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Building Resilient Systems

Via Strong Human Systems Integration

Better Buying Power Principles
What Are They?
by the Under Secretary of Defense for Acquisition, Technology, and Logistics

World War, Then and Now
World War III in the 21st Century

The International Defense System After-Action Review
An Industry Perspective

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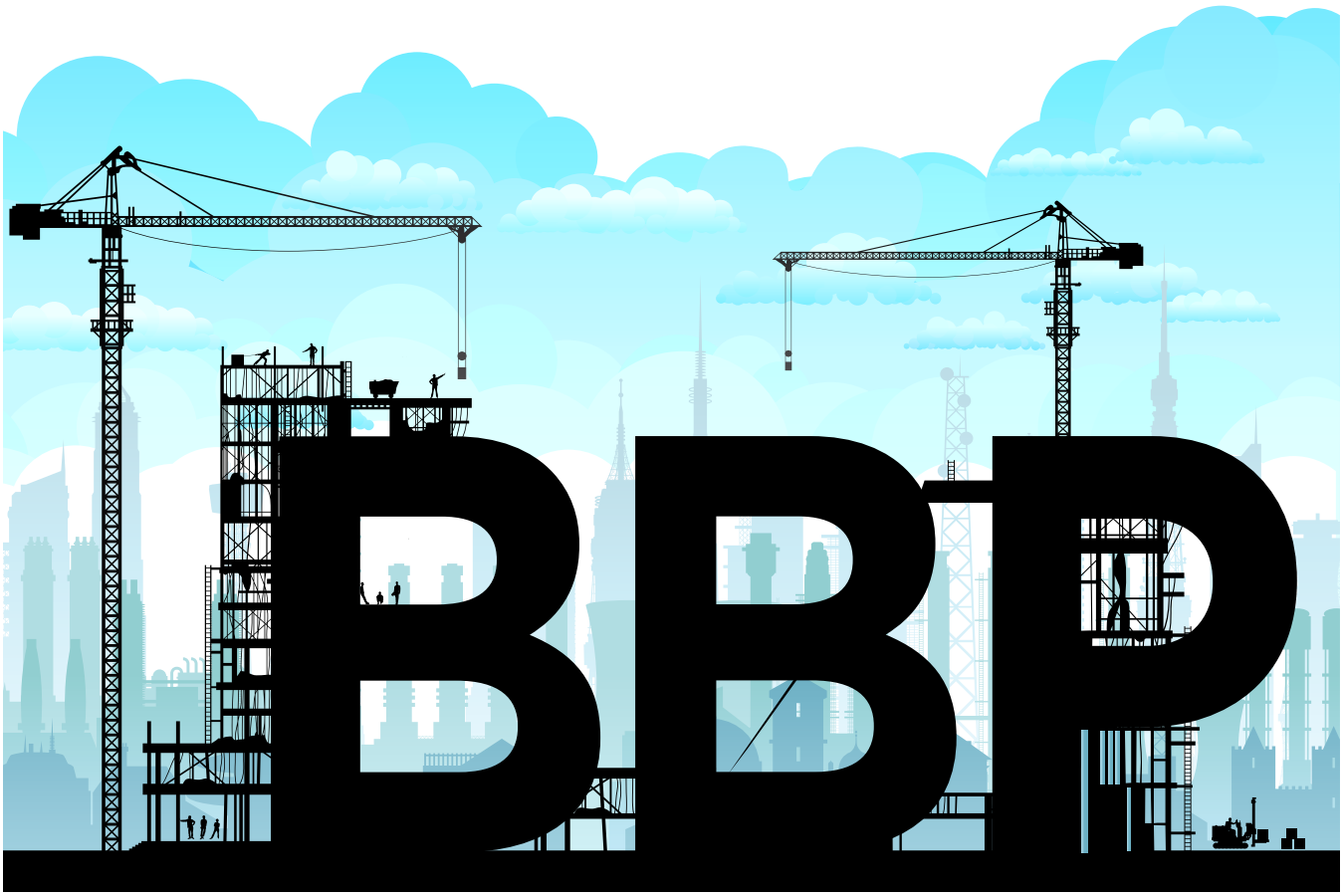
Better Buying Power Principles

What Are They?

Frank Kendall

Inevitably, whenever any senior leader embarks on a set of initiatives intended to improve an organization's performance and labels that set of initiatives, he or she can expect one reaction for certain. That reaction is what I would describe as genuflecting in the direction of the title of the initiative by various stakeholders who are trying to show the leader that they are aligned with his or her intent.

Sometimes—usually, I hope—this is sincere and backed up by real actions that reflect the intention of the initiative. Sometimes it is just, for lack of a better word, gratuitous. Better Buying Power (BBP) is no exception. One form this takes is assertions, which I see often enough to be writing this piece, that the recommended course of action is consistent with "BBP principles." (Presumably, the idea is that this will lead to instant support, but that is not a reliable assumption.)



I find this amusing, because so far as I know we've never articulated any BBP principles. When I do see this in a briefing, I ask the presenter what those principles are. So far, no one has been able to articulate them very well.

Under the circumstances, it seems like a good idea for me to provide some help answering this question. So here are some BBP principles. I also want to thank the 24 acquisition experts in the Defense Acquisition University's fall 2015 Executive Program Manager's Course who provided a number of suggestions for this list and article.

Principle 1: Continuous improvement will be more effective than radical change. All of BBP is based on this concept. It's the reason there have been three editions of BBP. We make incremental change focused on the biggest problems we see. Then we monitor the results and evaluate progress. We drop or modify ideas that aren't working, and we attack the next set of problems in order of importance, priority or expected impact. Those ideas and policies that work are not abandoned for the next shiny object we see. I have seen any number of acquisition reform fads that had little discernible impact on the acquisition performance of the Department of Defense (DoD). Some had adverse impacts. During my career, we have had the following: Blanket Firm Fixed Price Development Contracting, Total Quality Management, Reinventing Government, and Total System Performance—to name just a few.

I generally am not a fan of broad management theories and slogan-based programs. Sometimes they contain sound ideas and policies—but they seldom outlast the leaders who sponsor them, and the hype associated with them usually exceeds their value. The complexity of acquiring defense products and services makes simple solutions untenable; we have to work hard on many fronts to consistently improve our results.

Principle 2: Data should drive policy. Outside my door a sign is posted that reads, "In God We Trust; All Others Must Bring Data." The quote is attributed to W. Edwards Deming, the American management genius who built Japan's manufacturing industry after World War II. The three annual reports on The Performance of the Defense Acquisition System that we have published are based on this premise. It is difficult to manage something you cannot measure. Despite the noise in the data, it is possible to pull out the correlations that matter most and to discover those that have no discernible impact. As we have progressed through the various editions of BBP guided by the results of this analysis, we have adjusted policy, such as preferred contract type and incentive structure.

Principle 3: Critical thinking is necessary for success; fixed rules are too constraining. This principle was the core concept behind BBP 2.0, which was subtitled "a guide to help you think." Our world is complex. One-size-fits-all cook-book solutions simply don't work in many cases. The one question I most often ask program managers (PMs) and other leaders is "Why?" When we formulate acquisition strategies, plan logistics support programs, schedule a series of tests, decide which technology project to fund or do any other of the myriad tasks that acquisition, technology and logistics professionals are asked to do every day, we have to apply our skills experience and understanding of cost, benefits, and relative priorities to arrive at the best answer. There is no shortage of policy or history to assist us, but at the end of the day we have to figure out the best course of action in a specific circumstance, balancing all the complex factors that apply to a given situation.

Principle 4: Controlling life-cycle cost is one of our jobs; staying on budget isn't enough. This idea, that managing cost is a core responsibility, is at odds with a long history of focusing on execution (spending) in order to maintain budgets. The idea introduced in BBP 1.0 of "should cost" was intended to compel our managers (all of our managers) to pay attention to their cost structure, identify opportunities for savings, set targets for themselves and do their utmost to achieve those targets. I am hopeful that this idea is becoming institutionalized and, what is more important, is becoming part of a culture that values proactive efforts to control cost. Once in a while, I still see token savings targets. But, for the most part, our managers are implementing this concept and doing so effectively. One cautionary note is that this does not imply we should make poor decisions that result in short-term savings at the expense of high long-term costs.

The Principles Suggested by 24 Acquisition Experts

Principle 1: Continuous improvement will be more effective than radical change.
Principle 2: Data should drive policy.
Principle 3: Critical thinking is necessary for success; fixed rules are too constraining.
Principle 4: Controlling life-cycle cost is one of our jobs; staying on budget isn't enough.
Principle 5: People matter most; we can never be too professional or too competent.
Principle 6: Incentives work—we get what we reward.
Principle 7: Competition and the threat of competition are the most effective incentives.
Principle 8: Defense acquisition is a team sport.
Principle 9: Our technological superiority is at risk and we must respond.
Principle 10: We should have the courage to challenge bad policy.

Over the last five years, we have billions of dollars in savings that we can point to. In all cases, those dollars have gone to higher-priority Service, portfolio or program/activity needs. The result is more capability for the warfighter at less cost to the taxpayer.

Principle 5: People matter most; we can never be too professional or too competent. We introduced an entire section on building professionalism in BBP 2.0. It was a major oversight that former Under Secretary of Defense for Acquisition, Technology, and Logistics Ashton Carter and I left this out of BBP 1.0. Improving over time the expertise, values and competencies of our professionals is the best way to improve defense acquisition, technology and logistics outcomes. This was never intended to imply that the workforce is not already professional—of course it is. But more is better, and every one of us can be better at what we do—including me. The best statutes, processes and policies in the world will not by themselves make us or anyone in industry better managers, engineers, business people or logisticians. We should all constantly increase the DoD's professionalism, for ourselves and the people who work for us.

Principle 6: Incentives work and we get what we reward. Policies related to incentives are found everywhere in the various editions of BBP, most obviously those associated with contract types and incentive structures. Others include the use of open systems, how we manage intellectual property, the monetization of performance in source selection, and the use of prototypes to encourage innovation. In BBP 1.0 and BBP 2.0, we focused on getting the business incentives right. In BBP 3.0, we focused on incentives to innovation and technical excellence.

Principle 7: Competition and the threat of competition provide the most effective incentive. All businesses exist in large part for the purpose of making a profit for their investors. The opportunity to gain business through competition and the threat that an existing market position will be lost as a result of competition are powerful motivators. One thing I enjoyed about my time working in the defense industry was the simplicity of the metric and the fact that everyone in the firms I worked with understood that metric: If something increased profit, it was good; if it didn't do so, it wasn't good. When we rolled out the first set of BBP initiatives, industry was concerned that we were waging a "war on profit." That was never our intention. What we wanted and still want to do is align profit with the desired performance for the warfighter and the taxpayer. Many BPP initiatives are designed to foster competition or the threat of competition.

Principle 8: Defense acquisition is a team sport. Over the three editions of BBP, we have pointed to the importance of close cooperation and coordination between participants and stakeholders. The importance of the requirements and intelligence communities were highlighted in BBP 2.0 and 3.0, respectively. The nonacquisition leaders who are responsible for much of the DoD's service contracts are another important community. Defense acquisition can only be successful and efficient if all participants recognize and respect other participants' roles and responsibilities.

Principle 9: Our technological superiority is at risk, and we must respond. This fact is the reason for BBP 3.0. The combination of cutting-edge, strategic and increasing investments made by potential adversaries, coupled with our own budgetary stress and global commitments, are causes for alarm. We need to do everything we can to maximize the return on all our investments in new capability, wherever those investments are made. BBP 3.0 focuses on all the ways in which we expend research and development (R&D) funding (DoD laboratories, industry independent R&D, contracted R&D, etc.) and on the opportunities to spend those funds more productively. The Long-Range Research and Development Planning Program recommendations are intended to provide guidance on how to achieve this. BBP 3.0 also includes the increased use of experimental prototypes and other measures designed to spur innovation—such as early concept definition by industry and monetary incentives to industry to develop and offer higher-than-threshold performance levels. We need to reduce cycle time, eliminate unproductive bureaucracy, and increase our agility by accepting more risk when it is warranted. All of these measures are BBP initiatives.

Principle 10: We should have the courage to challenge bad policy. One of Deming's principles was that successful organizations "drive out fear." He meant that a healthy organizational culture encourages members to speak out and contribute ideas and inform management about things that are not as they should be. We should not be afraid to speak up when we see bad policy, or policy applied too rigidly where that clearly isn't the best course of action. We should not be afraid to offer creative ideas or to challenge conventional wisdom, and we should encourage others to do so as well. None of the BBP initiatives, or their more detailed implementation guidance, are intended to apply in every possible situation. All of us should be willing to "speak truth to power" about situations in which policies simply are not working or will not achieve the intended result. The annual PM Program Assessments that I started last year and included in BBP 3.0 proved to me that the chain of command has a lot to learn from the very professional people on the front lines of defense acquisition. This applies to all the professionals who support or work for those PMs also. Continuous improvement comes from the willingness to challenge the status quo.

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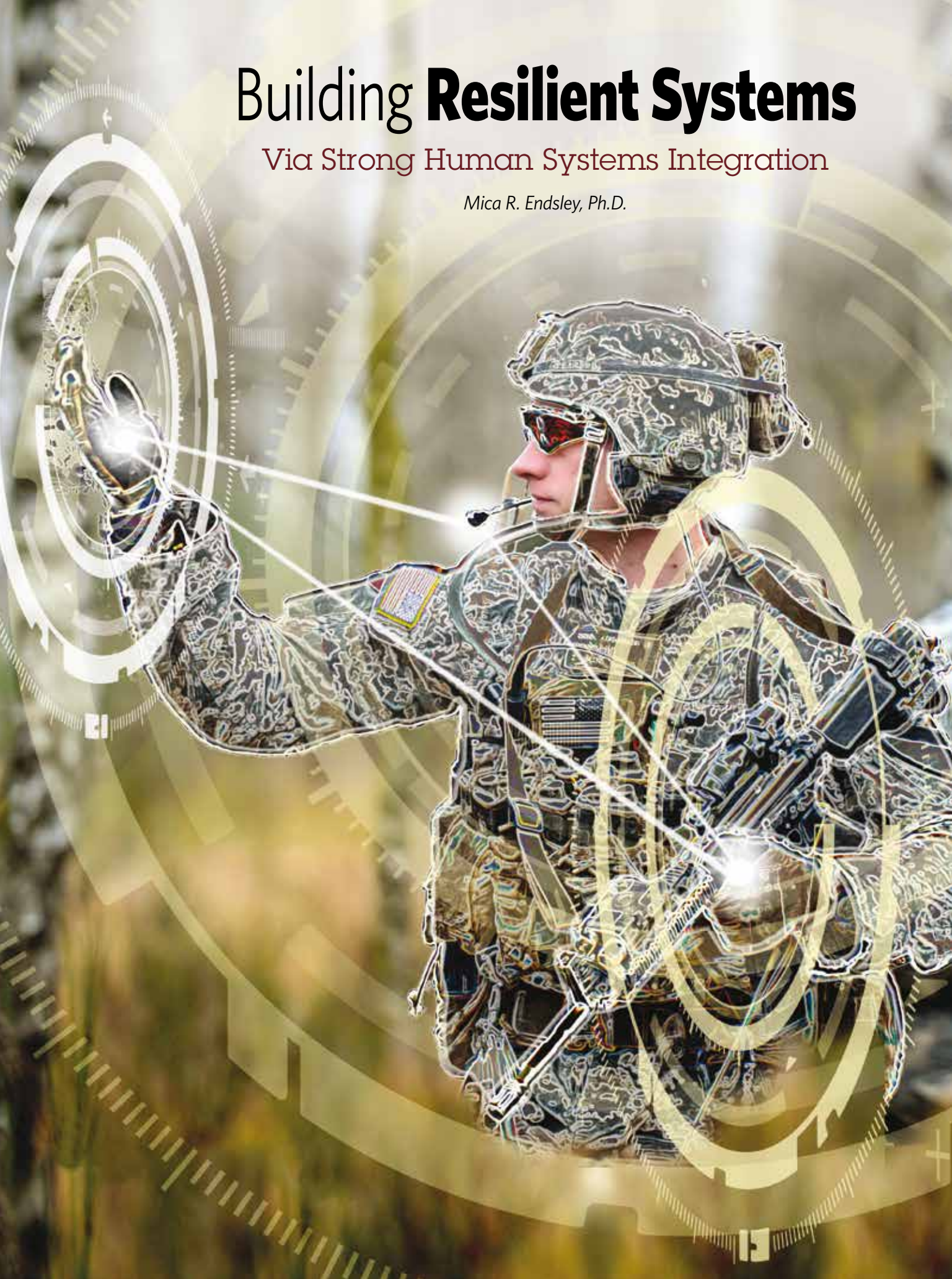
Building **Resilient Systems**

Via Strong Human Systems Integration

Mica R. Endsley, Ph.D.



