains, however, whether these new flexibilities will be used and professional judgment actually exercised. Or will the "suggested" or "recommended" approaches or "model programs" simply become additional sets of rules to be followed to the letter by a risk-averse bureaucracy?

culture, not just the rules. That is an excellent insight. The question remains: How?

The workforce members know that somewhere beyond the challenges of social, business and political change is institutional change in the bureaucracy, with its aversion to all risk.

Thornberry stated that effective acquisition reform must change the culture, not just the rules. That is an excellent insight. The question remains: How?

Leadership and change management literature generally all begin with the conclusion that a leader's most important role in any organization to set the example and make good judgments. If cultural change is to occur, and "using professional judgment" is to be institutionalized, it must begin with good leaders. To that end, the USD(AT&L) issued a November 2013 policy memo titled "Key Leadership Positions and Qualification Criteria." The memo outlines training, education and experience requirements for acquisition leaders as well as a process for screening members of the acquisition workforce to ensure they meet the criteria for key leadership positions. It's an excellent start.

Unknown, however, is whether, having selected key leaders with all the appropriate qualifications, their experience is the right experience. Does their experience support accepting risk, using professional judgment to tailor the process and challenge the planning fallacy? Or does their experience tell them the process is their protector and friend and "don't stick your neck out too far"? A board reviewing qualifications on paper has little way of knowing.

Even the concept of judgment is a fairly murky one. As Noel M. Tichy and Warren G. Bennis point out in a 2007 *Harvard Business Review* article: "The leadership literature has been conspicuously quiet on the topic, and we believe that's because good judgment is hard to pin down. What, exactly, is it? Does it differ from common sense or gut instinct? Is it a product of luck? Of smarts?" Ultimately, after a number of case studies, they conclude: "Judgment is a complex phenomenon, too intertwined with luck and the vicissitudes of history, too influenced by personal style, to pin down entirely."

In November 2013, the House Armed Services Committee and USD(AT&L) announced another attempt at acquisition reform, led by Rep. Mac Thornberry, Texas Republican. Thornberry stated that effective acquisition reform must change the

They also know their job is to deliver capabilities to the Armed Services by somehow bridging the ever-expanding canyon between the rapid pace of technology change and the glacial, risk-averse bureaucracy.

As it stands today, bridging that canyon in a timely fashion means a member of the workforce or project manager must be willing to put his or her career on the line for success. To their great credit, many PMs and acquisition workforce members do just that every day. These are the leaders who accept and manage risk, who use their best professional judgment, who find ways to make things work in a timely, cost-effective manner frequently despite the "help" they receive from "the process."

If the expectation for the acquisition workforce is to use professional judgment, to tailor processes, and accept and manage risk, then these are the leaders and workforce members who should be found, groomed for and given greater responsibilities. These are the leaders who are the vanguard of cultural change.

These new leaders must also be protected, nurtured and mentored by senior leaders. These new leaders will make mistakes. But rewards for success must outweigh punishment for failure. Senior leaders must also allow and encourage the application of common sense and judgment rather than create more rules and fixed procedures. Some of the conditions for success are now set in both the new Interim DoDI 5000.02 and the Key Leadership Positions and Qualification Criteria. But if senior leaders truly expect cultural change and the real use of professional judgment, they must likewise be willing to accept the risk and help stifle those focused solely on the process and not the outcomes.

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Acquisition Challenges of a **Lethal Virus**

Col. Russell E. Coleman, USA

It's 1995. "The Hot Zone" tops best-seller lists, and millions of people the world over are fixated on the threat of incurable "hot" hemorrhagic fever viruses like Ebola. Gruesome depictions of melting skin and oozing blood fill television and movie screens everywhere—but it's not science fiction.

Amid the panic and uncertainty, I am deployed to Zaire, where an outbreak of Ebola is occurring. As an entomologist with the Army Medical Research Institute of Infectious Diseases, I have expertise that will help determine whether the virus is insect-borne.

Coleman *is the joint project manager for the Medical Countermeasure Systems in the Department of Defense's Joint Program Executive Office for Chemical and Biological Defense. In 1995, Coleman deployed to Zaire with a World Health Organization team responding to an Ebola virus outbreak.*

I board the plane and leave behind my wife, who is seven months pregnant. On the tarmac in Kinshasa, I think about the unknowns: How is the virus transmitted? How will I protect myself? Will I bring the virus back home? The only thing I know for sure is this: There is no treatment for the virus I am going to track down.

Advancing Medical Countermeasures

Fast forward nearly two decades, and I am leading an organization charged with developing drugs, vaccines and medical devices to treat emerging infectious diseases—like the Zaire Ebola virus that I was sent to investigate in 1995. The organization, within the Department of Defense (DoD) Chemical and Biological Defense Program, is called the Joint Project Management Office of Medical Countermeasure Systems (MCS). It plays a vital role in implementing the DoD's strategy to prevent, diagnose and treat the effects of chemical, biological, radiological and nuclear (CBRN) threats and emerging infectious diseases.

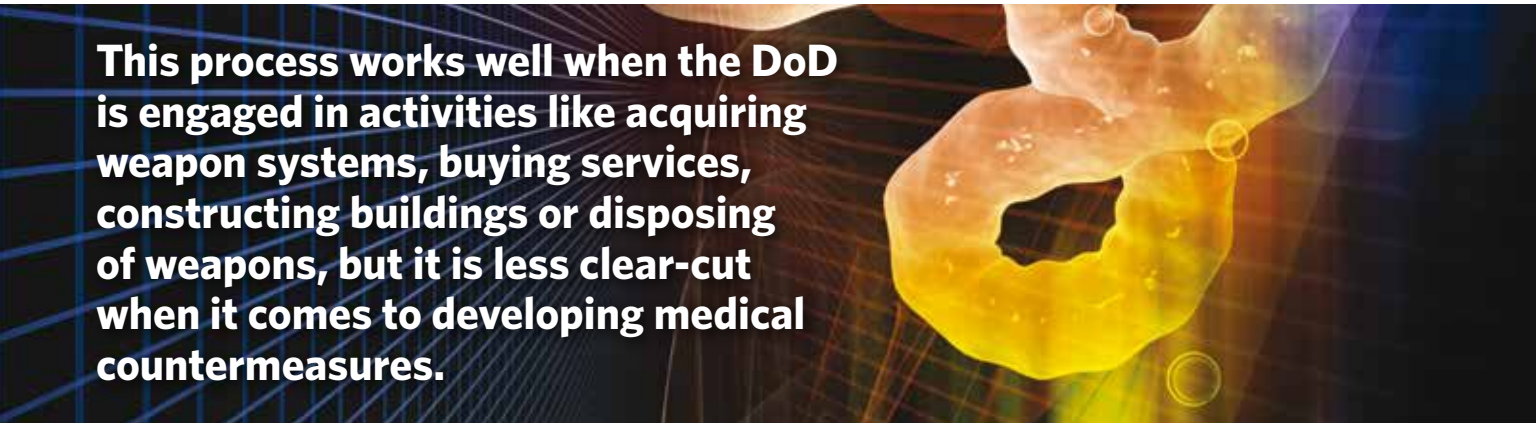
Infectious diseases—whether naturally occurring or engineered with intent to harm—can cause serious consequences for a fighting force. Absenteeism due to illness, costly prolonged recovery, the loss of combat readiness and—in the case of Ebola virus—even death are challenges facing military commands.

MCS is determined to find medical countermeasures (MCM) for several viruses, including Ebola. Recognizing the high failure rate associated with drug and vaccine development, our strategy is to advance several promising candidates concurrently so that if one MCM fails, we can keep moving forward with the more successful options. This is the government's most cost-effective and efficient approach, because by the time some drugs fail, others with better track records have reached important milestones.

The Case for Targeting Ebola

MCS' interest in Ebola and other hemorrhagic fever virus (HFV) infections stems from their high mortality rates. Because HFVs can spread through aerosolization or direct contact with the body fluids of infected persons, DoD has validated and prioritized combating the threat of HFVs, whether naturally occurring or engineered. Along with the agents that cause smallpox, anthrax, plague, botulism and tularemia, HFVs are among six identified by the Centers for Disease Control and Prevention as the most likely to be used as biological weapons.

While some HFVs can cause relatively mild illnesses, many others cause severe, life-threatening diseases. Ebola is a type of HFV characterized by high fever and bleeding disorders. The Zaire species of Ebola virus in particular has been associated with periodic outbreaks in human populations with mortality rates reaching 90 percent.



This process works well when the DoD is engaged in activities like acquiring weapon systems, buying services, constructing buildings or disposing of weapons, but it is less clear-cut when it comes to developing medical countermeasures.

Ebola virus continues to cause epidemics of lethal disease. A rapidly evolving outbreak in the West African country of Guinea was reported by the World Health Organization (WHO) on March 23, 2014. Since then it has spread to Sierra Leone and Liberia. As of July 3, 2014, WHO reported 779 clinical cases of Ebola virus disease, including 481 deaths—a 62 percent case fatality rate.

Acquisition Challenges to Protect the Fighting Force

An MCM to protect U.S. military forces from infectious disease agents like Ebola presents unique challenges in the DoD environment. The DoD acquisition process is complex and thorough for good reason. It is designed to manage risk, allocate resources and ensure that the government is acquiring useful technology. This process works well when the DoD is engaged in such activities as acquiring weapon systems, buying services, constructing buildings or disposing of weapons, but it is less clear-cut when it comes to developing MCMs.

Product variables and uncertainties. Despite technological and engineering challenges, the essential variables are known or somewhat predictable in the fields of weapons, services and construction. For example, we may identify that we need a platform to perform some specific activity, and we can determine that the technology is available. The DoD knows how to develop, integrate and test the equipment; when to replace it; and how to deliver it to the battlefield. While challenges

may arise in this process, there is an inherent amount of certainty in overcoming them.

MCMs are a different story. Viruses, for example, mutate. This immediately removes certainty when trying to develop or acquire an MCM against a specific virus. Beyond a virus' ability to rapidly mutate into other forms, the disease it causes may affect people differently. Symptoms of the same disease may appear and vary significantly from one person to the next. Therapeutics or vaccines to combat these viruses add to this uncertainty because individual reactions to them may differ as well. These variables are often very complex, requiring time to thoroughly understand.

High risk with low return on investment. The nature and backdrop of drug development must be understood and constant attention given to the realities of the industry. The oft-cited statistic is that new drug development takes 10 to 12 years and costs $1 billion. For example, large research and development pipelines may produce many potential candidate technologies in the early stages, but very few clear all of the subsequent required efficacy, safety and related hurdles of development. This results in a funnel, with many candidates entering the process and extremely few remaining viable to the end. Needless to say, it's a risky business.

Beyond the high risk of pursuing therapeutic development in general, the potential return on investment for an MCM is limited. Pharmaceutical companies spend billions of dollars on drug development for chronic diseases that can provide them sustainable profits. However, they typically do not significantly invest in developing vaccines or therapeutics for rare diseases with little recurring revenue potential. Let's face it: From a pharmaceutical company's point of view, the risk of being infected with Ebola is pretty small.

Obtaining DoD and FDA approval. These challenges are exacerbated by the fact that we must navigate not only the DoD acquisition landscape but also Food and Drug Administration (FDA) processes that determine the licensing of vaccines and approval of therapeutics. MCM development and production must work within, and conform to, FDA drug approval requirements in the U.S. Code of Federal Regulations Title 21. The FDA, which is outside the DoD, is required by law to approve all drugs, biologics and medical equipment before they are provided to the public, including to the military Services.

Essentially, the FDA process accomplishes the same goal for drug approval as the DoD acquisition process does for hardware—the FDA ensures that manufacturers provide only safe and effective drugs, biologics and medical equipment to the public. Each process has its own timelines and reporting and management procedures, as well as risk-reduction activities and decision points.

MCS synchronizes the DoD acquisition with the FDA approval process to move through the decision events required by both. Successful decisions allow the product to progress through the two processes to eventual fielding and use by Service members and the nation.

MCS' Strategy to Meet These Challenges

MCS' efforts are critical to our defense. We provide safe, effective and innovative medical solutions to counter CBRN threats by developing promising new technologies and guiding them through both DoD's acquisition process and the intricate FDA approval process. Our four Joint Product Management Offices and two Product Support Offices provide responses to these threats at distinct stages of the continuum of care through programs aimed at preventing, diagnosing and treating CBRN threats. An essential part of this continuum is treating those exposed to an infectious disease.

The TKM-Ebola Example

To provide a strong, layered defense against Ebola, MCS is developing vaccines to prevent the disease and therapeutics to treat it. Our vaccine candidate uses components for the Ebola—Sudan and Zaire—and Marburg viruses in a single formulation. Our anti-viral therapeutic, TKM-Ebola, has received a Fast Track designation from the FDA.

Finding products in the advanced stages of development. At MCS, we work with leaders in the pharmaceutical, biotechnology and medical device industries that have proven technology. Through a full and open competition, our product office for BioDefense Therapeutics (BDTX) found such a product in Tekmira's TKM-Ebola, a drug candidate based on a gene-silencing technique used by plants and animals called RNA interference (RNAi).

In the past decade, RNAi has become one of the most important innovations in the field of drug discovery and development. In fact, in 2006 the scientists who discovered the mechanisms of RNAi were awarded the Nobel Prize for Physiology or Medicine. Tekmira also employs the most widely adopted RNAi delivery technology to date—its proprietary lipid nanoparticle (LNP) technology. LNP is administered intravenously, and the delivery technology allows RNAi drugs to be encapsulated in tiny particles made of lipids (fats or oils) that can travel through the bloodstream to targeted disease sites. LNP formulations are manufactured by a proprietary method that is robust, scalable and highly reproducible. Additionally, LNP-based products have been reviewed by multiple FDA divisions for use in clinical trials. *[Editor's Note: For a general discussion of nanoparticles and their potential role in medical and military applications, see the following article in this issue.]*

In preclinical studies, the TKM-Ebola therapeutic demonstrated 100 percent protection from an otherwise lethal dose of Zaire Ebola virus when TKM-Ebola was used to treat previously infected non-human primates (Geisbert et al., *The Lancet*, Vol. 375, May 29, 2010). The product is under continued development to evaluate safety and efficacy.

The importance of FDA approval experience. MCS makes it a priority to work with industry leaders that have a proven track record in acquiring FDA approval. Tekmira's knowledge of the FDA process and its approved request for FDA's Fast Track designation are critical to bringing the TKM-Ebola therapeutic to the Service members as quickly as possible. The FDA grants Fast Track status to an MCM if it will treat or prevent a serious or life-threatening disease and demonstrates the potential to address unmet medical needs. This status gives Tekmira more frequent written and in-person access to the FDA and allows for Rolling Review, which is an opportunity for submitting the required regulatory documentation to the FDA as it is developed. This helps to compress review timelines because the FDA does not have to wait until all documentation and test results can be submitted at one time.

To conduct a clinical trial, MCS and Tekmira are utilizing ICON Development Solutions, a specialized contract research organization in Phase I-IV clinical studies with a proven track record of success. The TKM-Ebola Phase I clinical trial at the ICON facility in San Antonio, Texas, is assessing the safety, tolerability and pharmacokinetics of administering TKM-Ebola to healthy adult subjects. The trial is a randomized, single-blind, placebo-controlled study involving single ascending doses and multiple ascending doses of TKM-Ebola. As this drug moves through clinical testing, it could become the first FDA-approved therapeutic to treat disease caused by this deadly virus.

About JPM-MCS

JPM-MCS, a component of the Joint Program Executive Office for Chemical and Biological Defense, aims to provide U.S. military forces and the nation with safe, effective and innovative medical solutions to counter CBRN threats. JPM-MCS facilitates the advanced development and acquisition of medical countermeasures and systems to enhance our nation's biodefense response capability. For more information, visit www.jpeocbd.osd.mil.

The Ebola Threat—Revisited

Pursuing practical solutions to counter the complex threat of infectious diseases for the men and women who serve our country is the greatest professional challenge I have ever faced. I often reflect on how far we've come from those terrifying days in 1995. Back then, entire families and communities were being wiped out by the Ebola virus in Zaire. In the hospital in Kinshasa, I met a 70-year-old man who was his family's lone survivor. I think of the deep sadness in that man's eyes—and I return to work every day determined to continue our progress.

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Defense AT&L Wins 2014 APEX Award for Excellence

Defense AT&L magazine recently received an APEX Award for Excellence for magazines, journals and tabloids with issues of 32 pages or more. APEX 2014 awards were based on outstanding graphic design, editorial content and "overall communications effectiveness and excellence."

There were 2,075 entries in all categories from the United States, Canada and Australia, including many from major corporations and associations. APEX awards are an annual competition for publishers, editors, writers and designers who create print, Web, electronic and social media. The awards are sponsored by Communications Concepts Inc.

Assistant Art Director Tia Gray and Managing Editor Ben Tyree receive a 2014 APEX Award for Excellence for the *Defense AT&L* magazine.

Our Troops Need Your BRAINPOWER

Here's a way to put it to work

Join the best minds in science and technology on DoDTechipedia—the new internal wiki for the U.S. Department of Defense. Post ideas, ask questions, make suggestions, or share information with colleagues you can't reach now. It's a way to expand our brainpower, focusing on rapidly responding to the needs of the warfighter.

HERE'S HOW IT WORKS

- **Share your knowledge.** Every contribution counts. The more you contribute, the more the collective knowledge base expands. The wiki can easily be edited by any user, broadening your access to the latest and best research and ideas. DoDTechipedia is open to federal government employees and contractors with Common Access Card or DTIC registration.

- **Connect across walls.** Reach across command chains and departmental divisions to find other people working on ideas and solutions that interest you. Discuss hot topics. Stay on top of new trends. Read technical blogs—or create one of your own. You don't need to know the right people—you can connect on the wiki.

- **Collaborate.** The wars we are fighting today require immediate solutions. The wiki is the biggest brainstorming session ever at DoD. Network with others working in your areas of interest. Present new ideas or technical challenges. Stay abreast of research and development initiatives, conferences, and symposia. Collaboration across DoD increases our ability to identify challenges as they emerge and deliver vigorous solutions fast.

START CONTRIBUTING TO DODTECHIPEDIA NOW

If you have CAC or DTIC registration, you already have access to the wiki. Go to https://www.DoDTechipedia.mil and log in. Once on the wiki, visit the tutorials link to learn how to add or edit information.

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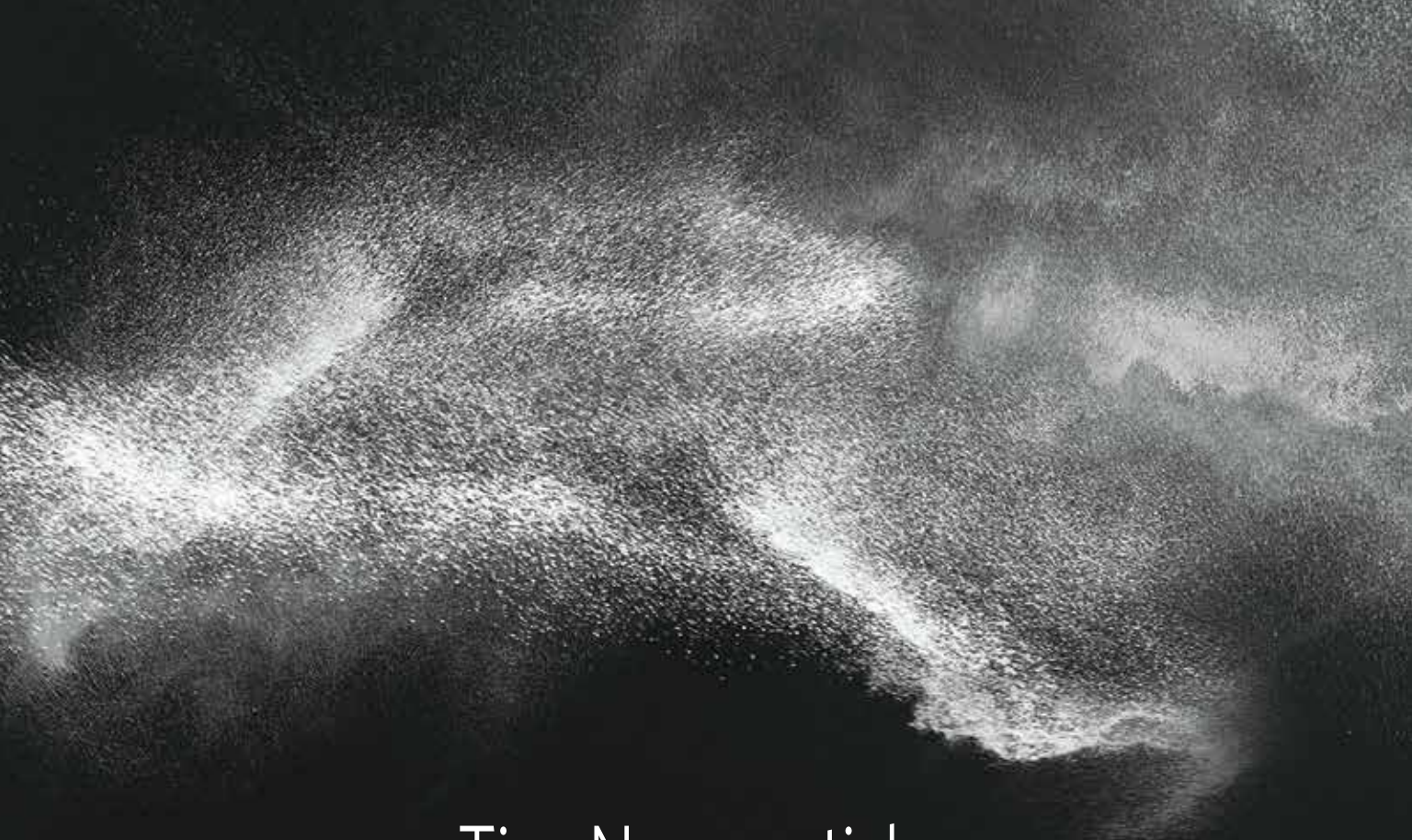
The U.S. Department of Defense Science and Technology Wiki

A project of Acquisition, Technology and Logistics, Defense Research and Engineering, Defense Technical Information Center, Networks and Information Integration and Department of Defense Chief Information Officer, and Rapid Reaction Technology Office



Tiny Nanoparticles

—A Big Battlefield Impact?