Imagine a land called Nonods in which the people built a great many bridges. These bridges had a tendency to collapse frequently, however, killing or injuring a number of Nonods in the process. The bridges were also fairly rickety requiring lengthy training as well as many procedures to avoid falling off of them, significantly slowing traffic across the land. Now within Nonods there were many civil engineers who had amassed significant knowledge about how to build strong bridges that would not fall and that would support much more rapid traffic. However, the Nonod bridge builders generally ignored these engineering principles. "Why, we cross bridges all the time," they said, "so we know perfectly well how to build bridges." As a result, the Nonods continued spending a great deal of their treasure on building bridges that worked poorly, and periodically a number of Nonods were killed trying to use them. "Oh, well," they would say. "Bridges fall down. Not much one can do about that." Or they would say, "The people walking on them must have done something wrong to make them fall." And thus the Nonods were quite unprepared to move their people across the land quickly when they needed to repel an invasion from the north and they were summarily defeated in battle. The Nonods were no more.

The story of our imagined Nonods illustrates a reality in our acquisition system. But the problem is not that of building bridges but systems that allow for effective human performance. Like the Nonods, many program managers believe that "people just make errors, and that is not something that can be remedied." However, there is a strong base of scientific research and engineering foundation in the field of human factors, developed over the last 60 years, that provides a rich basis for developing robust systems that can significantly reduce human error. Human factors engineering is based on the scientific understanding of

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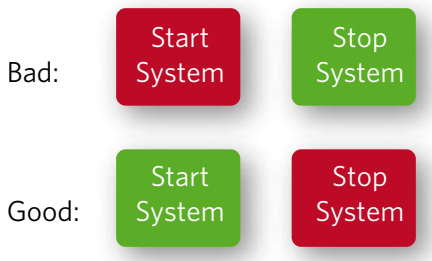
Figure 1. Poor Vs. Proper Interface Design



how people perceive and process information, their physical characteristics, and how people make decisions and carry out tasks with the use of technology.

One can substantially improve human performance and reduce the likelihood of errors, simply by designing a system that is compatible with the characteristics of the people who must operate and maintain it. For example, research shows that simply making text a combination of capital and small letters (rather than all capitals) can improve reading time for lines of text by between 10 percent and 15 percent and reduce errors by about 12 percent, according to Sanders and McCormick in "Human Factors in Engineering and Design" (1993). If displays use colors consistent with human expectations (e.g., red for stop and green for start), performance will be significantly faster and people will make far fewer errors than when the colors are the opposite of expectations. These are two very simple examples, but they demonstrate the significant improvements in human performance that can be made with design features that cost almost nothing to implement. And I have found systems in the military that violate both principles, leading to unnecessary problems and poor performance.

By applying human factors principles during the design and development of our military systems, we can significantly reduce instances of catastrophic failures that lead to crashed aircraft or fratricide. And we can significantly reduce the ongoing operations and maintenance costs that eat into our limited budgets.

For example, today's manned aircraft have benefited significantly from the application of good human factors principles during system design. Early flight experience during World War II led aviation experts to realize that perfectly good aircraft were crashing because pilots had difficulty integrating and understanding displays that worked in nonintuitive and inconsistent ways and that were prone to spatial disorientation and other hazards.

The field of human factors developed to address these problems and the incidence of "human error" decreased rapidly. Military Standards such as MIL-STD-1472 and MIL-STD-1295 were developed to codify this work. However, acquisition changes in the 1990s led many programs to stop requiring attention to these human factors design standards and we saw a resurgence of problems. For example, the grounding of the F-22 fleet of tactical fighter aircraft amid concerns about pilots' hypoxia-like symptoms was found to be due to the lack of a critical backup for the Onboard Oxygen Generation System (OBOGS). That backup system was eliminated to reduce weight, even though there had been insufficient modeling and testing of the life-support system to support the decision or detect problems with the pressure vests used by the pilots. The Air Force's failure to incorporate Human Systems Integration (HSI), including human factors, in its requirements and acquisition process was a major contributing factor to this problem, according to the Air Force Scientific Advisory Board that investigated the incidents.

Today, we see similar problems with many remotely piloted aircraft. Basic human factors design principles were not applied during the initial development of the Predator ground stations. Recent analysis by the Air Force Safety Center shows that our unmanned aircraft have 6 times more Class A mishaps than our manned aircraft, and 73 percent of these were associated with human-factors problems. While the loss of an unmanned aircraft generally does not involve loss of life, it does involve loss of an expensive asset and of mission capability.

The costs of ignoring human factors during system design are too great. How people perform with technology is a critical component of total system performance. While our systems development processes often focus only on the mechanical performance of the technology, it is important to remember that our job is not only about the technology; it's also about how well the technology will support the people who need to use it to accomplish their missions.

Human Systems Integration

The military has worked to improve the incorporation of human-factors design principles into the development of its programs through HSI, which is a disciplined, unified and interactive systems engineering approach for integrating human considerations into system development, design and life-cycle management. This works to both improve total system performance and reduce costs of ownership across the system's life cycle. It incorporates nine key areas: manpower, personnel, training, human factors engineering, environment, safety, occupational health and survivability. HSI takes into consideration human factors engineering principles, along with plans for the numbers and qualifications of the people assigned to use the system, and the amount and type of training needed to operate the system. This helps achieve effective system designs by simplifying the actions required for use, providing compatibility with human capabilities, and significantly easing training and manpower requirements in many cases. The environment in which the system must operate, along with various important safety factors, also is addressed in developing systems to support robust human performance.

HSI provides a detailed process for determining and incorporating requirements for effective human performance and safe operations, for applying sound engineering principles, and the metrics and analysis for enhancing overall system performance in a wide variety of demanding situations. The Department of Defense (DoD) has mandated inclusion of HSI in the development of our military systems. DoD Instruction (DoDI) 5000.02, Enclosure 7 addresses HSI, stating that the program manager should plan for and effect HSI, beginning early in the acquisition process and throughout the product life cycle, charging the program manager with responsibility for ensuring that HSI is considered at each program milestone.

The U.S. Army addresses HSI with its longstanding HSI (formerly MANPRINT) program through Army Regulation 602-2. The Navy has developed an HSI Management Plan for carrying out DoDI 5000.2. And the Air Force has incorporated HSI into its Air Force Instruction (AFI) on Life Cycle Management and has developed an *HSI Guidebook*, *HSI Requirements Guide*, and *Air Force Pamphlet 63-128* with mandatory requirements for conducting HSI as a part of systems development.

Nevertheless, in my travels across the Air Force, I have found that many programs still lack adequate consideration of HSI. Experience within the Army and Navy has been similar. While some programs manage to include HSI, in many cases HSI requirements take a back seat to other engineering considerations or are missing completely. It turns out that, like the Nonods, some program managers do not fully appreciate the ways in which HSI can improve system performance, or they remain confused about how to effectively incorporate HSI into their programs. This is due to a number of fundamental gaps in understanding about HSI.

Myth No. 1: HSI Means Asking What Users Want

Often when I have asked program managers what sort of HSI considerations they have included in their programs, they proudly tell me, "We showed it to some users." While a good step, this unfortunately is quite insufficient. Human preference does not equal human performance. User input is very important to development of good systems. Users know a lot about what their jobs entail and where the difficulties are, and they can provide useful feedback when looking at new system designs or when trying them out during Developmental Test and Evaluation (DT&E) or Operational Test and Evaluation (OT&E). However, they generally are not experts at understanding the detailed physical, physiological, perceptual and cognitive processes, capabilities and limitations of humans, and they often will miss the many subtle features of technology that can negatively impact human performance.

Good HSI means applying known human engineering design principles and performing objective evaluations of the functioning of the system when in use by a representative sample of its intended users. Time to perform tasks, error rates, workload and situation awareness can all be objectively

Table 1. Human Systems Integration (HSI) Domains

Manpower	The determination of total personnel required to operate, maintain and sustain a system in order to achieve full operational capabilities.
Personnel	The determination of total human characteristics and skill requirements for a system to support capabilities necessary to fully operate, maintain and support a system.
Training	The use of analyses, methods and tools to ensure systems training requirements are fully addressed and documented by systems designers and developers. This is necessary to achieve the level of individual and team proficiency required to successfully accomplish tasks and missions.
Human Factors Engineering	The consideration and application of human capabilities and limitations throughout system definition, design and development to ensure effective human and machine integration for optimal total system performance.
Environment	The considerations of environmental factors, such as water, air and land and the interrelationships between a system and these factors.
Safety	The consideration and application of system design characteristics that serve to minimize the potential for mishaps that could cause death or injury of operators and maintainers or threaten the system's survival and/or operation.
Occupational Health	The factors in system-design features that minimize the risk of injury, acute or chronic illness, or disability and/or that reduce job performance of personnel who operate, maintain or support the system.
Habitability	The consideration of system-related working conditions and accommodations necessary to sustain the morale, safety, health and comfort of all personnel.
Survivability	The consideration and application of system-design features that reduce the risk of fratricide (the death of one's own forces), the probability of detection, the risk of attack if detected and damage if attacked.

measured to find problems and make design trade-offs with the goal of creating effective total system performance. Just as we would not test an engine simply by having pilots look at it, we will not get a good assessment of the human interface just by having the user look at it.

Myth No. 2: HSI Means Including the Newest Display Techniques and Hardware

At the opposite end of the spectrum from neglecting HSI, some programs go looking for HSI in all the wrong places. That is, they want to make really cool user interfaces by incorporating the latest ideas from science fiction movies or computer scientists. I have seen displays built into three-dimensional rotating cubes, displays that project information into holograms and virtual reality headsets, or those that involve large arm movements for extended periods to interact with displays. While well intended, many of these so-called advancements can be fatiguing, can reduce situation awareness in critical situations, and actually can lead to much slower performance and higher error rates on critical tasks. Cool does not equal effective. Good user interfaces may not always require the latest hardware and software concepts. Instead designers must pay attention to the requirements associated with users' tasks and match the most effective hardware and software approaches to those tasks.

Myth No. 3: HSI Should Be Done at the End of a Program

Among program managers, one of the most pervasive misunderstandings is the belief that the user interface should be considered at the end of the program after the technology issues are sorted out. This is the worst time to do HSI. At that point, generally only small fixes can be applied to a system that has placed controls in the wrong places or that has software logic and layouts that fundamentally confuse users and do not provide the needed information in ways that will help users achieve good situational awareness or rapid performance. Just as one cannot really fix a poorly designed Nonod bridge with a few Band-Aids, one cannot fix a poor user interface with a few tweaks at the end of the program. And making the extensive changes needed is generally very costly at that point and causes program timelines to be exceeded.

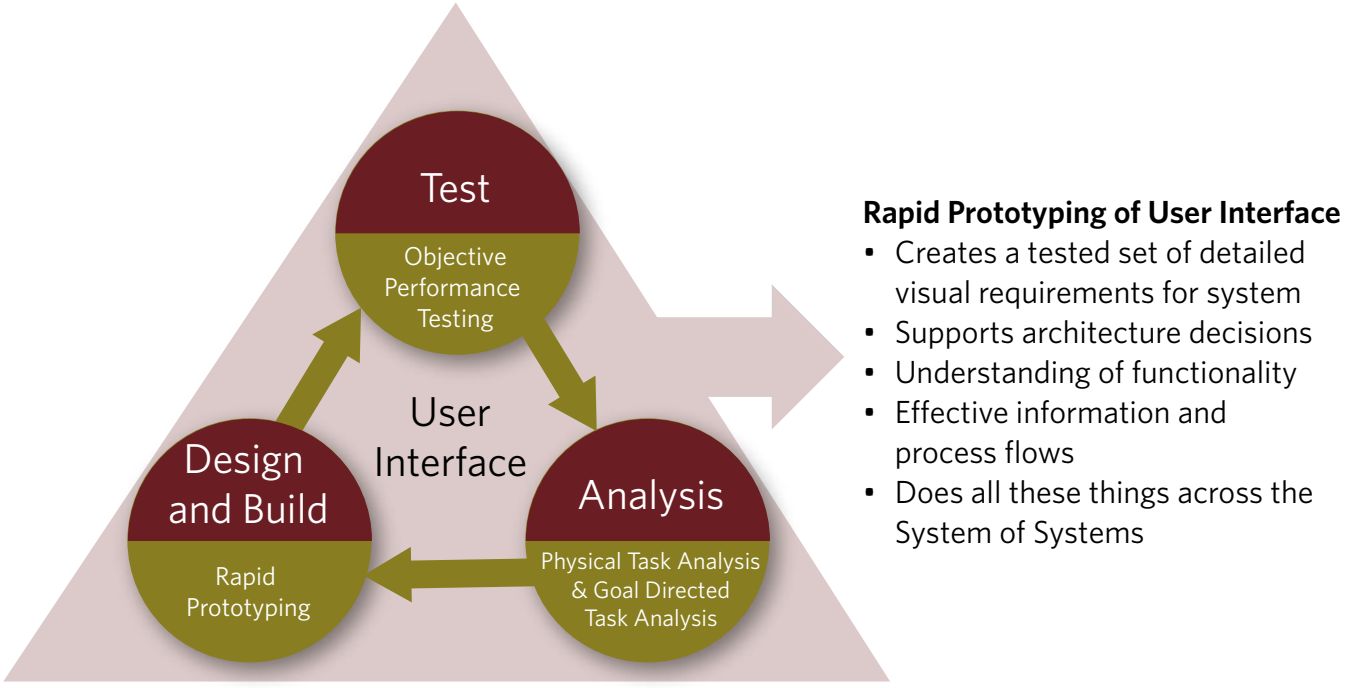
HSI should be started at the very beginning of a program. By conducting an early analysis of user requirements, tasks and information needs, an HSI team can create early prototype interface designs that can be tested with users early in the program. These prototypes then can create the foundation for software and hardware development. They provide a clear indication of what is needed before a penny is spent on bending metal or on expensive software coding of interfaces that will need to be changed repeatedly as users try them out.

This creates significant time and money savings for the program. The Air Force recently was forced to cancel its Expeditionary Combat Support System (ECSS) program, costing more than $1.1 billion and 8 years of effort. A major reason was the program's inability to understand the system requirements, leading to extensive churn in requirements and solutions and failed reprogramming efforts. Had this HSI process been employed early, there would have been a prototype system available for testing with the many users of the system. This would have established a means to ensure that the needed functionality and information flow was well understood before software development even started.

Myth No. 4: Anyone Can Do HSI

Just as the Nonods believed that they could design bridges because they were bridge users, many people believe anyone can do HSI because they are people and so they know what people need. However, even well-meaning people will not do an adequate job of HSI if they have not received the appropriate training—combining knowledge of human capabilities (physical, cognitive and perceptual) with knowledge on how to design systems, develop training or conduct the needed HSI domain analyses. As in other areas of engineering, there is a significant body of knowledge that needs to be acquired. Most HSI practitioners have advanced degrees in industrial engineering, psychology or physiology. However HSI is a multidisciplinary profession, so practitioners may have a wide variety of degree titles that can leave some people confused as to how to find the right expertise. Just as you can hire a Certified Public Accountant (CPA) to do your taxes, you also can find an HSI expert for your team who is a Certified Professional Ergonomist (CPE)—after having passed the required exams and demonstrated proficiency in the field.

Figure 2. Use HSI Tools and Processes to Define Requirements and Interfaces Early



Myth No. 5: We Can Just Train Around HSI Problems

There is a long history of trying to use training to compensate for poorly designed user interfaces. Unfortunately, training alone cannot overcome interfaces inconsistent with human expectations (for example, requiring the user to push down on a lever to go up), that create known physiological problems (for example, a lever that requires the pilot to move her head down and to the side during landing, resulting in the pilot's disorientation), or that require extensive time-consuming procedures for simple tasks. Even with extensive training, people will continue to make errors when the technology is incompatible with how they think and operate, particularly when under stress. And trainers will tell you that good HSI can significantly reduce the training time required for any system. Good training is important, but it is no substitute for good system design.

Myth No. 6: With Automation, We Don't Need to Worry About HSI

Many people believe that as systems become more automated, worrying about HSI or the human operators of the systems will become less important. However, exactly the opposite is true because almost all this automation still requires human interaction. Extensive experience with automated systems over the last 30 years has shown that automation actually can make the user's job more complicated. For example, pilots and system operators find that their cognitive workload can increase substantially as they work to understand how to properly program the automation during operations. And they can suffer from lower situational awareness when working with automation because it often leaves them out of the loop and struggling to understand what it is doing so they can supervise the automation and intervene in time-critical situations. The move toward more automation or autonomy in many systems requires that we pay even more attention to the user interface than ever to make the behavior of the system more transparent and understandable, creating effective human-automation teams.

Myth No. 7: HSI Costs Too Much

Actually, good HSI saves programs money, both during system development and later in operations. Attention to HSI early in a program can provide clear directions for system development, saving extensive rework later, when it is much more expensive to redo software or hardware. Attention to HSI also can save a great deal of money in the military's limited operations and maintenance budgets. Life-cycle costs account for between 35 percent and 70 percent of a system's overall costs. These costs can be significantly reduced if HSI is emphasized during system development. For example, attending to the design of the interface for a satellite control ground station or a command-and-control system can significantly reduce the number of operators required. Attending to the design of the aircraft for supporting maintainer tasks can significantly reduce the hours required for routine maintenance and increase its availability for flight. The truth is our development programs cannot afford a failure to apply good HSI.

The Acquisition Community Is the Linchpin for HSI

Acquisition professionals have a critical role in developing technology for their users. All of our airmen, soldiers and seamen have demanding and critical jobs to do that depend on well-designed systems that will work the way that they do—supporting the accomplishment of their tasks rapidly and

effectively. It is critical that we avoid system designs that are obstacle courses of hidden hazards and latent failures.

Acquisition programs can accomplish these goals by first paying attention to HSI requirements when establishing program requirements. If these requirements are not spelled out in clear measurable ways, experience has shown that contractors will not, and often feel they cannot, spend any effort in ensuring that systems are easy to use or consistent with human capabilities and limitations. And if HSI requirements are not included in program documents, there is little that can be done to make contractors fix even egregious interface problems without making expensive program modifications.

Second, make sure not only to require that system developers create an HSI plan but that it is implemented early in the program, and include it as a critical part of design reviews. In some cases, we have found programs that required an HSI plan but failed to require the contractor to actually implement it, which did no good at all. Design reviews should include not only a review of the contractor's progress on HSI tasks, but also a review of objective test metrics showing whether their work has been successful and identifying areas for further improvements.

Third, make sure you have the needed HSI professionals as a part of your program team. You won't be able to tell if contractors have done a good or a poor job if you don't have people with the required knowledge and experience to evaluate the system design, the methods used or the test results. In the Air Force, the 711th Human Performance Wing has a body of HSI professionals who can provide the expertise needed. The Army has the Army Research Laboratory Human Research and Engineering Directorate (ARL HRED), and the Navy has HSI professionals imbedded at the Naval Sea Systems Command (NAVSEA) and the Space and Naval Warfare Command (SPAWAR).

To learn more about HSI a number of resources are available. The Defense Acquisition University offers a 2-hour introductory course in Human Systems Integration (CLE 062). The Air Force Institute of Technology offers courses in Basic Human-Systems Integration (SYS 169), Intermediate Human Systems Integration (SYS 269), and a certificate in Human Systems Engineering, as well as advanced degrees. The Naval Postgraduate School offers an online Human Systems Integration Certificate, in addition to master's and doctoral degrees with emphasis in HSI.

The good news is that there is an extensive body of knowledge and expertise that can help all of our acquisition programs develop safe and resilient systems that promote effective human performance as a part of total system performance. Like the Nonods, we just need to apply that knowledge to our programs to be successful.

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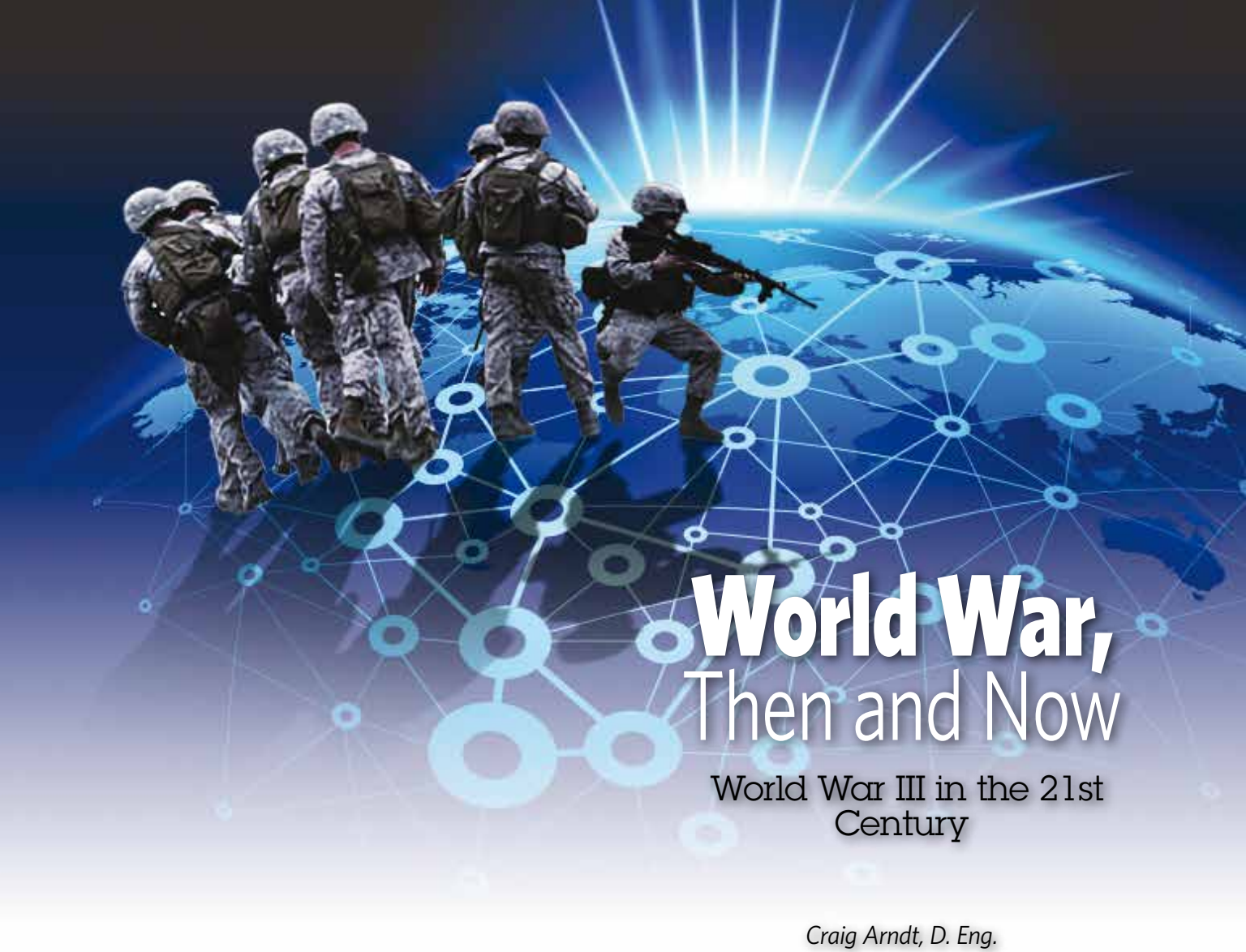

World War, Then and Now

World War III in the 21st Century

Craig Arndt, D. Eng.

This is the first of three articles addressing some of the challenges facing the U.S. Department of Defense (DoD) in developing effective weapons and systems to meet the challenges of the 21st century. This first installment addresses a number of issues centering on the Global War on Terrorism (GWOT), including what it is, how it is being waged, what effect it is having on long-term national defense strategy and force structure planning, and the GWOT requirements for developing weapons and tactics to meet these challenges. The second article in the series will focus on engineering a new generation of weapons and systems to win the war on terrorism. The final article will examine new approaches and methods for developing and fielding more capable defense systems faster with a smaller defense acquisition infrastructure in the next century.

A little bit about myself and my perspective: For more than 30 years, I have been professionally researching, building and using military systems as a naval officer, engineer and researcher. I also helped develop systems including

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the B1-1 jet bomber, F-16 fighter, advanced radar systems, the Mine-Resistant Ambush-Protected (MRAP) vehicle, and national biometrics infrastructure. My father developed the first generation of Intercontinental Ballistic Missiles in the 1950s.

Two generations of engineers have devoted their lives to developing the weapons and systems we needed to win the Cold War. Now, however, the United States is struggling with what many people call a new kind of war against a new kind of enemy on both traditional and new kinds of battlefields.

It has long been known that terrorists can be both traditional and nonstate actors; this has been a problem for warfighting policy and tactics. Terror has been used by different groups both by leaders of nation-states, and by nonstate actors (insurgents, revolutionaries, etc.). The one thing these groups have in common is that they all have political objectives.

In order to effectively develop new policy, weapons and tactics, we need to look at and understand the nature of the war we are fighting, the nature of our enemy, and the new environment of the 21st century. Then we can finally begin developing the weapons we need to win the GWOT.

So, who is the enemy in the 21st-century GWOT and how do we characterize them in a way that is useful in the development of weapons and tactics to win this war? Some have described the enemy as radical Islamic jihadists. Some of these radicals include criminal elements within different countries and cultures. The different terrorist organizations describe themselves as insurgents and revolutionaries, or even the legitimate governments of nations. Although some such descriptions are accurate and useful, they do not provide the complete understanding needed to develop weapons and tactics.

One characteristic of our current highly distributed and loosely affiliated enemies in the GWOT is that their political objectives also are distributed. The different terrorist organizations' objectives are individually specific, but the groups still have much in common. First of all, they seek to substitute their rules for the legitimate rule of law. Second, they rule by violence and intimidation. And, third, they chose to mask their intentions with lies based on anything that their followers will believe. Many current terrorists put forth the lie that their cause is pursued in the name of religion, rather than to promote their true objective of power over other people. Looking at different political models, this generation of terrorists most closely follows the goals and rules of fascist groups.

Fascism is a form of radical authoritarianism that became prominent in early 20th-century Europe. Fascists sought to unify their nations or peoples through an authoritarian state led by a revolutionary political movement that aimed to reorganize the nation or people in accordance with the principles of fascist ideology. Fascist movements shared certain features, including the veneration of the state, unchallenged devotion to a strong leader, and an emphasis on elimination of diversity and of civil and human rights and the rule of law. Fascism views political violence, war and imperialism as the means to achieve national rejuvenation and asserts that stronger nations have the right to expand their territory by displacing weaker nations, races or religions.

In order to effectively engage and challenge terrorist groups, we look at the enemies' centers of gravity. The center of gravity is a concept developed by the 19th-century Prussian military strategist Gen. Carl von Clausewitz to identify a nation's or organization's key aspect or strength that allows it to wage war. The first center of gravity for terrorist organizations is their followers' unquestioning devotion. This devotion is developed by indoctrinating recruits into the organization's false belief system and instilling a fear of rejection by the group (which often can result in the murder of those who are rejected). The next center of gravity for terrorists involves the underlying goals of their leaders. In some cases, they wish to rule a land to enslave its people and plunder resources. The last key center of gravity comprises the terrorist organizations' operational resources. These resources are gained in many ways—through criminal activity, the plundering of territories, and the support of external individuals, groups and nations that gain from the advancement of the terrorists' goals.

The interconnected support of many of these different fascist organizations brings us back to the question of world wars. In order to form a strategy and to develop and acquire the weapons we need to fight and win the GWOT, we need to view the the GWOT as a world war. A world war by definition involves some of the world's most powerful and populous countries. World wars span multiple countries on multiple continents, with battles fought in multiple theaters. Based on that definition, the GWOT is definitely a world war. At the same time, it differs from past world wars.

In World War II, the Axis Powers (Germany, Italy and Japan), did not wage war until they were on a military par with their enemies. This was predicated on the traditional military and political theories of war prevailing at the time.

In the case of the current world war, the different terrorist groups wage war partly as a way to gather strength. In most traditional 20th-century wars, the conflicts depleted resources quickly and, therefore, created vulnerabilities for the combatants. Terrorist organizations have developed methods to use the acts of war (or attacks) to increase their resources. They use attacks to recruit followers and soldiers and also to demonstrate to their supporters a greater likelihood of future success. This model of warfare is fundamentally different than the previous unlimited world wars.

The concept of limited versus unlimited war is very important when we talk about terrorist organizations. The different terrorist organizations are waging unlimited war on the United States in that their goal is the complete destruction of the United States. But the U.S. war against the terrorist

organizations can only be characterized as a limited war. To better understand the principle of limited and unlimited war and in view of the asymmetrical nature of the GWOT, the terms and definitions of limited and unlimited war need to be re-examined.