Donald Kennedy

Tiny metallic nanoparticles have the potential to change the landscape of defense technology, from obscuring warfighters from view to providing transparent displays in aircraft and vehicles. A nanoparticle is defined as a particle with one or more dimensions measuring 1 billionth of a meter (1 nanometer [nm]). Typical nanoparticles range from 1 to 1,000 nm. A typical human hair is about 90,000 nm thick. Therefore, an item of 1 nanometer would be invisible to the naked eye.

Scientists at the U.S. Army Edgewood Chemical Biological Center (ECBC), the Massachusetts Institute of Technology's Institute for Soldier Nanotechnologies (MIT-ISN) and the Harvard University Department of Physics are using nanoparticles to develop a novel transparent display technology and improve the design of obscurants, which are used to generate smoke that can hide a warfighter from plain sight.

Kennedy *is the communications officer at the U.S. Army Edgewood Chemical Biological Center (ECBC), where he oversees the production of Center-wide information products for distribution internally and externally. Prior to joining ECBC in 2008, Kennedy was the chief of Media Production at the John F. Kennedy Special Warfare Center and School, and managing editor for the Mid-Atlantic region of the Navy's largest newspaper,* The Flagship. *Kennedy served in California, in Virginia, and at sea on the USS* Enterprise *for the U.S. Navy during an eight-year career, where he was an award-winning journalist with multimedia responsibilities.*

Improved navigational imagery and information displays on various surfaces are just some of the battlefield uses that may be available to warfighters. Imagine an Air Force pilot using a map projected on his cockpit windshield to safely navigate to a location or soldiers in the field who are in turn digitally displaying information on an armored vehicle window. Through ECBC's In-House Laboratory Independent Research (ILIR) program, ECBC researchers are able to collaborate with the MIT-ISN on various projects such as the transparent display technology, which explores how particles scatter and absorb light efficiently.

Typically, when an image is projected onto a transparent material such as glass, it simply goes through the glass, and the image cannot be viewed. By coating the glass with a polymer that contains silver nanoparticles with the appropriate size, images can be reflected back and viewed as if they were on a screen. Additionally, the transparency of the glass is retained. Advantages of this technology also include a wide viewing angle and the ability to scale the materials onto large display areas.

Each of the silver nanoparticles used in this technology is designed to scatter or reflect one color while rejecting the rest. Although the current technology displays blue light successfully, researchers are working to implement red and green displays in the future. In order to achieve new colors, researchers will have to control the size, shape and composition of the nanoparticles across scattered light. Currently, a silver particle is used for scattering and imaging blue light. In order to simultaneously scatter multiple colors of light, researchers can use three different nanoparticles to scatter three different colors of light, or they can create a clever particle with the correct properties that enable the display of all three colors.

Brendan DeLacy, an ECBC researcher in the Toxicology and Obscurant Division, continues to work with MIT-ISN on the transparent display but is also pursuing how nanoparticles can enhance obscurants, concealing the location of a warfighter from plain sight. Recent design upgrades can now hide a warfighter from infrared and other sophisticated types of viewing, thanks to a range of metallic nanoparticles including gold and silver that enhance the attenuation of light in a given region of the electromagnetic spectrum. This type of obscurant work is especially important in improving defense in theater, as particles are used to absorb or scatter light in order to block a warfighter's visibility over several bands of light.

"The work on the nanoparticles in obscurants is closely related to the development of the transparent display technology. It's such a great opportunity to be able to work with MIT and Harvard to develop this type of technology that could make an impact across so many different disciplines," said DeLacy.

The next step in obscurant development will be to fabricate the nanoparticles in large quantities and disseminate them efficiently, so that the aerosolized particles retain their optical properties. Scientists at ECBC have made significant efforts to design and fabricate metallic particles with an ideal shape and composition for maximum obscuration.

"In our obscurants project, MIT provides computational models that predict the optimum size and shape of nanoparticles that are required to absorb and scatter light. ECBC is responsible for creating the particles that are predicted by those models," DeLacy said.

Silver and gold nanoparticles have been extensively studied for their unique optical properties which arise from localized surface plasmon resonance (LSPR). This resonance results in a very strong attenuation of light in the visible and near-infrared regions due to the strong enhancement of the local electric field both inside and near the surface of the particle. LSPR is the resonance between the collective oscillation of conductive electrons and the incident light. This phenomenon has been employed in chemical and biological detection techniques such as surface-enhanced Raman scattering and enhanced fluorescence spectroscopy. The size and structure of the silver and gold nanoparticles have a significant impact on LSPR, which can affect sensors and photonic devices.

An additional application of plasmonic nanoparticles is their use in tagging, tracking and smart bar code applications. For example, gold nanoparticles coated with an alkanethiol can be deposited and printed onto paper, plastic or cloth, with a specific circuit pattern. The circuits form radio frequency identification (RFID) tags and can be used in security applications to identify a given material as a friendly or enemy force.

Metal oxide nanoparticles, which have also been explored as potential obscurants, have alternative military uses, including their ability to react with and destroy chemical and biological warfare agents. Nanocrystalline metal oxides are semiconductors that are activated upon interaction with light. Once activated, the metal oxide nanoparticles act as both acids and bases, and bind efficiently to chemical and biological agents, thereby converting the hazardous material to safer byproducts. *[Editor's Note: For medical and biological warfare applications, see the preceding article in this issue.]*

Using nanoparticles, an image of a blue MIT logo is superimposed on a glass screen. The cups are physical objects behind the screen.
MIT News photo.

According to recent studies and papers on nanoparticles, the tiny structures could have big implications in the biomedical field. Some investigations explore how magnetic nanoparticles potentially could be injected into the body to detoxify people who might have been exposed to poison gas. The magnetic particle would bind to the toxin and literally drag it out of the body. Other biomedical projects include the possibility of using gold nanoparticles as a replacement for chemotherapy in cancer patients.

While ECBC and MIT-ISN have not pursued all of these types of nanoparticle applications, there is a vast field of possibilities. ECBC and MIT-ISN continue to develop the design and fabrication of improved obscurants, and also the transparent display technology. Nature Communications recently published an article, "Transparent Displays Enabled by Resonant Nanoparticle Scattering," which describes the work being done toward transparent display technology.

MIT-ISN serves as one of the U.S. Army's University Affiliated Research Centers. This status means that the Army funds these university centers to research and develop new technology for military uses. The research for this project was funded by the U.S. Army Research Office and by the National Science Foundation.

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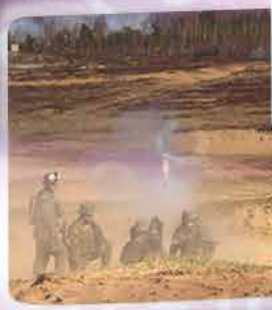
For more information,

Army Acquisition **Lessons Learned**

Jill Iracki



The Center for Army Acquisition Lessons Learned (CAALL) was established within the U.S. Army Materiel Systems Analysis Activity (AMSAA) to collect, analyze and disseminate acquisition lessons learned. The center serves as the authoritative source for timely, real-world acquisition lessons learned to enhance the performance of the Army's project offices in support of the warfighter.

The mission originated with the 2010 Army Acquisition Review, which repeatedly cited the need for a centralized source for lessons learned across the acquisition life cycle. The report stated that there are lessons learned within the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA[ALT]), the test community and other acquisition stakeholders, but they are all dispersed and need to be synthesized. In addition, the report stated there is no formal way to track successes, analyze failures and develop best practices from historical programs. Therefore, the acquisition community needs a robust, readily accessible database and associated analytical capability to extract relevant information. The report recommended that a Center for Army Acquisition Lessons Learned be established to provide a record of acquisition experiences in order to allow others within the acquisition community to understand what occurred and avoid previous mistakes, as well as to provide the basis for making improvements.

Consequently, the Army Acquisition Executive (AAE) distributed a memorandum in January 2012 directing all Army acquisition programs, regardless of Acquisition Category (ACAT), to conduct After Action Reviews (AARs) and document lessons learned following

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all milestone reviews and program terminations. The memorandum also directed AMSAA to establish CAALL to collect these lessons via a Web-enabled database and to conduct analysis on the lessons learned.

Acquisition Lessons Learned Portal (ALLP) and Lessons Learned Collection

CAALL has established the ALLP as the authoritative source for Army acquisition lessons learned. The ALLP aims to serve as a knowledge management tool for the program executive offices (PEOs) and their project offices, as well as the broader acquisition community. The primary function of the portal is to allow easy input and retrieval of lessons learned. To facilitate collection of acquisition lessons learned, the ALLP provides an online form for lesson submission, as well as a downloadable form that can be completed offline and then uploaded to the portal. This allows the form to be filled out and distributed through different offices for review prior to submission if needed.

The Center for Army Acquisition Lessons Learned ... provide[s] a record of acquisition experiences in order to allow others within the acquisition community to understand what occurred and avoid previous mistakes, as well as to provide the basis for making improvements.

Lesson Input

The main fields on the form include the Lesson Learned, Background, Recommendation, and Cost, Schedule and Performance Impacts. The Lesson Learned field is a concise (maximum of 200 characters), specific and actionable statement that describes the knowledge the author gained through the experience that can benefit other programs if shared and reapplied. This allows readers to easily and quickly identify the lesson and determine whether they would like to read further in the Background and Recommendation fields. The Background for the lesson describes the events observed or the actions taken and why they were taken. The Recommendation field provides details on how the lesson can be reapplied in the future and how it can benefit other programs or organizations. The form also has fields for capturing impacts to the program's cost, schedule and performance. This information allows users to get an idea of the possible impact of the recommendation on another program if reapplied and allows CAALL analysts to identify those issues having the largest impacts on programs. In addition, the form collects metadata for the lessons, such as phases and milestones of the acquisition life cycle, categories, key words and ACAT level to which the lessons apply. This information aids users in finding lessons that may be applicable to their programs or types of work. It also is critical to CAALL's analysis processes, as it allows the team to look at frequently used categories and key words to help identify trends within the lesson-learned submissions.

Lesson Searches

The ALLP includes a lessons-learned search page, where users may easily find lessons pertaining to their interests through a text-based keyword search. Users may refine their search criteria using filters for the category, ACAT, milestone and phase to which the lesson applies. The search will return a table of lessons along with any other information/fields the user specifies should be included in the search results table. Users may click on the Lesson Learned text for each lesson that appears in the search results to view the full lesson-learned record.