Traditionally, unlimited wars seek to destroy all aspects of the enemy, including industry and to some extent the civilian population, in order to compel the enemy's submission. This definitely is the goal of terrorist organizations. Terrorists try to use asymmetrical warfare to gain an advantage over nations that fight wars in a more conventional manner. The terrorist organizations use both nontraditional weapons and nontraditional combatants (women and children). Their tactics and their agendas show a complete disregard for human life (both of their enemies and their followers).

Clearly, these terrorist organizations are engaging in what we call unlimited war. But what kind of war is the United States waging against the terrorist organizations? History has demonstrated that using the tactics of limited war to fight an unlimited war ends in disaster (the Vietnam War). Then the question becomes: How does the United States define and fight an unlimited war with nonstate actors that have total disregard for lives of their people and that choose to conceal themselves and their true motives?

In their pursuit of total war, the terrorist organizations use a wide range of tactics, including mass murder, slavery and indoctrination. By using the Internet and modern social media, this generation of terrorists has added to the weapons and tactics of earlier generations. These methods allow the terrorists to continuously wage war against the United States and other free states.

Many analysts had called the GWOT the long war because of the diversity of the war and enemy but also because of our failure to find effective ways of dealing with many of the tactics the terrorists use. It is important to deal with the terrorists' tactics, but doing so cannot in itself provide an effective long-term strategy.

The United States' ability to destroy terrorist enemies has been questioned repeatedly over the last few years. As part of a long-term strategy to eliminate these terrorist organizations' threats to the United States and to civilize the nations that provide their bases of operations, we need to attack and utterly destroy the terrorists' centers of gravity, which include again the unquestioning devotion of their followers, the ruthlessness of their leaders and their operational resources.

The United States has many weapons and capabilities for fighting our wars. However, we need to develop new weapons to win this war, and these must be weapons of unlimited war, designed to utterly destroy these centers of gravity for all time. During World War II, the United States developed many new weapons and strategies (the atomic bomb, heavy bombing of civilian and industrial centers, naval aviation, etc.). However, the greatest and most important weapon of that war was the involvement and dedication of every American citizen.

The dedication of the American public is incredibly powerful, and it will be a necessary part of combating our current enemies, who lie, deceive, enslave and kill with no remorse and with an efficiency augmented by use of the Internet and other electronic and social media.

Conclusions

Based on this new more complete understanding of the nature of the GWOT, we can come to a few critical conclusions. First, the United States is at war with terrorist organizations, if for no other reason, because they are at war with the United States. As in the Cold War, the GWOT is a real war with real battles. But unlike the Cold War, our enemies in the GWOT include both nation-states and nonstate players. The jihadi movement consists of loosely affiliated fascist organizations engaged in

unlimited war against anyone that they believe stands in the way of their gaining wealth and power.

Many analysts tell us that these terrorists fundamentally differ from other enemies faced by the United States in the past. The enemy is not fundamentally different. The United States fought wars against fascists before—most recently against Saddam Hussein and Iraq's Ba'ath Party. Although the nature of the enemies is the same, their methods and tactics have changed and evolved. The clear conclusion is that the nature of war and combat is changing. The advent of nonstate actors, social networking and the 24-hour news cycle have changed the nature of the capabilities and the tactics of the terrorist organizations and modern war. The changes in the nature of war are evidenced by the fact that our traditional adversaries (in this case, China and Russia) use some of the same tactics as terrorist organizations. From a strategic standpoint, therefore, terrorist organizations are more opportunistic than innovative.

The weapons of hatred, brainwashing, slavery, brutality, lying and the hijacking of religion have been used by fascistic forces for centuries. Current available technology has made these weapons more powerful and given them greater reach and penetration. In the past, we battled fascist foes with the weapons of traditional state-to-state warfare. However, traditional state-to-state warfare methods are problematic in engaging nonstate actors. Previously, the United States has waged the GWOT as a limited war, which has yielded a key advantage to our enemies. In order to ultimately defeat these enemies, we need additional weapons, systems and tools. These weapons will need to be based in a new class of unlimited war and an understanding of what that means to the DoD.

In the second part of this series of articles, I will address how the United States defines this new unlimited war and how the research and engineering community will develop a new generation of weapons in order to secure victory. The last article in this series will address fundamental changes needed in the DoD's approach to acquisition to support the requirements for a new generation of weapons to win the GWOT.

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The International Defense System **After-Action Review**

An Industry Perspective

Lawrence E. Casper

This is the fourth in a series of articles by the author on international defense sales. The previous three articles appeared in the September-October 2014, March-April 2015 and September-October 2015 issues of Defense AT&L *magazine.*

* * *

The defense industry spends significant financial resources and manpower executing international pursuits. An international defense systems pursuit or capture normally spans several years—therefore, the investment is considerable. Once a contract is signed or a competition lost, the company quickly transitions to the next opportunity. This article discusses ways to record and analyze both successes and failures during a pursuit by using an After-Action Review (AAR). The article is based on the author's experience in international arms sales, and the methodology discussed is intended to provide industry (and, to some degree, the U.S. Government) an approach for conducting AARs to increase the probability of success in future pursuits.

It has been my experience that industry AARs usually focus on the competitive loss. This may be explained by management's eagerness to learn why there was no return on the company's investment. On the other hand, capturing what went right during the execution of a successful international pursuit is equally informative and valuable.

The AAR is a powerful tool, and there are multiple published processes and methods for conducting reviews. But regardless of approach, the objective remains the same: Accomplish a thorough investigation of what did and did not work and why; derive conclusions; and make recommendations to improve upon identified shortcomings and sustain positive actions/processes.

Casper *is a former U.S. Army colonel who is retired from defense industry management. He has authored a number of articles in defense and military Service-oriented journals as well as the book* Falcon Brigade–Combat and Command in Somalia and Haiti *(Lynne Rienner Publisher, January 2001).*

An AAR should produce a report that is thorough and comprehensive, yet simple to reference. The more complex the report, the less likely it will be read. The report should result in "nuggets" that program or business development managers can use to develop strategy and tactics. Remember that an After-Action report should not be viewed as a document to close out a past pursuit but rather the basis for developing a winning strategy for future campaigns.

Timing is critical, and an AAR needs to be conducted as soon as practical after the pursuit is complete—preferably before the capture team is dismantled and while the information is fresh and the participants are still available.

Ideally, the AAR encompasses all the key participants in the pursuit—capture and proposal teams, functional staff, forward deployed personnel, international representatives and consultants, domestic field offices and Washington D.C. staff. But sheer geographic dispersion usually eliminates this option. Completion of the AAR is more likely to be accomplished by a single individual tasked by management to conduct a review. If lucky, that person may be able to assemble a few participants. But more often than not, the effort and execution falls to the AAR lead. It is with that individual in mind that the AAR approach discussed in this article was developed.

An After-Action report should not be viewed as a document to close out a past pursuit but rather the basis for developing a winning strategy for future campaigns.

The AAR lead should be respected and senior enough to command attention and obtain honest answers. At the same time, if the manager is too senior or if the participants fear retaliation, the leader will be told what people think he or she wants to hear.

If the AAR is guided by a group facilitator or defaults to an individual review, the best results are attained if the person is familiar with the international pursuit process but not close enough to the capture activity to be biased. Regardless of how robust or lean the AAR effort is resourced, the idea is to capture and build upon lessons learned.

After-Action Review Steps

Unlike an AAR for a course of instruction, exercise or event, an international defense systems pursuit AAR examines activities of multiple organizations (both civilian and government) that normally span a number of years. This may involve reviewing actions by people no longer affiliated with the program or company.

Ensure any information recorded is factual and not made up of opinions or speculation. It is important to limit data to specifics that define the outcome of the pursuit—what went right, what went wrong and why.

Step 1: Request a debriefing from the customer. An acquisition program debriefing frequently is offered by the customer after a procurement decision, but if not a request should be initiated. The debriefing will provide the customer's perspective but must be received with some skepticism as the briefing will have been vetted carefully through the customer's acquisition and legal staffs.

Step 2: List sources. Next, identify and list the information sources. These might be capture-team members, functional staff, company domestic and overseas offices, the program's in-country representative or consultant, company and government documents, emails, briefings, internal correspondence (e.g., memos, white papers) and interviews. Additionally, major proposals normally undergo a formal documented review process (e.g., Bid/No-Bid briefings, Black Hats, Blue Teams, Red Teams). Reviewing real-time documentation often is more reliable than what people remember—but, in any case, the key is to leave no stone unturned.

Step 3: Determine organizational resources available to the capture team. This listing of organizations, agencies and offices might include the company's functional and Washington D.C. staff, suppliers' staffs, the U.S. Government Washington team (e.g., agencies in the Department of Commerce, the Department of Defense and the State Department), U.S. Government program office, U.S. Government country team, in-country consultants and representatives, and host-nation industrial partners. When complete, it should encapsulate the magnitude of the effort and the diverse organizations that contributed. More importantly, it aids in identifying organizations absent from the pursuit or underutilized.

Step 4: Identify key personnel. These are personalities sprinkled throughout the pursuit who were crucial to its outcome—from U.S. Government and company staff to customer decision makers and indigenous industry partners. They may be as prominent as a minister of defense or as obscure as an assistant program manager for contracts. In any case, these are the people who shaped the pursuit, supported or impeded the effort, made decisions or provided critical inputs. Examples might be members of a Parliamentary Defense Committee, an industry partner's manager, U.S. Government desk officer or the Director for the Office of Defense Cooperation. If the personalities are separated from the organizations, a better picture emerges of the role each played in the pursuit's outcome.

Step 5: Construct a chronology of key events, decisions and milestones, from pursuit inception to contract decision. This consequential compilation, when overlaid on the customer's procurement process and timeline, often reveals missed opportunities, poor (or good) decisions and resource shortfalls. The more detailed the listing, the easier it is to capture an accurate portrait from start to finish. This is when a picture begins to emerge of why actions and events occurred.

Step 6: Organize the facts, events and milestones. This should be done along with U.S. Government/customer/contractor actions and outcomes into one of three pursuit imperatives—political/industrial, price and performance (The three Ps). Grouping information into these three competitive discriminators focuses the collection effort and facilitates conducting analysis and reaching conclusions. Examples under the three categories might be listed as follows:

Political/industrial:
- Competitor's government was engaged at highest levels; U.S. Government was not.
- Competitor's in-country industrial partner aggressively lobbied customer.
- Customer's Army Chief of Staff publicly favored the least-expensive solution.

Price:
- Price-to-win was based on flawed assumptions.
- The competition never lost its price advantage.
- The U.S. Government and the company were unable to provide a pricing level that was not to be exceeded.

Performance:
- The U.S. system outperformed competition in the majority of required tasks.
- The customer did not publish criteria for a technical schedule, cost risk or past performance.
- The capture effort sometimes was disjointed and uncoordinated.

Step 7: Develop conclusions. Once the information is grouped into one of the three Ps, the next step is to extrapolate AAR conclusions. The conclusions should be succinct and easily understood and focus on issues that had the greatest impact. Examples could be as follows:

Political/industrial:
- It was considered a "must win" program by competitor's government.
- The competitor teamed with the country's largest and most influential defense company.
- The customer favored the least-expensive solution so long as baseline performance was met.

Price:
- Faulty intelligence led to price-to-win miscalculation.
- The importance of life-cycle cost was underestimated.
- Pricing was impeded by the U.S. Government's and the company's protracted multiyear contract negotiations for the system offered.

Performance:
- From the customer's perspective, both systems met the prescribed performance criterion.
- Although the customer did not publish a comprehensive evaluation criterion, it did possess one.
- There was no dedicated company capture lead. Capture lead was responsible for multiple international pursuits, which caused a convoluted effort.

From the conclusions, recommendations are derived.

Step 8: Propose recommendations. If a thorough and disciplined approach was used for the first seven steps, than the last step will result in useful recommendations that can provide the basis for developing campaign tactics and the pursuit strategy. Recommendations should be within the company's sphere of influence—in other words, within the company's ability to improve upon or reinforce a conclusion. Examples of recommendations might be as follows:

- The U.S. Government and industry must operate as one. Therefore, seek joint strategy sessions early in the pursuit.
- Select an in-country industrial partner early. The partner must provide "value added" both politically and technically with a tertiary benefit of denying the competition.
- Validate assumptions and supporting intelligence when determining price-to-win.
- Seek U.S. Government approval for Direct Commercial Sale or hybrid Foreign Military Case in order to gain pricing flexibility.
- Ensure a complete understanding of customer selection criteria and who evaluates performance.
- Assign a dedicated capture lead and ensure adequate resourcing.

Remember that a recommendation is useful only if it improves upon past performance or sustains a desired action or outcome.

Conclusion

To a seasoned capture manager, much of what has been presented may appear obvious or commonsensical, but experience has proven otherwise. I have seen knowledgeable international capture managers and their staffs make mistakes that easily could have been prevented by reading an After-Action report.

In order to ensure a comprehensive and valid AAR, enough discipline is needed during the pursuit to document what is occurring throughout the capture process.

If the pursuit was a "win," there is a good opportunity to develop a close relationship with the customer. Over time, this affiliation may provide insight into what the customer was thinking and what the competition was really doing. The result could verify or revise the AAR findings.

Whether the AAR was done for a win or a loss, the competitor likely will be faced again in future pursuits. Therefore, it is important, using the three Ps framework, to assess and record what was learned about the competition's strategy and tactics.

Conducting an AAR, writing a report and developing a management briefing are major undertakings. A lack of time always is the culprit for not doing a review. It takes a combination of company policy, senior management insistence, and program and business development discipline to routinely complete an AAR. Likewise, experience has shown it takes the same commitment to get program and business development management and staff to read and act upon an After-Action report.

Finally, the value of an AAR is its report, and the value of the report is found in its conclusions and recommendations. But the best AAR in the world is useless unless this beneficial corporate memory is easily accessible.

By performing a thorough and comprehensive AAR assessment, recording the findings, drawing conclusions and developing recommendations, the company and the program are certain to avoid the many pitfalls of an international pursuit, prevent the tendency to repeat past mistakes and build upon proven successes.

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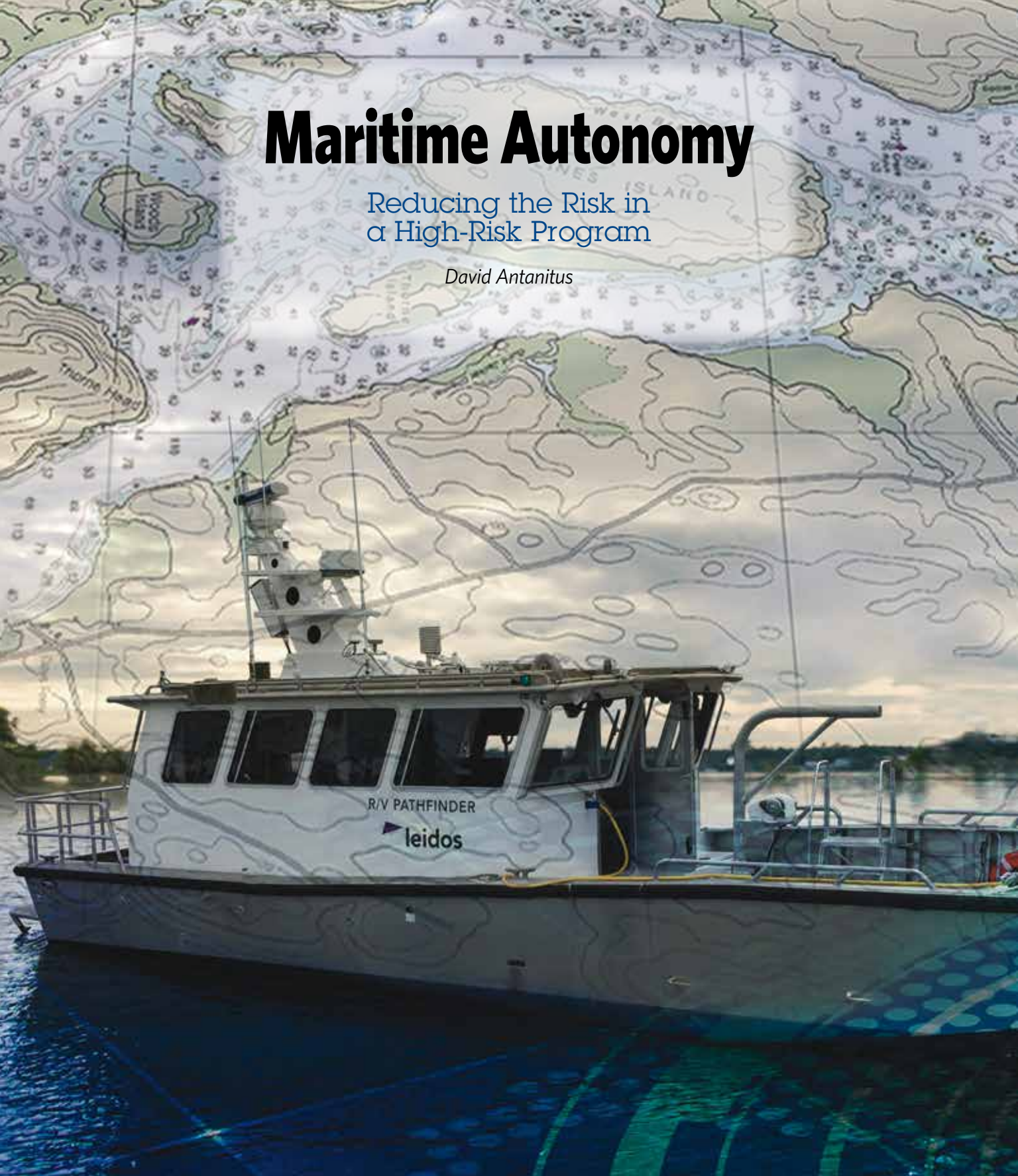
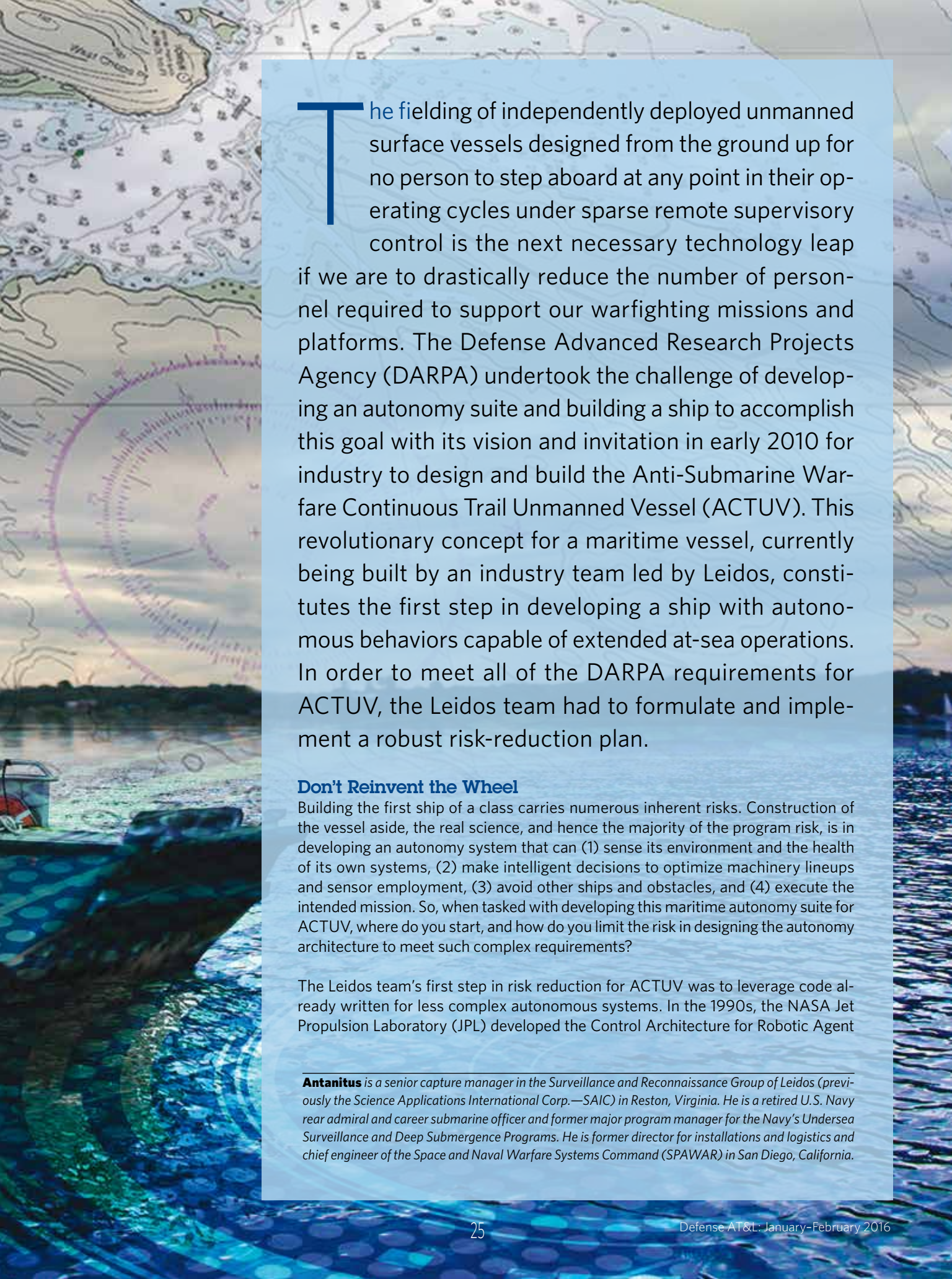
Maritime Autonomy

Reducing the Risk in a High-Risk Program

David Antanitus



A Test/Surrogate Vessel.
Photo provided by Leidos.



The fielding of independently deployed unmanned surface vessels designed from the ground up for no person to step aboard at any point in their operating cycles under sparse remote supervisory control is the next necessary technology leap if we are to drastically reduce the number of personnel required to support our warfighting missions and platforms. The Defense Advanced Research Projects Agency (DARPA) undertook the challenge of developing an autonomy suite and building a ship to accomplish this goal with its vision and invitation in early 2010 for industry to design and build the Anti-Submarine Warfare Continuous Trail Unmanned Vessel (ACTUV). This revolutionary concept for a maritime vessel, currently being built by an industry team led by Leidos, constitutes the first step in developing a ship with autonomous behaviors capable of extended at-sea operations. In order to meet all of the DARPA requirements for ACTUV, the Leidos team had to formulate and implement a robust risk-reduction plan.

Don't Reinvent the Wheel

Building the first ship of a class carries numerous inherent risks. Construction of the vessel aside, the real science, and hence the majority of the program risk, is in developing an autonomy system that can (1) sense its environment and the health of its own systems, (2) make intelligent decisions to optimize machinery lineups and sensor employment, (3) avoid other ships and obstacles, and (4) execute the intended mission. So, when tasked with developing this maritime autonomy suite for ACTUV, where do you start, and how do you limit the risk in designing the autonomy architecture to meet such complex requirements?

The Leidos team's first step in risk reduction for ACTUV was to leverage code already written for less complex autonomous systems. In the 1990s, the NASA Jet Propulsion Laboratory (JPL) developed the Control Architecture for Robotic Agent

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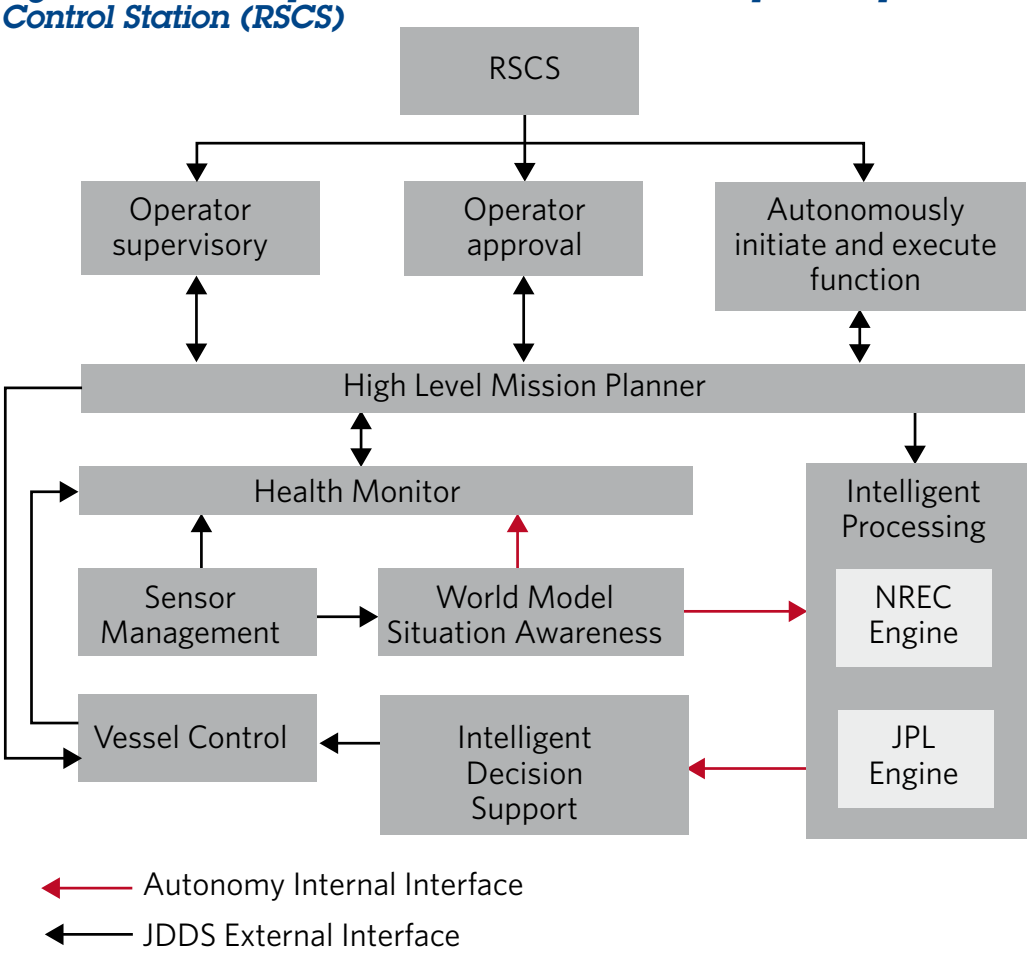
Figure 1. Autonomy Architecture with Remote Supervisory Control Station (RSCS)



Source: The author

Command and Sensing (CARACaS) for the Mars Rover Project. CARACaS already has been successfully adapted for several unmanned surface vessel programs—e.g., for the work done by DARPA in developing Grand Challenge I and II and for the Urban Challenge architecture for an autonomous ground vehicle. Leidos leveraged the work done by JPL in developing CARACaS and by DARPA in developing Urban Challenge (NREC Engine) to develop a maritime autonomy capability that uses open standards, libraries and tools.

Employ a Truly Open Architecture

The ACTUV autonomy suite contains decision algorithms embedded as software modules using an object-oriented framework in which key interface definitions isolate algorithm implementations. It supports multiple, simultaneously executing decision engines and the arbitration logic to choose the best decisions for future actions. It implements a true open systems architecture (OSA) approach that allows for the autonomy capability to be modularly connected to other subsystems—within the same platform and external to the platform. This "plug-and-play" modularity minimizes life-cycle costs, enables reuse, and promotes healthy competition among capability vendors. It also reduces overall risk to the program. In addition, the autonomy capability implements the Service Availability Forum industry standards to achieve a high-availability solution that results in near-continuous uptime when the system is fully integrated.

The OSA uses the Society of Automotive Engineers (SAE) AS4 Joint Architecture for Unmanned Systems (JAUS) messaging between major segments and the OMG Data Distribution Service (DDS) message protocol layer to achieve advanced quality of service. The autonomy engine is a set of algorithm-level specifications for the behaviors and capabilities of the autonomy platform. It lists all the important, high-level, mission-oriented tasks either planned or implemented in the context of the vehicle scenario. It employs a modular approach that supports a Distributed Hierarchical Autonomy (DHA) model and uses replaceable, modular and standard interfaces.

Putting all of the components and modules together, we end up with an autonomous ship control system that is based on a DHA employing new advances such as self-learning and multi-model arbitration. However, before we take this system to sea, we must demonstrate that our ship can safely navigate and comply with the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS)—basically, we must show that our vessel can operate safely at sea and not collide with another vessel or run aground with only sparse remote supervision. As the system and capability matures, we must also demonstrate that the ship can simultaneously execute that desired mission and comply with COLREGS.

Maximize Modeling and Simulation

To cost-effectively mitigate the risk in our autonomy system performance at sea, we must verify quantitatively that the autonomy path-planner engines can navigate safely on the water. Our systematic approach to this quantitative verification is shown in the following assertions:

This "plug-and-play" modularity minimizes life-cycle costs, enables reuse, and promotes healthy competition among capability vendors.

Assertion 1: Simulations
If the simulation can be demonstrated to correlate highly with on-water testing results in all relevant qualitative senses, we can be confident further simulation results are likely to reflect actual on-water behavior.

Assertion 2: Metrics
If metrics can be demonstrated to correlate highly with subject-matter experts' understanding of safe navigation, we can be confident those metrics can be used for evaluation of the path planners.

Assertion 3: Scenarios
If the set of scenarios can be demonstrated to provide good coverage of on-water situations, we can be confident that performing well in that set of scenarios will correlate with performing well in any on-water situation.

Assertion 4: Effective evaluation tools and methodology
If we have a good simulation (as per Assertion 1), good metrics (as per Assertion 2), and a good set of scenarios (as per Assertion 3) along with a path planner that performs well in that environment, we can be confident that the path planner really is capable of doing safe navigation.