Collaborative Tools

The portal includes other collaborative tools, such as a document repository and user forums. In the document repository, users may share detailed documents pertaining to their lessons learned, such as lessons-learned reports, useful templates, guidance, etc. In the user forums, users may post questions and informally discuss acquisition issues with other members of the acquisition workforce.

Spotlight Zones

The ALLP includes two Spotlight Zones—Web pages focused on a particular hot topic in acquisition. The Spotlight Zones aim to provide the acquisition community with specific information that will aid programs in those areas of acquisition that are receiving significant attention in the acquisition world. The current Spotlight Zones include Reliability and Modeling and Simulation and provide lessons learned, case studies, links, guidance and tools pertaining to these two topics.

Populating the Portal with Lessons

Upon establishment of the ALLP, CAALL began to populate the acquisition lessons-learned database with historical lessons from existing sources. The team gleaned lessons from various

reports, such as the RAND Corp.'s report on lessons from the Future Combat Systems as well as Government Accountability Office reports. CAALL has had continuous interactions with the PEOs, as well as the greater acquisition community, to solicit lessons learned based on their real-world experiences. CAALL regularly attends Army Systems Acquisition Review Council meetings to stay informed on programmatic decisions and gather lessons or potential topics for lessons to be developed by the project manager (PM). In addition, PEOs and project offices have begun to populate the database with lessons from AARs following milestone reviews as directed by the ASA(ALT) memorandum, as well as informal, unprompted lesson submissions. The ALLP currently has over 600 users and provides access to more than 500 lessons learned.

Analysis and Dissemination

A key element of the acquisition lessons-learned mission is the analysis of lesson-learned submissions. This includes trend analysis of lesson submissions and deep-dive analyses of specific topics or trends, as well as case studies of particular Army acquisition programs. The AAE has recognized the need to continually identify the top five issues affecting Army programs and the need to have data to support these findings. CAALL synthesizes lessons and identifies trends to provide to ASA(ALT) in an effort to address systemic challenges and provide the basis for acquisition policy changes and strategic decisions. CAALL has begun to conduct deep-dive analyses of particular acquisition issues that have emerged from the synthesized trends. One such trend that has been identified is that documentation preparation and approval processes are resource drains for project offices. Consequently, CAALL is conducting a deep-dive study on acquisition documentation requirements and staffing in an effort to determine which documents cause the most issues, where duplication exists in documentation requirements, and where there are inefficiencies within the staffing and approval processes. Analyses such as this will be presented to ASA(ALT) leadership to provide detailed findings and potential recommendations for process changes. Furthermore, CAALL conducts case studies on programs that have had significant learning experiences that led to increased attention from Army leadership. Thus far, case studies have been completed on the Long Endurance Multi-intelligence Vehicle (LEMV) and the Armored Multi-Purpose Vehicle (AMPV). Findings from these efforts are available through the ALLP.

In addition to the ALLP's lesson-learned search page, lessons are disseminated through periodic bulletins and article publications. CAALL distributes new lessons and other information on the current activities of the team through a quarterly *Acquisition Lessons Learned Bulletin*, which is provided to all ALLP users and Acquisition Lessons Learned stakeholders. Current readers include the PEOs and other acquisition organizations, such as the Army Test and Evaluation Command, Training and Doctrine Command, and the Defense Acquisition University. CAALL also regularly provides, to the *Army AL&T* magazine, articles that tie lessons learned and best practices into the magazine's current theme. In an effort to push lessons to the project offices, CAALL has prepared "Just In Time" lesson-learned packages, each of which contains a set of lessons grouped by category (such as contracting, test and evaluation, systems engineering, etc.) pertaining to a particular phase of the acquisition life cycle. These packages will be available through the ALLP, as well as disseminated to a point of contact at each PEO so that PMs and their staffs may be provided with relevant lessons learned up front when entering a new phase of the acquisition life cycle. These packages will facilitate the sharing of repeatable good practices and knowledge from past mistakes with other project offices so they may benefit from the knowledge of those programs that have completed that acquisition phase.

Current Acquisition Lessons Learned

The ALLP houses a wide range of acquisition lessons learned from across the acquisition life cycle. Lessons pertain to a variety of topics, such as program management, technology and engineering, contracting and financial management. Highlighted below are a few lessons currently available in the ALLP.

Oversight, Review and Documentation

One of the largest trends within the current collection of Army acquisition lessons learned is the need for early and efficient milestone and documentation preparation. Programs have repeatedly cited the need to coordinate with stakeholders early, utilize documentation Integrated Product Teams and tracking tools, and know what is required for the milestone review. One program reported that the PM often needs to allocate critical resources to produce and staff, or obtain waivers, for documents that are not relevant to the program. The program had to meet traditional documentation requirements for its milestone review, which could have been averted if Army leadership would allow certain requirements (such as the Corrosion Prevention and Control Plan, Program Protection Plan, and Clinger-Cohen Compliance) to be declared inapplicable for programs that have existing materiel solutions and/or that don't have certain components (such as electronics). Prior to the milestone review, the program had a materiel solution that was currently in use in the field, and contracts were already in place and producing the system to support deploying warfighters at a rate equivalent to Full Rate Production. However, the program still had to complete or obtain waivers for statutory, regulatory and policy requirements to achieve the milestone. The program recommended that PMs seek ASA(ALT)/Headquarters, Department of the Army, approval for the Milestone Decision Authority to declare certain documents to be inapplicable for certain programs instead of requiring a waiver or streamlined version of the document. A waiver or streamlined version can take almost as much time to prepare and staff as the traditional document. This would have saved the program many hours that could be used in other initiatives and would have allowed the milestone to be executed months earlier.

Program Management

Another Army program reported that PMs need to be proactive and deliberate in initiating and establishing an Earned Value Management System (EVMS) for production activities at arsenals and depots. Proper Earned Value Management metrics were not established at the beginning of the program between the PM and the arsenal. The product office did not have EVMS or a similar management tool in place to establish a planning baseline or to measure cost and schedule performance over time. The lack of these tools contributed to what became a more than $41 million cost overrun and a 10-month schedule slip. The arsenal relies on a logistics system that proved inadequate for tracking earned value, defining the estimate at completion and managing end-to-end parts acquisition, production and costs. The system would not allow for material to be charged to a program until it is used, which can be several months after it has been purchased. Since the system has no automatic triggers or warnings, the arsenal would be able to continue to charge against a Military Interdepartmental Purchase Request (MIPR) even if funds had been exhausted. Consequently, the program provided the following recommendations for applying Earned Value Management type oversight:

- Conduct Start of Work Meetings and incorporate EVMS up front.
- Execute disciplined routine Program Management Reviews that focus on cost, schedule and performance.
- Utilize Integrated Master Schedule/Integrated Master Plan tools to measure program performance.
- Update cost estimates as the program evolves and every time the scope changes.
- Establish a measurable baseline at the outset of the program.
- Provide monthly cost reports to Life Cycle Management Command, customers and installation Commanders.
- Continuously refine metrics and reporting.

Test and Evaluation

Another trend that has begun emerging from acquisition lessons submitted by the PEO community is the need to consider test efficiencies during test-plan development. This includes increasing the number of test articles, combining different types of tests, using test data from similar programs and using modeling and simulation. One program reported that using similar program-and-design-level test data can reduce the number of required tests for the fielding of a system. The program had requirements to undergo some very expensive tests of multiple systems and subsystems. The program initiated a study to evaluate alternative solutions that would satisfy the testing requirements in the most cost-effective way. For this study, the program reviewed all test data from similar systems that had undergone these types of tests so the program could predict through test knowledge the results of the test. These predictions and results by similarity were briefed to the testing board, and a reduced test matrix was proposed leveraging these similar program and past design-level test results. The final test matrix required only 33 percent of tests originally planned/required, and the tests that were ultimately required were easy to fit into the schedule for fielding the system. The program recommended that other programs review their design tests and similar system tests to leverage this test data when putting together the required test matrix to meet materiel release requirements. The benefits of understanding the testing and ways to predict results based on similarity or design-level tests saved the program $1.86 million in hardware and test-range costs. In addition, the program benefited from a shortened schedule and reduced travel costs to meet the schedule required for materiel release of the system.

The Spotlight Zones aim to provide the acquisition community with specific information that will aid programs in these areas of acquisition that are receiving significant attention in the acquisition world.

The ALLP continues to rely on valuable submissions from across the Army acquisition enterprise. These and other acquisition lessons learned may be accessed through the portal at https://allp.amsaa.army.mil/. The ALLP is open to all DoD military and civilians, and AMSAA welcomes you to contribute to this valuable mission by sharing your knowledge and experiences, as well as leveraging those lessons currently in the portal.

The author can be contacted at **jill.l.iracki.civ@mail.mil**.

Cybersecurity Challenges

for Program Managers

Steve Mills ■ Rob Goldsmith

Cybersecurity threats to Department of Defense (DoD) acquisition programs are both challenging and complex. Program managers (PMs) have the daunting responsibility to minimize cybersecurity vulnerabilities in their systems against current and future cybersecurity threats.

To effectively address cybersecurity threats in DoD acquisition programs, PMs need a combination of the right policies, processes, people and tools. Furthermore, cybersecurity is dynamic by nature, requiring proactive engagement and expertise to minimize risk throughout the acquisition life cycle. Effective cybersecurity can only be achieved through a holistic approach that takes into account more than just information

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assurance compliance. This holistic approach includes areas of known cybersecurity risk for DoD programs and provides an effective framework for developing, planning and implementing an effective cybersecurity strategy. Such a strategy must be based on the following expanded set of areas:

- Information Assurance
- Hardware/Software Assurance
- Supply Chain Risk Management
- Blue Team—Computer Network Defense/Vulnerability Analysis
- Red Team—Threat vulnerability/penetration testing

Failure to address all these areas as part of the cybersecurity effort will likely result in failure from a cybersecurity perspective. This article will briefly address revised DoD cybersecurity policy and highlight a unique Aviation and Missile Research, Development and Engineering Center (AMRDEC) cybersecurity initiative supporting DoD PMs.

New DoD Cybersecurity Policy

The focus and emphasis of cybersecurity within the DoD changed significantly with the release of DoD Instruction (DoDI) 8500.01 (Cybersecurity) and DoDI 8510.01 (Risk Management Framework for DoD Information Technology [IT]). A key purpose of these revised instructions is an attempt to align DoD cybersecurity efforts with the best practices of both private industry and other federal agencies. By doing so, DoD can leverage proven and effective processes to make DoD networks and systems more resilient against current and future cybersecurity threats. Another major focus of the revised DoD policy is to address cybersecurity risk in a manner that takes into account the unique challenges presented by such threats.

The revised DoDI 8500.01, titled Cybersecurity, provides several changes, including a revised focus. The term "Information Assurance" is no longer used and has been replaced with the term "cybersecurity." A quick review of the DoD definition for both terms reveals little change in wording but a clear change in focus. First, the cybersecurity focus has been expanded to include communications systems, communications services, wire communications and electronic communications. Implicit in the definition above is an understanding that electronic and wire communications are increasing at an exponential rate and that providing security for those forms of communication is extremely important.

Additionally, this DoD instruction places increased emphasis on operational resilience, integration and interoperability. This emphasis recognizes the critical part interoperability plays in the development, acquisition and fielding of DoD systems and our ability to operate effectively on the battlefield. Finally, the term "cybersecurity" emphasizes the concept of prevention. Incorporating cybersecurity early in the acquisition life cycle is both proactive and preventive. DoDI 8500.01 advocates incorporating cybersecurity early and continuously throughout the acquisition life cycle. The acquisition life-cycle process embodied in DoDI 5000.02 promotes the importance of "upfront and early" planning and incorporation of logistics to ensure program success. This same proactive approach should be used for early incorporation of cybersecurity in the acquisition life-cycle process and is in line with the "Shift Left Initiative" advocated by Dr. Steven J. Hutchison, Acting Deputy Assistant Secretary of Defense for Developmental Test and Evaluation.

According to Hutchison:

> The Shift Left initiative fundamentally is about improving DT&E to set the conditions for successful production and deployment. Shift Left achieves this goal through earlier identification and correction of failure modes, thereby avoiding the high costs of late cycle repair and reducing the impact to our warfighters of fielding capabilities that do not satisfy requirements. There are three key elements of Shift Left: earlier testing for interoperability, earlier testing of Cybersecurity, and conducting DT&E in a mission context.

Early incorporation of cybersecurity into the DoD acquisition life cycle will likely lower overall program risk and lead to better acquisition outcomes.

The revised DoDI 8510.01, Risk Management Framework (RMF) for DoD IT, is DoD's authorization process for information technology systems and supersedes the previous process known as the Department of Defense Information Assurance Certification and Accreditation Process (DIACAP). The focus of RMF is on iteratively managing cybersecurity risk through a six-step process that includes the key component of continuous monitoring. According to *Bloomberg Businessweek*, the recent cybersecurity data breach experienced by Target stores was the biggest in U.S. history and primarily was due to lack of continuous monitoring and response. RMF uses a risk-based approach for decisions on cybersecurity versus the former approach (DIACAP) that focused on checklists and compliance. Just focusing on compliance via checklists will yield some benefit but does not sufficiently address cybersecurity risk. The goal of the RMF process in DoD acquisition programs is to incorporate RMF up front and early and in a continuous manner throughout the acquisition life cycle.

AMRDEC Cyber Integrator Initiative

AMRDEC at Redstone Arsenal, Huntsville , Ala., is proactively supporting DoD Project Management Offices (PMOs) and Program Executive Offices (PEOs) through several cybersecurity initiatives. The recent shift in DoD cybersecurity policy and the language in the 2013 and 2014 National Defense Authorization Acts (NDAAs) are forcing PMs to proactively address cybersecurity risk throughout the acquisition life cycle. Acquisition programs can mitigate cybersecurity risk by addressing it early in the acquisition life cycle and by "widening the aperture" when developing the mandatory Cybersecurity Strategy.

A noteworthy AMRDEC cybersecurity initiative is the concept of a "cyber integrator (CI)" added to the PEO/PMO staff of select DoD acquisition programs. The purpose of the CI is to lead the cybersecurity efforts within the program, which includes effective integration of cybersecurity across all functional domains, and act as principal advisor to the PM on all cybersecurity matters. The designation and empowerment of a CI as the "cybersecurity champion" within the PMO clearly puts program cybersecurity in an elevated and proactive posture. Cybersecurity encompasses additional components such as hardware, software and firmware assurance, supply-chain risk management, Blue Team/Vulnerability analysis activities and Red Team testing. These additional focus areas coupled with the integration required across all functional domains necessitate the requirement for the CI.

The potential impact of the CI really comes into focus through the use of the Cyber Dashboard, which was developed by AMRDEC and is a measurement/management tool that tracks key cybersecurity milestones and program dependencies across critical cybersecurity focus areas. The CI using the Cyber Dashboard concept is an ongoing pilot program in the Integrated Air and Missile Defense Program Office, an ACAT I program in Huntsville, Ala. The CI produces a holistic view of the system's cybersecurity posture for senior leaders in the PMO, enabling them to make decisions based on actionable information.

In addition, the CI attempts to stay informed on all new cybersecurity initiatives and communicates these to the program management. The CI works with the appropriate program office resources to help determine what support is required from outside agencies and coordinates these efforts to ensure that cybersecurity requirements are met, the overall system cybersecurity risk is effectively mitigated and that all cybersecurity-related acquisition life-cycle requirements are adequately addressed.

Cybersecurity threats will continue to be a significant threat to DoD acquisition programs. Effective mitigation of cybersecurity risks relies on several key factors. First, we must continue to look for opportunities to take the fight to the enemy and not be complacent and defensive. We must maintain a proactive posture including a situational awareness for new threats at all times. Next, we must look for innovative methods to address cybersecurity risk. The CI and Cyber Dashboard concept constitute such an approach. By designating a "cybersecurity champion" in the Project Office, we are putting increased emphasis and resources toward securing our systems against cybersecurity threats.

Finally, we must identify and resource a new and expanded legion of cybersecurity warriors to take the fight to the enemy. We need to find and incentivize personnel with the right technical acumen and leadership to get the job done. DAU and AMRDEC look forward to the challenge.

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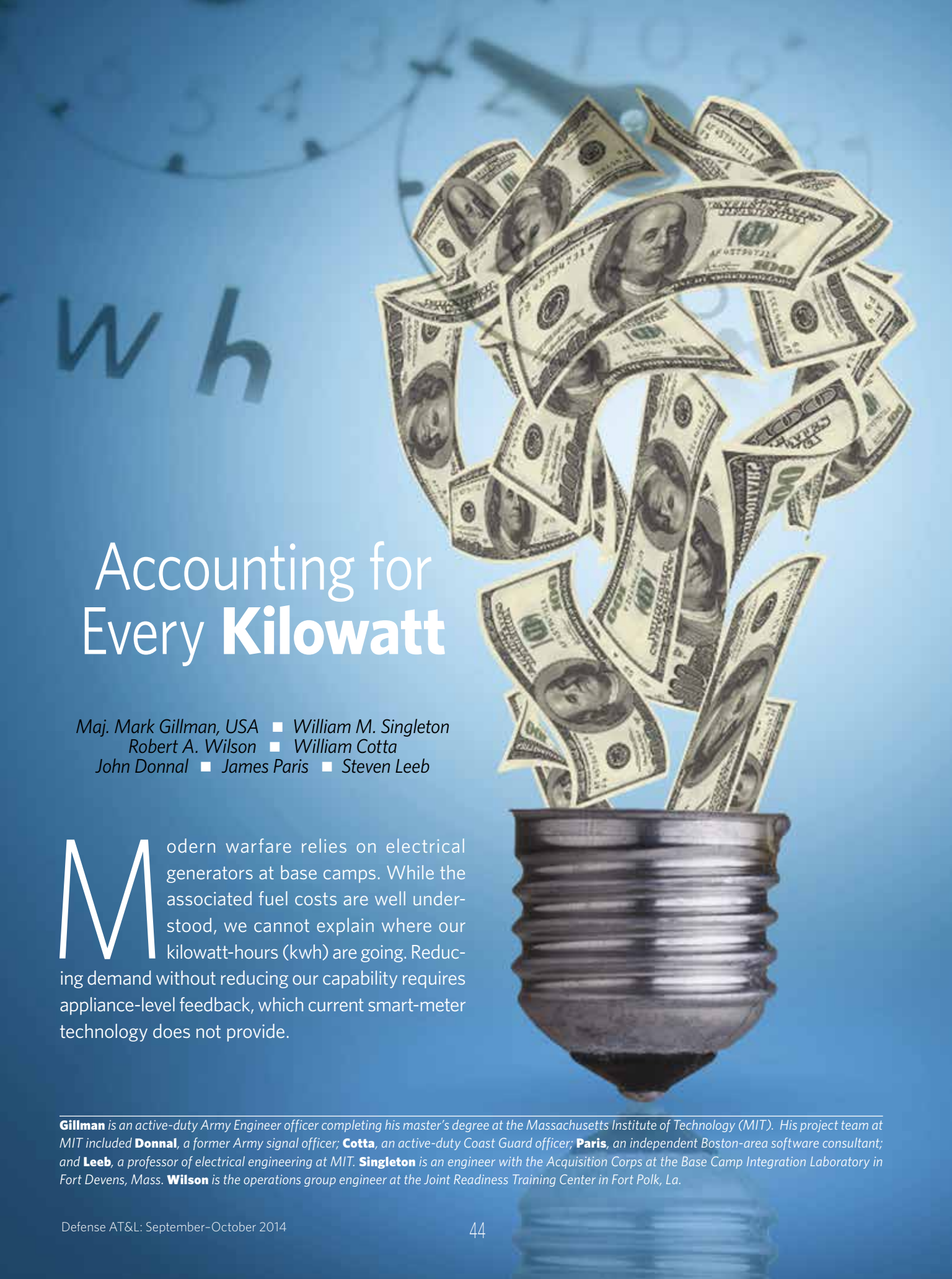
Where Can You Get the Latest on the **Better Buying Power** Initiatives?

- BBP Gateway (**https://dap.dau.mil/bbp**) is your source for the latest information, guidance, and directives on better buying power in defense acquisition
- BBP Public Site (**https://acc.dau.mil/bbp**) is your forum to share BBP knowledge and experience



Accounting for Every **Kilowatt**

Maj. Mark Gillman, USA ■ William M. Singleton
Robert A. Wilson ■ William Cotta
John Donnal ■ James Paris ■ Steven Leeb

Modern warfare relies on electrical generators at base camps. While the associated fuel costs are well understood, we cannot explain where our kilowatt-hours (kwh) are going. Reducing demand without reducing our capability requires appliance-level feedback, which current smart-meter technology does not provide.

***Gillman** is an active-duty Army Engineer officer completing his master's degree at the Massachusetts Institute of Technology (MIT). His project team at MIT included **Donnal**, a former Army signal officer; **Cotta**, an active-duty Coast Guard officer; **Paris**, an independent Boston-area software consultant; and **Leeb**, a professor of electrical engineering at MIT. **Singleton** is an engineer with the Acquisition Corps at the Base Camp Integration Laboratory in Fort Devens, Mass. **Wilson** is the operations group engineer at the Joint Readiness Training Center in Fort Polk, La.*

Enter the Deployable Nonintrusive Load Monitor (DepNILM, pronounced "deep" NILM) system in development at the Massachusetts Institute of Technology (MIT). Field tests on base camps at Fort Devens, Mass., and Fort Polk, La., show DepNILM can provide accountability of individual load consumption, forewarning of maintenance problems, and awareness of human activity based on electrical activity.