These assertions resulted in three distinct categories of products being developed to support the safe navigation requirement analysis for the maritime autonomy program:

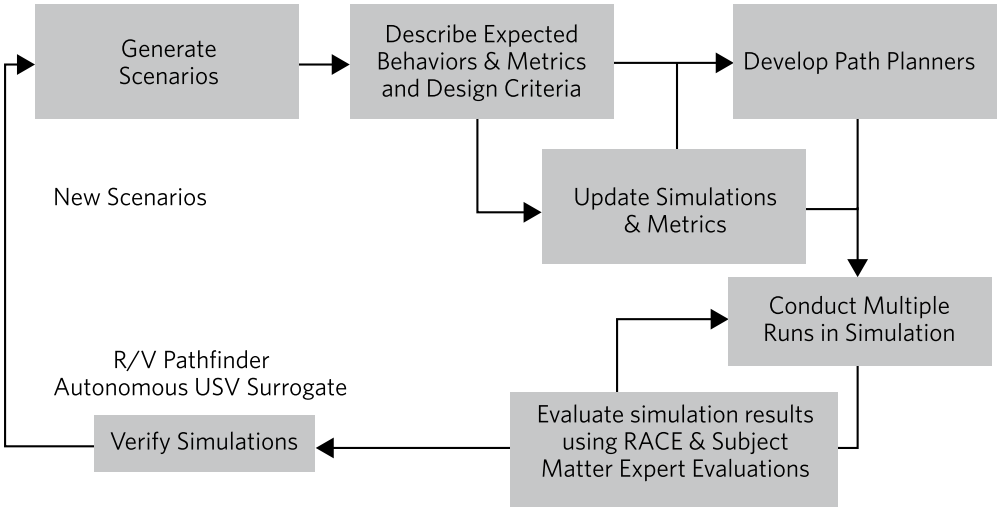
- Simulations (Archivist Simulation Integration Framework, Distributed Simulation Environment)
- Metrics (Real-time Autonomy COLREGS Evaluator [RACE])
- Scenarios

Prior to at-sea testing, Leidos conducted more than 26,000 simulation runs modeling more than 750 different meeting, crossing and overtaking scenarios in its System Integration Laboratory (SIL) to demonstrate that the autonomy suite would direct actions in accordance with the COLREGS for avoiding collision. Scenarios were developed with the assistance of former U.S. Naval officers with Officer of the Deck and/or Command at Sea certifications, who used a design-of-experiments approach (levels and factors, bounded by the Taguchi method) and included stand-on and give-way behaviors. The approach used to generate and test scenarios is shown in Figure 2.

Employ a Surrogate Vessel Early

After satisfactory completion of SIL testing, the autonomy suite was installed on a 42-foot test vessel (see photo on page 22), where frequency-modulated continuous-wave and "X"-band radars provided the sensor input to the autonomy suite, and commands from the autonomy suite were forwarded to the vessel's autopilot for control of the rudder and engines. The test vessel acted as an ACTUV surrogate and allowed for testing of all the autonomy software and ACTUV sensor systems in parallel with the ACTUV ship construction. Before ACTUV ever goes to sea, the autonomy system and sensors will be proven at sea on the surrogate vessel, thereby reducing overall program risk and duration.

Figure 2. Approach Used To Generate and Test Scenarios



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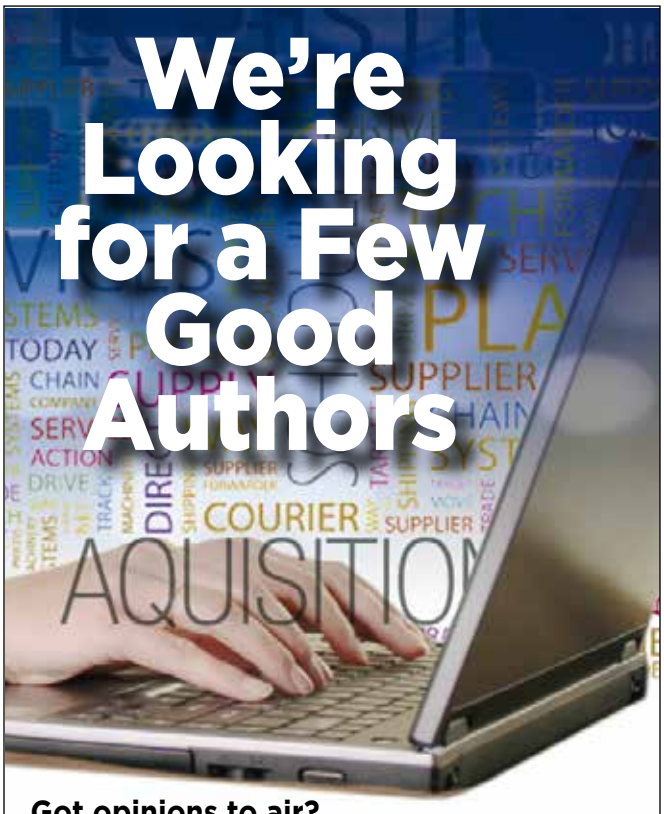

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To date, more than 100 different scenarios have been executed at sea with the surrogate vessel. During these test scenarios, the autonomy system directed course and speed changes of the surrogate vessel to stay safely outside a 1-kilometer stand-off distance from the interfering vessels. The test program clearly demonstrated the ability of the surrogate to maneuver and avoid collision with another vessel and paved the way for follow-on testing involving multiple interfering contacts and adversarial behaviors of interfering vessels.

In addition to the structured test events, the surrogate vessel recently completed a voyage between Biloxi and Pascagoula, Mississippi, with only a navigational chart of the area loaded into its memory and inputs from its commercial off-the-shelf radars. The surrogate vessel sailed the complicated, inshore environment of the Gulf Intracoastal Waterway, avoiding shoal water, aids and hazards to navigation, and other vessels in the area—all without preplanned waypoints or human direction or intervention. During the 35-nautical-mile voyage, the maritime autonomy system functioned flawlessly, avoiding all obstacles, buoys, land, and interfering vessels.

The Leidos team commenced construction of the first ACTUV vessel in 2014. Named Sea Hunter, this prototype vessel is to launch in early 2016 and embark on a 2-year test program co-sponsored by DARPA and the Office of Naval Research. While problems and issues undoubtedly will surface during this test program (they always do for the first vessel of a class), it is hoped that the number and severity of the issues will be minimized by the work, testing and risk-reduction efforts in the design and execution of the program.

In a program as complex and software-intensive as ACTUV, you have to look beyond the "build a little, test a little" approach and find innovative ways to mitigate as much of the program risk as possible, as early as possible. Ultimately, the success of the ACTUV program will have its roots in the risk-reduction efforts employed in building and testing the autonomy system in parallel with the construction of the vessel. Fielding a revolutionary concept such as ACTUV requires a blend of innovative program management, breakthrough technical skill and a tuned test program.

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MDAP/MAIS Program Manager Changes

With the assistance of the Office of the Secretary of Defense, *Defense AT&L* magazine publishes the names of incoming and outgoing program managers for major defense acquisition programs (MDAPs) and major automated information system (MAIS) programs. There were no such changes of leadership, for both civilian and military program managers, reported for the months of September and October 2015.

Collaborative Supply-Base Risk Assessment

Uncovering Risk With Suppliers Enables Strategic Investments

Jeff Sorenson ■ Kevin Krot ■ Jason Krajcovic ■ Andrew Webb

"No other supplier can provide you the service that we do."
"Next year's workload is 50 percent of our minimum sustaining rate and without more workload we will have to exit the business."
"Because you're not ordering enough, costs are going to more than double next year."

Most defense acquisition and supply-chain professionals hear some version of these statements on a weekly, if not daily, basis. As overseas contingency operations wind down and sequestration becomes a yearly challenge, developing strategies to assist these suppliers is becoming ever more difficult for the acquisition community—especially the program manager.

But in a time of constrained resources, which capabilities are truly important or critical and at risk? To each supplier, the answer and the remedy are immediately clear and justifiably self-serving—more work for their unique capabilities. Department of Defense (DoD) acquisition and sustainment executives increasingly find that, without a proactive industrial base mitigation strategy, their limited resources are quickly directed to the loudest voice, not the greatest risk.

Sorenson *is a partner,* **Krot** *a principal, and* **Krajcovic** *and* **Webb** *are managers at the global management consultancy A.T. Kearney in Arlington, Virginia.*

Figure 1. Supply-Base Landscape Dimensions

	Dimensions	Definition	Elasticity (Supplier POV)	Mobility (Buyer POV)
Capability	Market Availability	Availability of the capability in the marketplace	X	X
	Intellectual Property	Difficulty to move the capability based on technical knowledge		X
	Interconnectivity	Interchangeability of the capability across the buyer's network		X
	Importance	Level of development for a capability which provides a significant strategic/tactical advantage		x
Capacity	Availability	Accessibility of securing and absorbing capacity	X	
	Continuality	Risk of maintaining capability through a period of zero or significantly reduced demand for roughly 3 years	X	
	Lead Time	Impact on lead time of a dip in demand	X	
Cost	Set-up	Cost impact of less than optimal production lot sizes due to reduced volumes	X	
	Conversion Costs	Exposure to increased facility overhead rates due to a dip in demand	X	
	Procurement	Ability to source effectively and maintain supplier relationships during a dip in demand	X	X

The traditional approach to mitigating critical industrial-base risks is to fund additional workload for the supplier. What is left unsaid is that the incremental workload normally fails to address the underlying cause and delays a right-sizing that is both necessary and unavoidable. Not only does it fail to address the root cause, it also compounds the problem by increasing inventory beyond sustainable levels which then prolongs the expected dip in demand and increases inventory obsolescence costs. Most acquisition executives are rightly concerned that such an approach is at best a poor use of taxpayer dollars, and, at worst, fails to address the truly critical risks within the industrial base.

Assessing Risk From DoD's Viewpoint

A new approach is needed for maintaining a sustainable defense industrial base. Too often, the acquisition community, prime contractors and legislative entities assess risk from the supplier's point of view—thus, scarce financial resources are normally committed to mitigating a firm's unique risk.. An effective strategy that maintains the industrial base must proactively answer four fundamental questions:

- What capabilities are at risk?
- What capacity, if any, of that capability is required to meet DoD's future needs?
- Who is ultimately responsible for mitigating that risk?
- What is the most cost-efficient way to mitigate that risk?

Each of these questions requires the evaluation of risk primarily from the buyer's (i.e. , the DoD's) point of view, not that of the respective supplier. While challenges at individual suppliers may require risk-mitigation efforts led by the DoD program managers when the capability is sufficiently unique or critical, more often than not an individual supplier's capability is replicated elsewhere in the industrial base. Rather than address these unique risks, DoD should use its limited financial and personnel resources to deal with the truly systemic risks with wide-ranging impacts to core or critical capabilities.

These business choices may result in an individual firm exiting the defense sector or even going bankrupt. However, the loss of one supplier usually does not constitute systemic risk for the broader defense industrial base. In fact, after a multiyear surge of demand due to overseas contingency operations, opportunistic suppliers are expected to exit the industrial base as demand returns to historical norms.

The traditional approach to buyer (DoD) interactions with the supply base focuses on buyer power versus supplier power that can seem, and often is, adversarial. In comparison, many corporations have adopted the best practice of assessing risk alongside suppliers for mutual benefit.

Two DoD program executive offices employed this approach through onsite facility assessments of more than 100 suppliers within their respective industrial bases. These assessments clearly identified the essential factors and scoring criteria that enable acquisition and sustainment executives to identify which suppliers possess truly critical capabilities and determine which of those are at greatest risk due to a number of factors.

Identifying Critical Capabilities

Assessing supply-base capability is a daunting task for DoD acquisition and sustainment executives. In order to identify critical capabilities and risks to those capabilities within the supply base, a collaborative supply-base landscape assessment leverages data on each supplier's capability, capacity and cost.

The goal of the assessment is to determine how unique the supplier is in the broader market, how important the supplier is to DoD, and how difficult it is to move or integrate the capabilities into a new supplier. To accomplish this, the landscape uses 10 dimensions of capability, capacity and cost to assess each supplier. Each of the dimensions measures discrete elements and, taken together, provide an accurate picture of the supplier's criticality.

For example, the capability assessment focuses on four main elements: market availability, intellectual property, interconnectivity, and importance. These dimensions measure the relative importance of the buyer to the supplier (supplier point of view) and contrast that with the importance of the supplier to the buyer (buyer point of view). All four elements of capability influence the buyer's point of view, but only one impacts the supplier's point of view.

Pinpointing the Risks

Once the evaluation of a supply base is completed, defense buyers not only can create a comprehensive picture of capabilities but also can determine where resources should be dedicated to mitigate the risk of losing those capabilities. The supply-base landscape ultimately is used to evaluate two key characteristics: a supplier's elasticity and the buyer's mobility.

Supplier elasticity measures the impact to a supplier's cost structure from varying demand profiles while maintaining overall lead time and product quality requirements. Mobility considers the relative ease of moving manufacturing capability from one supplier to another while considering the importance of the capability, how many programs are affected, and the ability to overcome any intellectual property-related obstacles. Taken together, these two viewpoints result in the Supply Base Landscape and identify which suppliers and capabilities are critical and/or represent a systematic risk to the buyer.

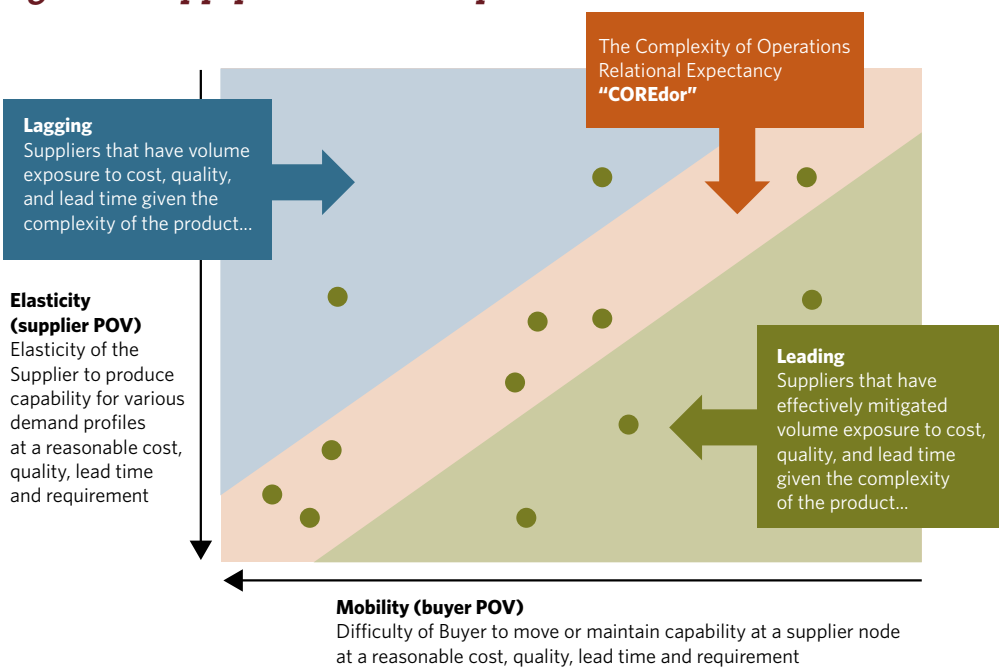
The supply-base landscape identifies a simple yet often overlooked attribute of any supply base—the strong correlation between product cost elasticity and mobility. Suppliers with unique capabilities that lower the assessor's mobility generally have lower elasticity—i.e., their cost structure and associated pricing respond substantially to changes in demand. The more specialized and highly engineered the product, the likelier it is that the supplier's business is both inflexible to cost and driven by only a few core buyers.

With this mutual dependence in mind, suppliers with relationships that are the most closely correlated with the assessor's needs should fall within a narrow corridor in the supplier risk landscape. This corridor is called the Complexity of Operations Relational Expectancy (COREdor).

Suppliers that fall within the COREdor are performing as expected given their relative elasticity and mobility. Suppliers that fall beneath the COREdor are more elastic than expectations, given the relative mobility from the buyer's point of view. These suppliers often embody the best practices that should be extended to the rest of the supply base: Suppliers that fall below the COREdor generally employed one or more of the best practices:

- They are able to leverage a commercial business with strong synergies to their military business.
- They deliver products or services with a high level of commonality with other DoD programs.

Figure 2. Supply-Base Landscape

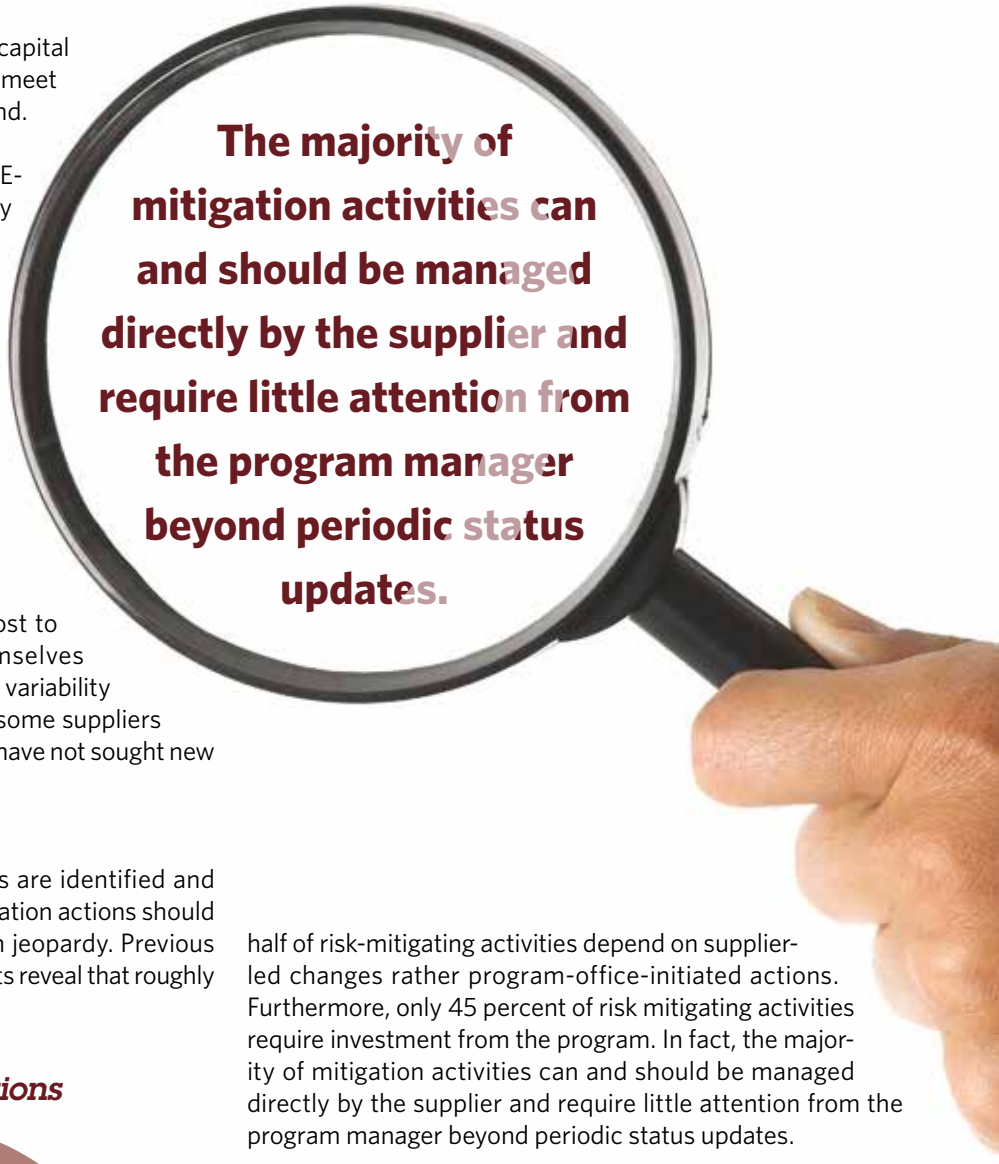


- Or they outsource work and minimize capital expenditures when adding capacity to meet temporary surges in production demand.

Conversely, suppliers above the CORE-dor are more inelastic than the mobility measurement would indicate. Generally, suppliers are lagging due to business decisions that drive unsustainable cost structures. The assessment found that the risk was most often the result of:

- Aggressive capital investment to meet short-term demand
- Failure to adjust facility sizes and cost structure to expected demand
- And an undiversified business model

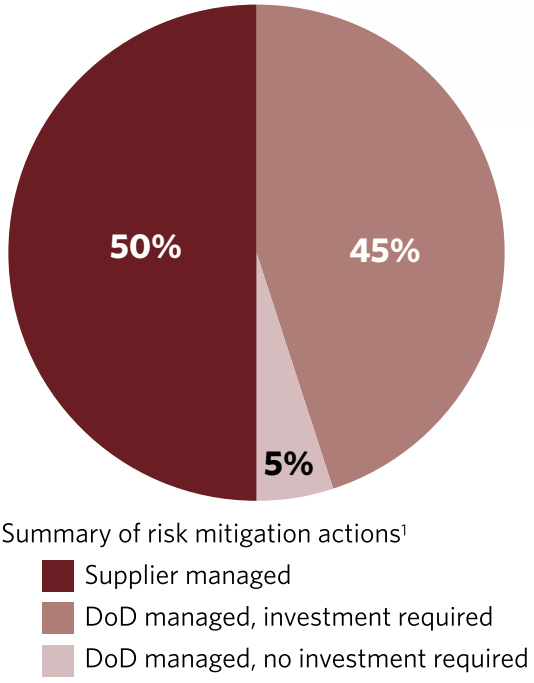
By increasing the proportion of fixed cost to overall cost, these suppliers left themselves poorly positioned to handle the inevitable variability in demand. Even with these challenges, some suppliers with commercially attractive capabilities have not sought new sources of revenue beyond the DoD.



Addressing the Risks

Once critical manufacturing capabilities are identified and critical risks assessed, targeted risk mitigation actions should be taken to address those capabilities in jeopardy. Previous experiences with supply-base assessments reveal that roughly half of risk-mitigating activities depend on supplier-led changes rather program-office-initiated actions. Furthermore, only 45 percent of risk mitigating activities require investment from the program. In fact, the majority of mitigation activities can and should be managed directly by the supplier and require little attention from the program manager beyond periodic status updates.

Figure 3. Risk Mitigation Actions



[1]A.T. Kerney previous experience

Conclusion

The future of the DoD industrial base is at a critical juncture. These suppliers have been instrumental in delivering and maintaining required warfighting equipment. With a top-line budget that over time either is flat or declining in real terms, the DoD's main weapon for meeting fiscal requirements will remain painful cuts to its Other Procurement and Research Development Test and Evaluation accounts. Failure to reverse this trend will jeopardize the ability to sustain an industrial base that leads the world and that can modernize future forces.

Looking to the future and an expected environment of reduced budgets and aging facilities, the DoD must make some hard choices, much as the private sector has done in past downturns. Only by carefully assessing the critical aspects of capability, capacity and cost can a meaningful analysis be done to develop a robust supply chain strategy to sustain and modernize the industrial base so that it can satisfy future warfighter requirements.

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S U R V E Y

Military Throwaways?

Why Acquirers Should Go Disposable

Maj. Patrick Dugan, USAF
Maj. Jon D. McComb, USAF
Maj. Chad Steipp, USAF

The military tends to keep equipment for a long time. Unfortunately, extended product life cycles leave many operators with worn-out or obsolete gear. Aircraft, vehicles, ships, radars and radios are examples of the outdated equipment our Armed Forces use daily.

There are many reasons to keep equipment for 10, 20 or 30 or more years. Some equipment never goes out of style—a well-maintained 105-millimeter cannon is just as effective today as it was 20 years ago. Other items stand the test of time even in the face of ever-evolving threats—the KC-135 aerial refueling aircraft served just as well in the Gulf War as it does now against al Qaeda. Still others cost too much to refresh on a regular basis—we probably won't divest the F-22 stealth fighter jet anytime soon. These cases provide a framework for what can be considered a "traditional" materiel acquisition: Robust designs intended to provide a long-term return on investment.

This article aims to challenge the idea of traditional materiel solutions by proposing a disposable alternative.

"Disposable" products get a bad rap. Often characterized as cheap, flimsy or wasteful, these products fill interim needs when more robust solutions would be overkill. But disposable products aren't all paper plates and napkins; let's think more along the lines of smart phones and automobiles. Both have realistic life cycles of 2 to 10 years. Both can be repaired, reused and/or recycled (to a limited extent). Neither is "cheap" or "flimsy." Both are indispensable parts of our day-to-day lives. Both are disposable.

Using these consumer products as our baseline for disposable equipment, we'll now turn to military needs and the applicability of disposable goods to a customer that often measures

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effectiveness in decades. It is undeniable that pace is a central theme to this discussion. Things change when research and development efforts take multiple years, but this is not another argument for rapid acquisition. It is an argument for a fundamental examination of the solutions proposed to satisfy military requirements. Why can't we have 5- to 10-year life cycles versus 30-plus years? Assuming that the military customer would embrace a disposable solution and could acquire what it needs through the existing Department of Defense (DoD) acquisition construct, we are left with the following question: What criteria could an acquirer use to determine if a requirement should be satisfied with a disposable solution? The first criterion outlines the effects of technology refreshment and its impact on existing systems. The second criterion involves rapid threat evolution and its adverse effects on U.S. military equipment. The final criterion is cost. Disposable military equipment should be pursued when the technology, threat and cost all support a product life cycle of less than a decade.

The first consideration when contemplating a disposable military solution is technology. Rapid technological advancement quickly renders obsolete otherwise functional equipment. Your 10-year-old automobile may still be functional, but it probably lacks many of the features (navigation systems, back-up cameras, electronic traction control, etc.) present in today's models. To stay "competitive," you need to make some major overhauls or simply buy new. The same could be said for some of our most technologically advanced military systems. Why does our B-52 strategic bomber have an avionics computer that is measured in thousands of instructions per second when an iPhone is measured in millions of instructions per second? No longer is dumb steel sufficient to dominate the battlefield. Products must be smart, agile and allow users to make sense of it all.

Technologies in the areas of materials, electronics and manufacturing have revolutionized 21st-century warfighting equipment. Everything from aircraft to radios has a size, weight and power (SWaP) consideration that could be renewed with the regularity of Moore's law (the doubling of transistors per square inch every year). In reality, some products can still be effective more than 2 years after fielding.

But what about those technologies that fundamentally change, beyond just software advances, from year to year? The current military acquisition strategy is to incrementally upgrade or replace existing components to extend the life of the system. This strategy works for a while, but ultimately results in a steady degradation in capability typified by Diminishing Manufacturing Sources (DMS)—the industry-accepted term for addressing components so outdated they no longer are manufactured. Unfortunately, the military regularly deals with DMS issues. Going disposable would alleviate DMS concerns and allow us to transition more quickly from one fielded product to the next. Disposability facilitates agility.

So what specifically should an acquirer consider when evaluating technologies for disposability? The main consideration should be whether the primary function of the product is subject to rapid market changes. An iPhone could be used as a hammer for 100 years, but its primary function will be obsolete in 5 years. Look for solutions requiring rapidly evolving technologies and you will find the opportunity for a disposable product. Once a technological determination is made, an acquirer can consider the expected impact from external threats.

The threat today is not the one we faced yesterday nor is it the one we will face tomorrow. The pendulum constantly shifts between peace and war, thereby requiring flexibility within our military resources. Our military's task is to be effective not only throughout the range of military operation but to do so against a constantly evolving enemy within a tactical environment that also is dynamic. It often is forgotten that the enemy gets a vote. Our adversaries will continue to develop, counter and deploy new capabilities and tactics, techniques and procedures (TTP). There are endless variables, and not even our best strategist can predict the threats of tomorrow; so flexibility is the cornerstone of our nation's military might.

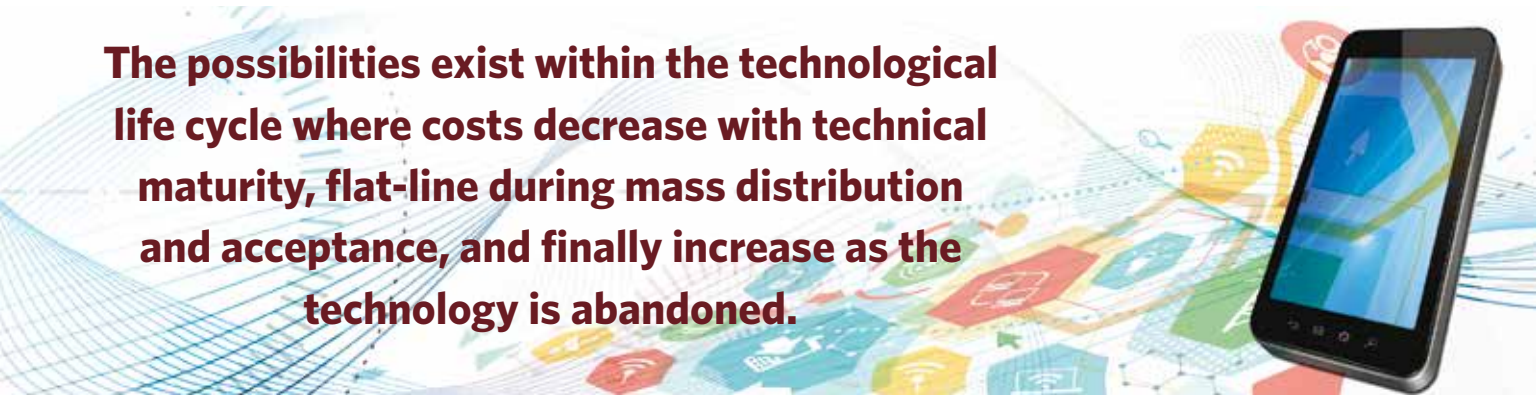
Our adversaries' technology and TTPs combined with the operational environments always are changing. The enemy can develop a new technology or TTP to attempt to get inside our observe, orient, decide and act (OODA) loop, causing confusion and disorder. Consider what happened during the Cold War with the Soviet Union. In the 1940s and 1950s, it was thought that the next generation bomber would have to be a supersonic high-altitude nuclear bomber. After decades of development, the B-58 supersonic delta-wing medium bomber was born. But after all that development and promise, the environment seemed to change overnight with the advent of deadly surface-to-air missiles. The B-58 became limited in its abilities even as it was rolling off the production line. Ultimately, the weapon system was considered obsolete in fewer than 10 operational years. Why are we to believe that the fate of the F-35 and F-22 fighter jets or Long-Range Strike Bomber will be any different?