Functionality

The system measures voltage and current at the generator or electrical panel 8,000 times per second using off-the-shelf sensors. When custom software is used to process the data, subtle changes in power begin to stand out. Every electrical device has distinct features similar to a human fingerprint. Once you program software to recognize those features, every heater, refrigerator, pump or light turning on or off is a detectable event.

Accountability

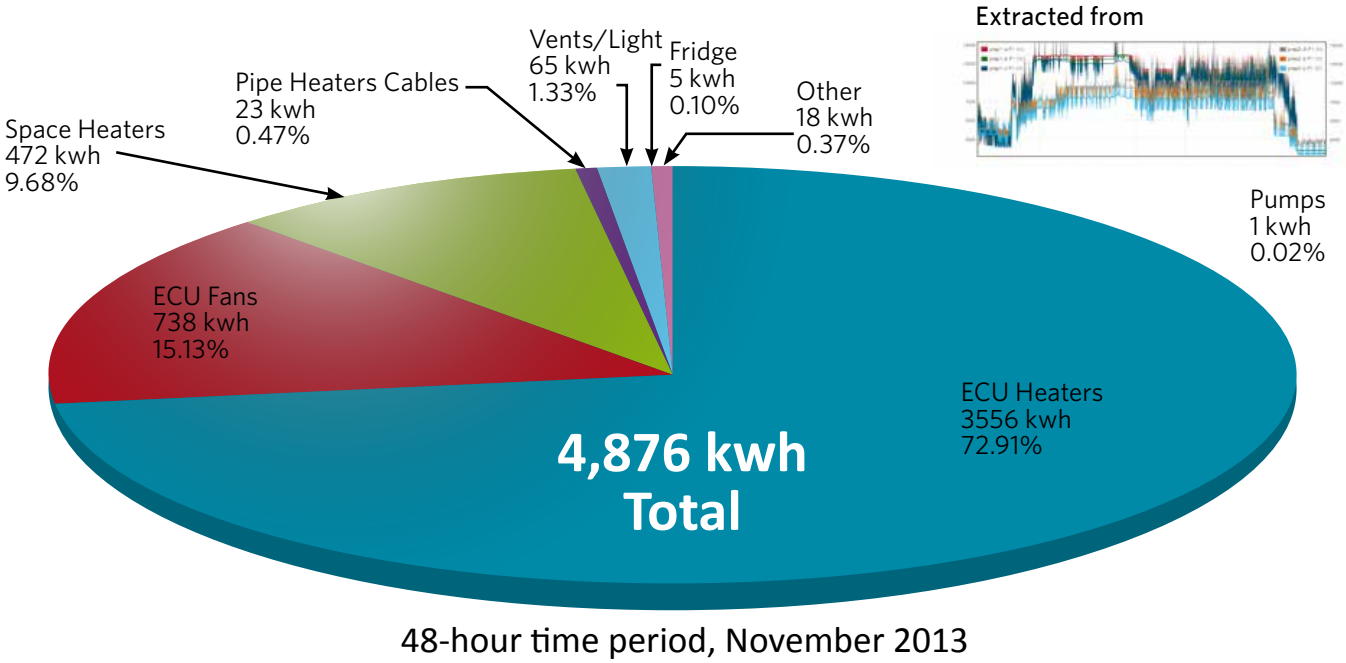
Soldiers need appliance-level feedback to reduce electrical consumption. Specifically, they need to know what loads are currently on and how much power each load uses. When the cost and behavior of each individual appliance is understood, facility managers have the information they need to make smart decisions. DepNILM permits users to distinguish between mission-critical loads, quality-of-life loads, expendable loads and even wasted energy.

Forward deployed soldiers live at base camps like the Force Provider 150 (FP-150) standing at Fort Devens. The camp at Fort Devens is a fully functional research and training facility, which includes living tents, latrines, showers, laundry and a kitchen. The following timeline provides some context for the top plot in Figure 1. Ninety infantry soldiers came to Fort Devens on a Friday. Around 9 p.m., they washed and went to bed. Saturday morning at 5 a.m., they woke, shaved, ate breakfast and departed for the weapons range around 7 a.m. At 4 p.m., they returned to the base, ate, cleaned their weapons and showered before retiring around 10 p.m. On Sunday, they arose at 6 a.m., packed their things and departed by noon.

DepNILM itemized the power consumption of the largest loads over the weekend (Figure 2). Seventy-three percent of the energy over the weekend went toward Engine Control Unit (ECU) heating coils. If the supply fan, which circulates the inside air across the heating coils, is considered part of the heat system, 88 percent of the cost over the weekend is attributed to 11 ECU machines. Adding in the smaller space heaters (and the window unit air conditioners), used in the showers, latrines and kitchen, 98 percent of the total cost came from keeping the rooms at a desirable temperature. The refrigerator, vents, pipe heater cables, pumps, lights and all other unaccounted for loads consume negligible power in comparison to the heaters.

Appliance-level detail enables important comparisons. Although only two soldiers were left behind, all heaters in all tents remained on while the rest of the unit went to the range. Figure 3 shows the effect conservation efforts would have. The top plot of Figure 1 shows an unoccupied consumption graph during those nine hours. When unoccupied, only the rooms with water service are heated. Actual use from 7 a.m. until 4 p.m. was 913 kwh. The unoccupied consumption of a similar-temperature day during the same nine hours was 209 kwh. This translates to 14 percent of the total weekend energy cost

Figure 1. Power Consumption (kwh) During the Training Weekend



(704 kwh) going toward heating unoccupied living quarters. With absolutely no loss of comfort or mission readiness, the cost could have been 14 percent less.

The conversion from kwh to gallons of diesel fuel is Equation 1. One estimate of the energy density of diesel fuel (ρ_{diesel}) coupled with the efficiency (η) of a 60-kilowatt generator operating at full load is 11.76 kwh per gallon. Using the energy savings of 704 kwh for the energy savings (ΔE), the cost of waste in this example equates to 60 gallons of fuel for this 48-hour period.

$$\Delta E \times \frac{1}{\rho_{diesel}} \times \frac{1}{\eta} = Gallons_{diesel} \quad (1)$$

A rational operator will not knowingly waste energy. However, running equipment in ignorance of the cost allows perpetuation of inefficient behavior. DepNILM clarifies the cost of doing business down to the appliance level. Targeted conservation efforts will have the greatest effect when soldiers know what they are using and how much it costs.

Figure 2. Power Use Itemized by Device During a Winter Weekend

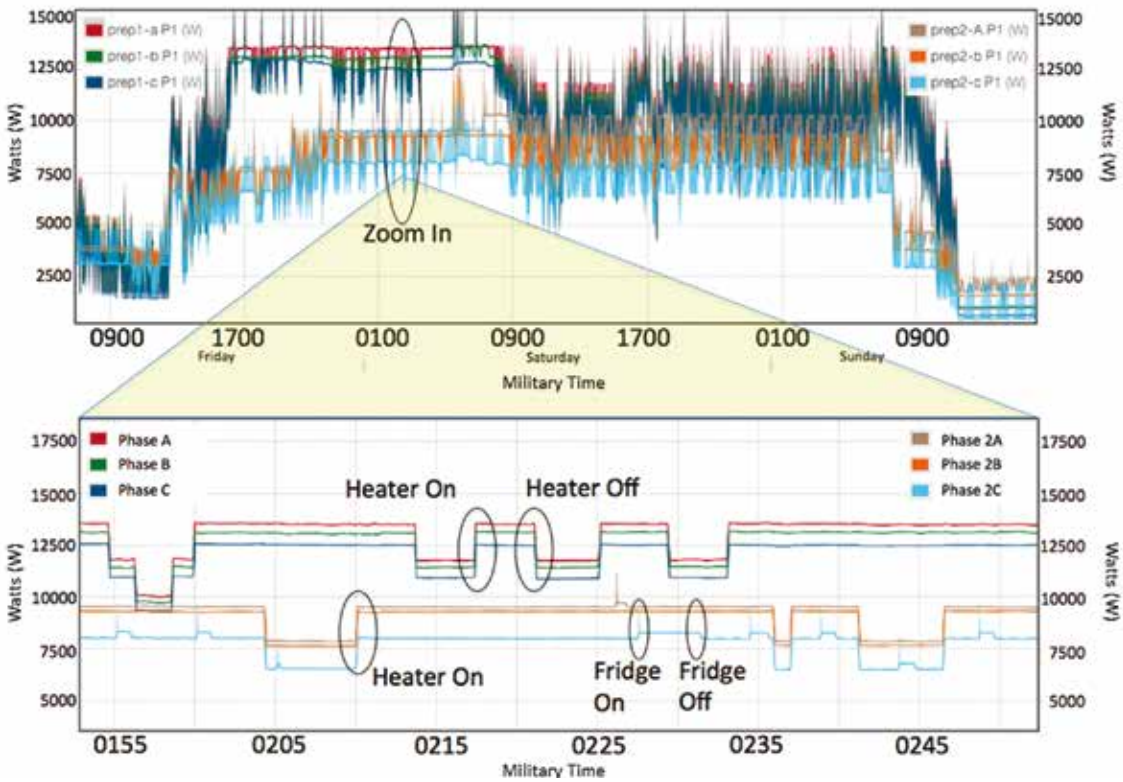
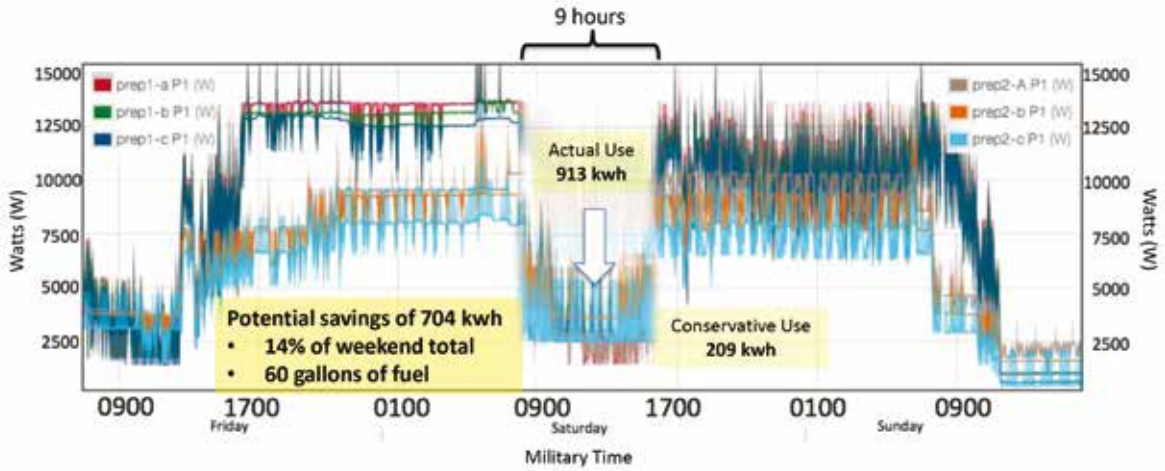


Figure 3. Potential Kilowatt Savings From Not Heating Empty Tents



Condition-Based Maintenance

Signs of machine wear and dysfunction are detectable through their electrical signals. Observable with DepNILM's high-resolution data, subtle details of machine transients can signal anomalies in the sequence of operations and trigger alarms.

Fort Polk, home to one of three Army Combat Training Centers, has several Forward Operating Bases (FOBs) built to emulate conditions in current theaters of operation. DepNILM monitored a portion of one FOB during a training rotation, including sleeping quarters and two headquarters buildings. The organic loads consisted only of lights and environmental control.

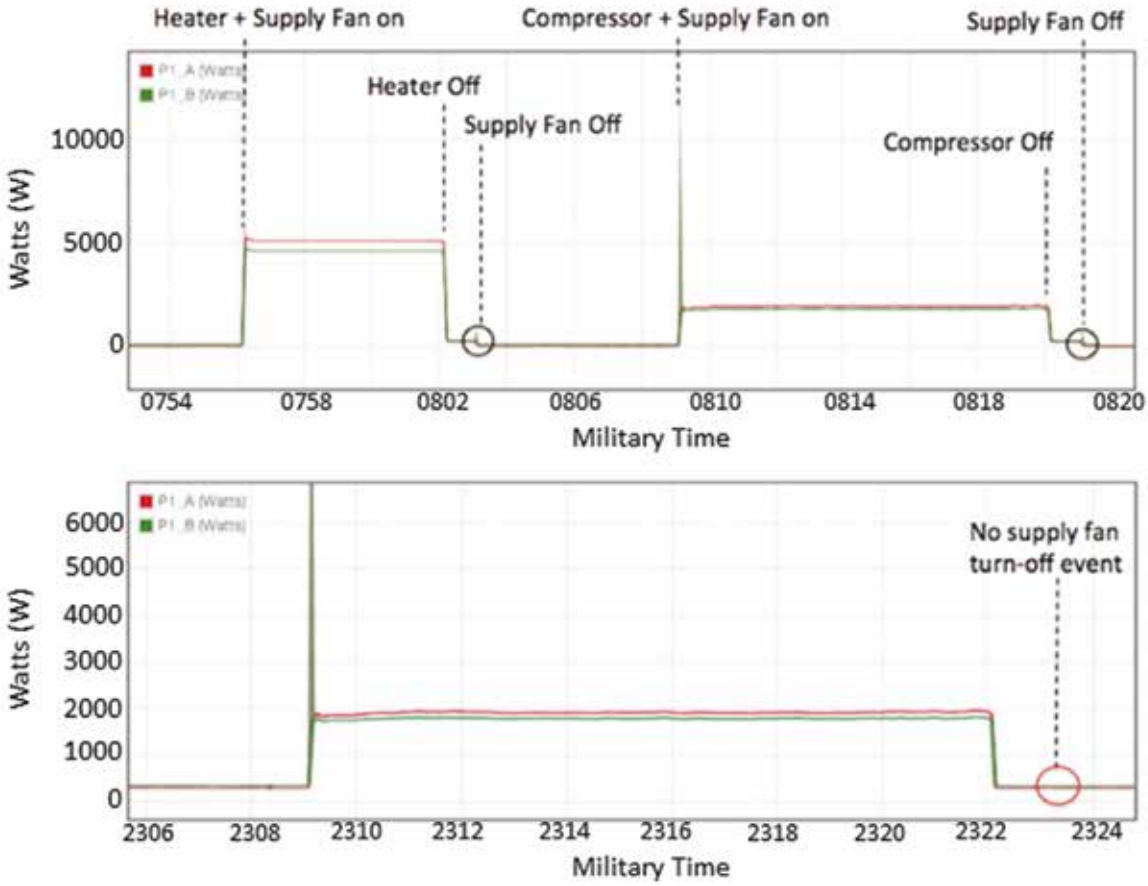
When one A/C unit stopped behaving normally, DepNILM caught it. After hours of regular 12-minute cycles, the compressor turned on and stayed on for more than 12 hours straight. Afterward, the supply fan ceased to function. We detected the fault by comparing the bad ECU (Compressor 1) with a good ECU (Compressor 2). First, the power draw of Compressor 1 after the 12-hour runtime was consistently about 0.3 kilowatt (kw) less than before, dropping from about 3.3 kw to just 3 kw. This difference is about how much the supply fan uses. Second was the distinct absence of the "fan off" fingerprints from all future cycles (Figure 4). The fan is supposed to turn off one minute after the compressor does (right side of top plot). Third, a comparison of the run times between Compressor 1 and Compressor 2 indicated significant likely differences in future operation. During a five-hour period, the hottest part of that day, the broken unit ran more than twice as long as the good one, using almost 2.5 times as much power.

With appliance-level resolution, equipment malfunctions can be identified and targeted efficiently. Through any Web interface, the DepNILM system permits the users to access highly detailed data regarding the electrical network, even in a bandwidth-constrained environment. To quantify the reduced data-transfer requirements, we remotely accessed, analyzed and diagnosed electrical consumption data from Fort Polk using a mobile third-generation—relatively common and slow—WiFi hotspot from AT&T collocated with the three DepNILM systems. Over the following weeks of analysis, total data transfer among all three DepNILMs was less than 2 gigabytes. Most of the preceding accountability and maintenance examples were identified from our desks at MIT. Tech support can be anywhere and do the same.

Human Activity

DepNILM provides awareness of human activity within a network. Each device has an electrical fingerprint, and specific devices imply associated human actions. When electrical activity is detailed enough to tell when appliances cycle, experience and intuition can extract meaning.

Figure 4. Power Signature: Working vs. Malfunctioning



We monitored a Combat Support Hospital unit powered off of mobile generators. The loads in the hospital are numerous and technical, but three in particular shed light on human behavior and schedule. Hypothermia, common among trauma patients, is treated with a Bair Hugger, which pumps warm air under a blanket. Cycling six times per second, it has a distinct fingerprint. The Pressurized Oxygen Gas System, which harvests medical-grade oxygen from the air, is run continuously for patients requiring ventilation or respiration. It has a distinct periodic wave form that ramps up and drops off every 30 seconds. These two appliances are good indicators of the arrival of new casualties. The third device is the ubiquitous coffeemaker. Its signals clearly stand out and feature repeated 45-second bursts of power use followed by 15 seconds of rest. In the sleeping quarters, where the hospital staff rested, a small coffeemaker started most mornings shortly after 6 a.m., corresponding to the 12-hour shift changes at 7 a.m.

Finally, we show an example of a refined human activity product based on discrete machine cycles. Pump events correspond to times when soldiers are using water, namely the latrines and showers. Figure 5 shows pump event times overlaid with the training timeline milestones. A general understanding of when the troops are asleep or awake is possible by observing when pump events are not happening, including Friday night (between 10 p.m. Friday and 4:59 a.m. Saturday and Saturday night (from 10:22 p.m. Saturday to 5:56 a.m. Sunday). Conjectures are possible about when the base is occupied or minimally manned. Normal use during occupied times shows pump events approximately every 25 minutes. Periods of heavy pump use indicate washing and showering times.

Detailed electrical measurements permit another means of confirmation of human activity. A skilled analyst accustomed to looking at electrical data may be able to recognize specific equipment simply from experience if actual loads are unknown.

The Way Forward

DepNILM offers a unique, accurate and inexpensive method to infer human activity from electrical activity, gain accountability of individual load consumption and be forewarned of looming maintenance problems.

The benefits of the DepNILM system scale well. Forward bases, no matter how large, are composed of essentially modular base camps like the FP-150. At the height of the War on Terror, more than 200,000 soldiers lived at base camps on

Top: Connection to a generator during unit field training at Fort Polk, La.

Left: Force Provider tents at Base Camp Integration Lab, Fort Devens, Mass.

Photos by Mark Gillman

foreign soil. From the previous example at Fort Devens, saving 60 gallons of fuel per FP-150 per weekend is strategically significant—40,000 gallons per day.

These savings are possible when users have the right information to base decisions on. Figure 6 presents our design for the user feedback display, what we think the average FOB manager needs to know to make energy-conscious decisions. Live data are still being collected at Fort Devens to test and improve the system. This vision is clear: Actionable feedback leads to cost savings (and a whole lot more).

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Figure 5. Occupancy-Related Energy Usage

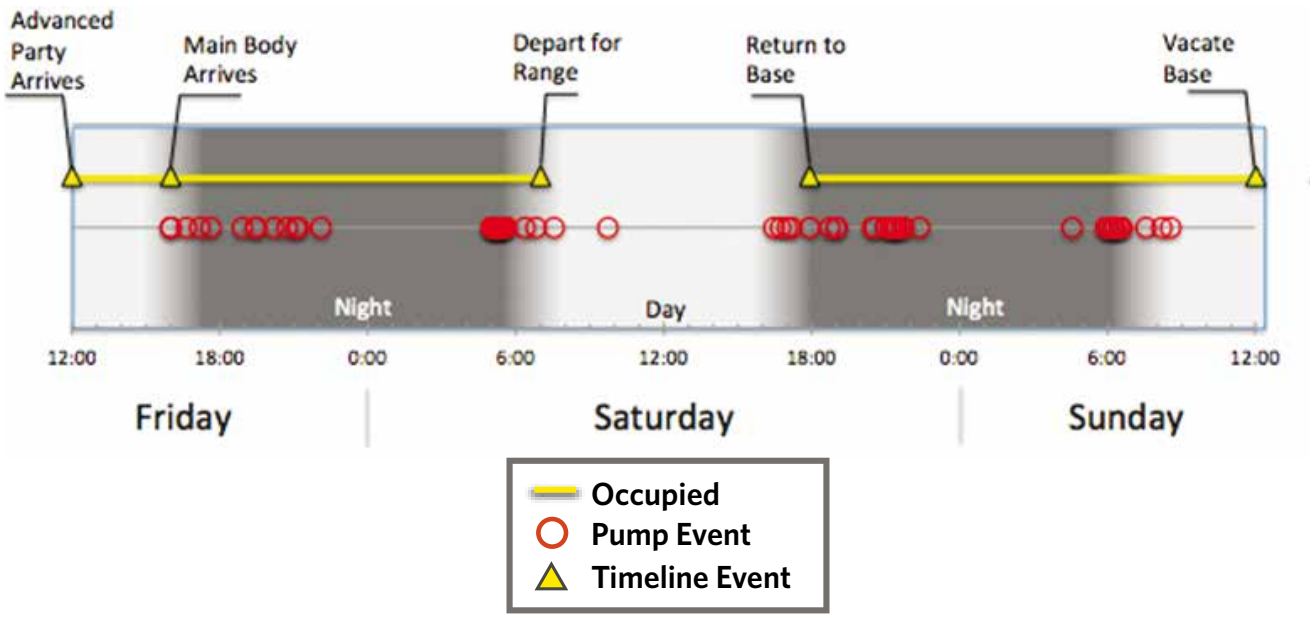
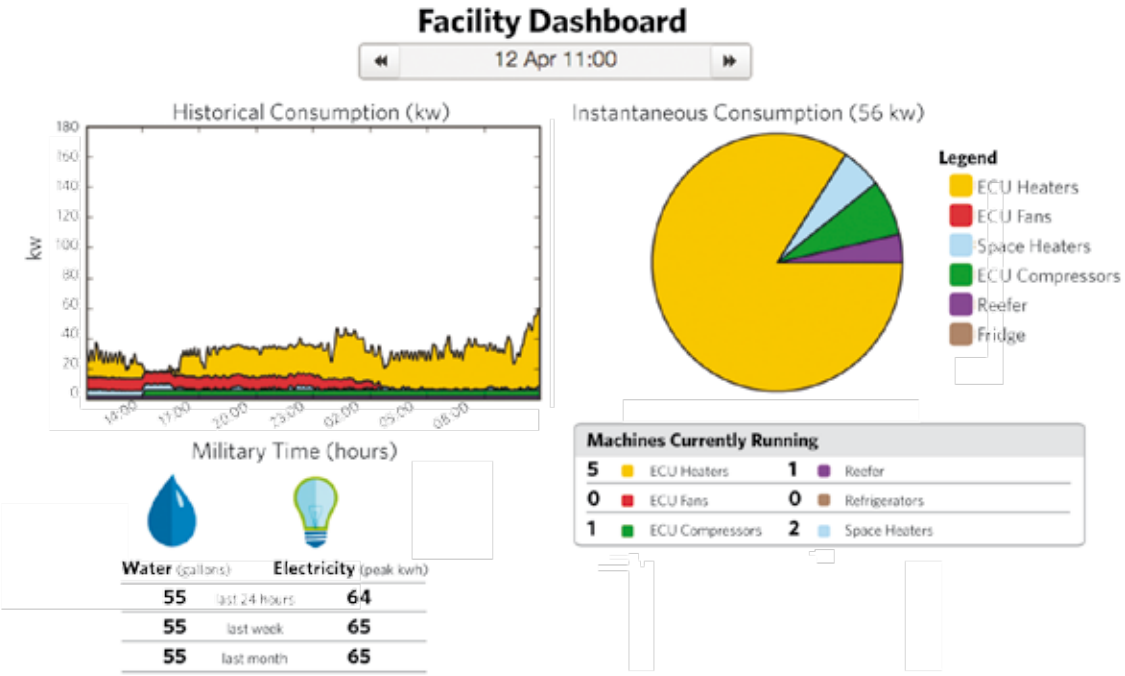


Figure 6. Design of User Feedback Display



More Time Management Tips for Busy People

Roy Wood, Ph.D.

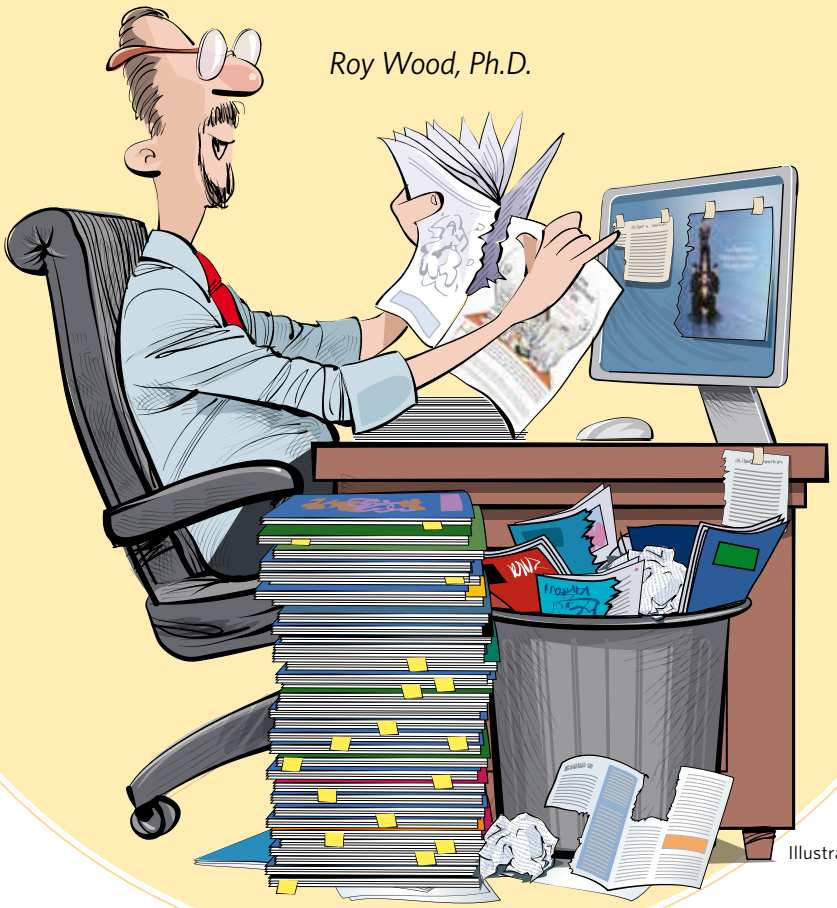


Illustration by Jim Elmore

A few months ago, I wrote a short article, "Time Management Tips for Those Who Don't Have the Time" (*Defense AT&L*, November–December 2013, p. 58), that offered some time-saving tips for busy people like you. Here are a few more ideas that I hope you find helpful.

Rip Up Your Magazines

If you are overwhelmed by subscriptions to interesting magazines or professional journals, you also likely find yourself with quite a few stacks of them, unread and cluttering the corners of your office or den. Those small mountains of unread publications beckon you to spend time with them, but the sheer numbers are often daunting. So you continue to ignore them month after month as they continue to grow to new heights, intruding on your space and your consciousness.

Wood *is the dean of the Defense Systems Management College at the Defense Acquisition University (DAU) and also teaches for the Phoenix School of Advanced Studies. He is a retired naval officer and acquisition professional. No comments in this article constitute an endorsement of any product by the U.S. Department of Defense or DAU.*

My advice: Rip 'em up. Yes. When you get a few minutes to spare and feel the need to whittle down that stack a bit, start with the one on top; flip it open and page through it quickly. If you see an article title that looks intriguing, rip the article out of the binding, staple the pages together, and set it aside in its own little stack. Continue to move quickly through the magazines removing only those articles you may truly be interested in reading. Chances are, there will be somewhere between zero and one article in each publication that you truly think you will want to spend time with. Keep those and throw away the rest of the articles, advertisements, and color glossy covers. You will be surprised how quickly you can shrink those monster-stacks into something more manageable and less intimidating.

So, what now? Simply put a couple of those saved articles in your organizer binder or other notebook that you carry with you all the time and pull one out when you find yourself between meetings, waiting in the dentist's office, or riding on the subway. Using those spare minutes for productive reading will help pass the time, finally get you through some of your most important reading, and make you smarter in the process.

Stop Trying to Multitask

More and more evidence is emerging from neuroscience that the brain simply doesn't multitask well. In fact, trying to multitask introduces massive inefficiencies and actually wastes time. So, how do busy executive types like you avoid multitasking as part of the job description? First, recognize when you are trying to multitask and refocus your attention on the most important task at hand.

Here's an example: When you are having a conversation with a subordinate or colleague, turn away from, or minimize, your e-mail program and focus your whole attention on the conversation. This sends a strong message that you are truly invested in what your guest has to say and totally concentrating on the conversation.

Here's another: If you are interrupted while you are trying to work on an important task, politely ask the interrupter to come back later or schedule a dedicated meeting with you so you can provide them the full attention they deserve.

One final, but really important, example: When you need to concentrate on your work, make an appointment with yourself and block time on your electronic calendar. People who can view your calendar will see you have a commitment during that time and are less likely to interrupt. Closing your door or hanging a "please do not disturb" sign on your cubicle may also prevent "drive-by" interruptions.

Consider Going Paperless

Much of the information we get today is already in electronic form—e-mail, PDF files, Word and PowerPoint documents, and the like. We can print those out and file them in our paper system, but with modern electronic filing and search, paper files seem so 20th century. Desktop search is now so sophisticated that locating an electronic file is almost effortless. If you like to take notes or want a bit more order in your most important files, I would point you to a fabulous little tool that you probably already have on your computer, but may have never opened—Microsoft OneNote.

OneNote comes with most versions of Microsoft's Office suite and has quite a few nice features that make it really easy to use. First, I'm writing this article draft using OneNote, so it has very good word-processing capability—not as fancy as Word, but who uses all those features anyway, right? Second, the software uses a familiar notebook metaphor with tabs you can add and customize for your favorite projects or categories and unlimited pages you can create within each tab. You can copy and paste text, pictures, Web pages, or whole documents onto a OneNote page. The best feature, however, is the ability for a single search to look across all the pages and tabs of your entire notebook to find that long-lost snippet of information that you need to save your bacon when the boss asks "Remember that meeting we had a few months ago when I said ...?"

By the way, the copy of OneNote I'm using now is on my iPad and I'm writing this on a cross-country flight at 30,000 feet. After we land, I can sync this with my Mac or PC, too, so I will have my important files wherever and whenever I need them. Convenient, huh?

And one last tip for being really productive in the e-world—get a second monitor for your computer. I resisted this for a long time as an unnecessary expense and additional clutter on my desk. After I had used it for a few days, however, you would have had to pry it from my cold, dead hands rather than get me to go back to being shackled to single monitor. I usually keep my Outlook e-mail open on one screen, and use the other to open or create attachments, work on Word or PowerPoint documents, or most other tasks. When I have a big job to do that requires me to have, say, Excel open to pull data from a database to create a chart for my PowerPoint presentation, I can minimize e-mail for a while and have both screens to spread out my other programs. This keeps me from having to constantly move and resize running programs and saves a lot of time and frustration.

Summary

I've covered three ideas here that I use to be more efficient and effective. Ripping up magazines allows me to focus on the articles I really want to read and declutters a lot of wastepaper in the process. Next, I try very hard not to multitask and to be more mindful and focused on the most important task at hand. Finally, I am a long way down the path to becoming paperless, using tools like OneNote and two desktop monitors. All these tips require some initial investment of time to incorporate them into your workflow and habits, but the payoff over the long haul is amazing. Start small and give some of them a try. Let me know what works for you, and any other tips or tricks that keep you productive.

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DAU

Defense AT&L

Writers' Guidelines in Brief

Purpose

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

Submission Procedures

Submit articles by e-mail to datl@dau.mil. Submissions must include each author's name, mailing address, office phone number, e-mail address, and brief biographical statement. Each must also be accompanied by a copyright release.

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

Deadlines

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

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

Audience

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

Style

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

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

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

Length

Articles should be 1,500–2,500 words.

Format

Send submissions via e-mail as Microsoft Word attachments.

Graphics

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

TIF or JPEG files must have a resolution of 300 pixels per inch; enhanced resolutions are not acceptable; and images downloaded from the Web are not of adequate quality for reproduction. Detailed tables and charts are not accepted for publication because they will be illegible when reduced to fit at most one-third of a magazine page.

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