Threats also can spark development or use of environments we never envisioned in the past. Consider the surprise of the British during the American Revolutionary War when they realized the destructive power of David Bushnell's game-changing submarine nicknamed the "turtle." Warships with all the firepower then available were held at risk by a hand-operated, single-man submarine. Now fast forward 240 years, and consider the vast possibilities cyberspace offers. Technology has created a new environment that can sabotage nuclear reactors and use social media to recruit transnational extremists. The dynamic nature of technology, the ever-changing TTPs, and the shifting environments must cause the acquisition community to pause and think of new ways to remain agile and maintain our superiority.

Rapid changes in the external threat and internal technologies ultimately must be balanced with the ability to pay for a disposable solution. Even if the DoD one day finds itself removed from the shadow of budget sequestration, it is forever answerable to the taxpayer for responsibly using federal funds to achieve National Security Strategy objectives. Therefore, we cannot discuss the revolution of disposable technology without applying our understanding of how it would fit within the current budget limitations, grounded in a reasonableness determined by fair market value. As with anything, the determination of "reasonableness" depends greatly on the environment and facts surrounding the procurement. Based upon the timelines a disposable tech policy would drive, cost can be looked at under two broad categories: reactive and proactive.

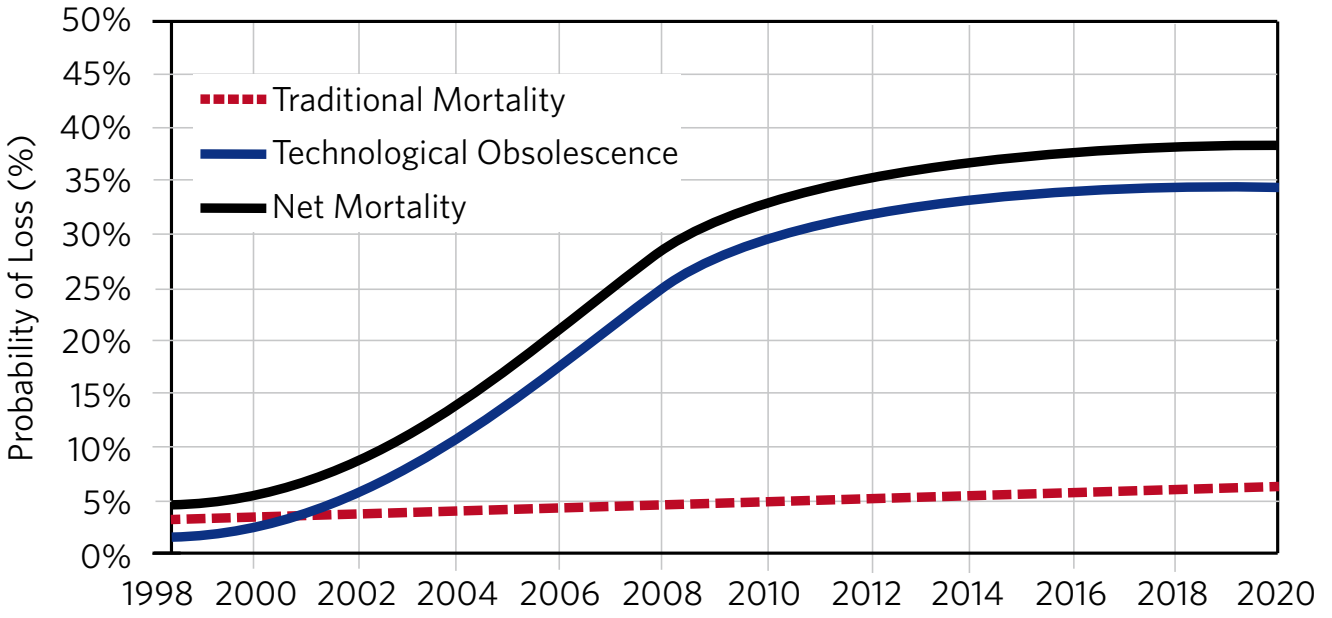
Procurement of disposable tech can be justified if the need is immediate—driven by the urgency of an emerging requirement or threat. It can be argued that, if we're forced to respond reactively, cost is largely removed as an obstacle to procurement. An assessment is expected of cost to complete, dollarized risk, logistics costs and other life-cycle costs against a small number of companies. But ultimately, the nation will buy what the soldier, airman, seaman or Marine needs to enter into combat in this situation. Cost will inform, but not drive, the procurement decisions. We've seen this phenomenon most recently with the explosion of funding for Overseas Contingency Operations in 2003–2010. This added funding to meet operational needs either has directly funded—or provided the offset for—mine-resistant vehicles, low-collateral-damage weapons, and counter-rocket artillery mortar technology, to name a few items.

The possibilities exist within the technological life cycle where costs decrease with technical maturity, flat-line during mass distribution and acceptance, and finally increase as the technology is abandoned.



The other side of cost is represented by a business case in which it makes the greatest financial sense to proactively address technical obsolescence, hardware or software, through tech refresh rather than traditional system sustainment. Services often address technical obsolescence through end-of-life buys, aftermarket manufacturing, component replacement within the obsolete item itself (motherboards, switches, lines of code, etc.) and other solutions that equate to replacing a car's major subcomponents rather than complete replacement with a new vehicle. This practice is rife within the DoD. Traditional life-cycle modeling has focused on environmental conditions we attribute to usage and the environment. Stephen L. Barreca in an article titled "Technical Life-Cycles and Technical Obsolescence" (Barreca Consulting and Research, Inc., UAB Technology Center, Birmingham, Alabama) honed this argument by insightfully assessing that, not only is technological obsolescence a significant driver behind overall system obsolescence, it may in fact be the primary driver in our assessment of a replacement timeline.

Figure 1. Obsolescence Timeline Chart



With permission from Stephen L. Barreca of BCRI Valuation Services, Birmingham, Alabama.

A 2003 article by P.A. Sandborn, T. Herald, J. Houston and P. Singh and titled "Optimum Technology Insertion into Systems Based on the Assessment of Viability" (Institute of Electrical and Electronics Engineers, December 2003) argued for use of proactive modeling, MOCA mobile care or other, to assess the appropriate time to leave one technology and step to another. While the time component of our thesis was addressed earlier, ultimately technological life cycle is a repeatable process in which traditional methods of sustainment can stave off a system's death while proactive methods develop and field replacement systems capitalizing on improved technology. These same authors would postulate that these practices allow for budgetary planning and forecasting that truly makes replacement more cost-effective. The possibilities exist within the technological life cycle where costs decrease with technical maturity, flat-line during mass distribution and acceptance, and finally increase as the technology is abandoned. Those left behind are forced to pay increasingly high prices as support dwindles.

Clearly, there is a time and place when and where it makes good business sense to pursue disposable technology. Whether in reaction to operational environment changes, or thoughtful and proactive planning, altering how we view life cycles at the component or systems level and bravely capitalizing on available technology may make us more responsible to the taxpayer and yet more capable against our adversaries. Failure to think through Moore's Law and its applicability to the cost condition only enables our wasteful spending habits by fielding technology that is no longer viable, needed or relevant.

Some would argue that our acquisition framework is not set up for disposable technology. With a lengthy requirements process, daunting acquisition timelines and deliverables and a yearly budget cycle, there is no way disposable technology can be effective. When our backs are against the wall, we utilize Joint Urgent Operational Needs Statements, establish undefinitized contract actions and request overseas contingency operations funds, all of which provide the flexibility and speed to field solutions. They all, however, are shortcuts in an arduous process. We need a system that stands between the urgent operational need and our current acquisition pace.

The current personal survivor radio is an example of a good idea at program initiation that no longer makes sense. It has taken a decade to fully field the Combat Survivor Evader Locator radio and it is cumbersome, obsolete and falls short of what can be done today in a device half its size. This capability doesn't satisfy the criterion of urgent operational need, but it does require expedited procurement. It is just one example of disposable tech where visionary acquirers will be needed to boldly implement disposable technology.

Military requirements that necessitate rapid response in a dynamic threat, tech and cost environment should be satisfied with intentionally disposable solutions. Technological change modifies the industrial base many times faster than traditional materiel acquisitions. The pace of threat evolution continues to minimize the effectiveness of technologically static weapons systems.

Cost balancing makes disposable products affordable. Disposable technologies are a reality of the modern world. The sooner the military embraces this reality, the better.

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For Hire:
Intelligence, Surveillance, Reconnaissance

Small Firms Meet Growing Demand

France Hoang

Within seconds of recognizing something out of the ordinary on a real-time video feed from a nearby unmanned aerial vehicle (UAV), an expert analyst was able to identify a problem and rapidly redirect the UAV and sensors toward a sinking ferryboat in the water.

This action, taken by Momentum Aerospace Group, or MAG, tactical UAV operators and analysts supporting United Nations activities in Africa last year, wound up saving lives in Lake Kivu near Goma, a city in the eastern part of the Democratic Republic of the Congo.

"We discovered a capsized ferry boat and were able to call in the marine patrol to rescue 14 of the 21 people due to the awareness that our operators had that were flying over the lake. The analyst noticed something was out of the ordinary and was able to redirect the sensors and task the pilot to bring the aircraft back around to save lives," said Matt Bartlett, MAG executive vice president for business development.

The boat had capsized in waters about 6 miles off the coast of Goma; many passengers were in the water without life jackets. Due to an alert sent

Hoang *is chief strategy officer of MAG DS Corp. (Momentum Aerospace Group), a private corporation supplying specialty aviation, aerial surveillance and intelligence, surveillance and reconnaissance and support services worldwide. He is a West Point graduate and has a law degree from Georgetown University.*

Unmanned operations utilize ground control stations.
Photo by Momentum Aerospace Group

by MAG UAV operators, U.N. officials were quickly able to redirect Uruguayan riverine troops to send speed boats while the UAV provided constant surveillance. That night 14 people spent the evening with their families but without that rescue operation would have perished in the unforgiving waters of one of Africa's Great Lakes.

More and more government entities are increasingly interested in outsourcing to private companies for Intelligence, Surveillance and Reconnaissance (ISR) capability. Outsourcing can reduce acquisition and developmental costs, help sustain a need to keep pace with changing technologies, and work at meeting what has become an insatiable appetite for real-time information and data.

MAG is among the handful of small private companies providing ISR capability to the government. Founded in 2009, MAG deploys more than 400 pilots, UAV operators, sensor operators and ISR professionals across the globe where their aviation expertise is increasingly in demand. MAG professionals operate, maintain, lease and provide training on a range of manned and unmanned aerial assets in a host of locations, including the United States, Africa, Afghanistan, Canada and South America.

ISR companies like MAG recruit seasoned operators and analysts with the expertise needed to account for a wide range of dynamic, fast-moving factors known to influence or affect sensor feeds and ISR information. The idea is to draw from tactical experience and institutional knowledge to quickly provide the government customer an integrated analytical picture of a given scenario in order to enable decision makers to take needed action quickly—as was the case on Lake Kivu in Goma.

MAG is different than most other ISR companies in that it is configured to provide an end-to-end, turnkey, manned aircraft or Unmanned Aerial System (UAS) solution worldwide. It can support aerial ISR by deploying the full spectrum of expertise required to deliver a solution, including operational planners, pilots, sensor operators, ground control station technicians, propulsion mechanics, avionics, logistics, mission directors, collection managers, and all source intelligence expertise; including SIGINT (electronic signal intelligence), GEOINT (geospatial intelligence), HUMINT (human intelligence), TECHINT (technical intelligence) and ELINT (electronic but nonverbal intelligence).

A key benefit of ISR is rapid shortening of the decision-making cycle by providing on-the-spot multi-intelligence analysis of data, imagery and video using the latest software tools and communications equipment.

"We provide customers with information they need to make key decisions in a rapidly changing environment. Often times those decisions are critical to saving lives and resources," said MAG Chief Operating Officer Sam Sblendorio.

Contract ISR operators are familiar with a wide range of broadly used sensors such as the nearly ubiquitous Canadian-manufactured WESCAM MX camera series. They also have the ability, acquired in many cases through years of military and technical experience, to recognize how issues such as weather, proximity, and other key intelligence can impact equipment and operations. This, coupled with a thorough understanding of command critical intelligence requirements, operational priorities, target demographics and the agility to respond quickly to variables, results in a

better understanding of how sensor images therefore can best be collected and interpreted.

For example, properly using the sensor's spatial filter can allow the operator to see through or mitigate dust, fog or other obscurants, explained Nathan Smith, MAG deputy program manager for UAS.

"The spatial filter allows you to get rid of some of the haze and dust if some colors are not coming through properly. It tells the processor to enhance colors," he said.

Making needed adjustments to an infrared (IR) sensor in fast-changing conditions is another key attribute of an experienced ISR operator, Smith explained.

"It is harder to manipulate IR because the ground is constantly changing. Manipulating IR is the same as EO (electro-optical sensors)—but because of the constantly changing temperature of the ground you need to constantly change your setting to keep up with the terrain," Smith added.

operations and intelligence plan to effectively connect the dots," said MAG Chief Executive Officer Joe Fluet.

As a result, private ISR operators are able to quickly filter through a range of seemingly disparate sources of information and determine if real-time action is required, as was the case in Africa with the capsized ferry boat.

Maritime Patrol

In another example of the government turning to private companies for ISR capability, MAG professionals also detected and assisted the United States and partner nations in intercepting a half-billion dollars' worth of illicit drugs transiting across international waters in recent years.

By providing contract support to the U.S. Government, MAG operators worked closely with maritime forces to crack down on drug trafficking.

"During our maritime patrol mission in 16 months of operations, MAG flew 334 missions that detected 166 suspected

Outsourcing can reduce acquisition and developmental costs, help sustain a need to keep pace with changing technologies, and work at meeting what has become an insatiable appetite for real-time information and data.

For instance, if sensors are following a person who either jumps into water or enters a cave, IR settings will need to be adjusted to allow for temperature changes, Smith said.

Using private companies to deliver ISR capability allows government customers to access tactically relevant expertise and adapt quickly to changing technological trends. Successful private ISR companies such as MAG embrace a "plug and play" philosophy designed to help them integrate their turnkey solutions anchored by their operational and analytical expertise into any potential customer architecture or configuration.

Alongside refining and harvesting the requisite technical expertise needed to properly interpret all source intelligence, contract ISR operations focus intently upon substantial pre-mission planning scenarios in order to provide important context to live sensor feeds.

"Our operators have the expertise to understand the big picture and shorten the intelligence cycle—to take action on information gleaned from live collection and near-real-time analysis. It can be just a guy looking through a soda straw for others, but our operators understand the big-picture

Go-Fasts resulting in 39 positive identifications, 24 boardings, and the seizure, disruption or detection of $663.7 million of drugs. MAG provides support to each phase of the Find, Fix, Finish cycle regardless of the mission profile," Fluet explained.

MAG operators used their expertise to detect speed boats, known as "go-fasts," that transport drugs under cover of darkness. MAG maritime patrol aircraft (MPA) are equipped with surface search radars that can detect go-fast boats up to 50 miles away. The maritime radar can track several "tracks of interest" simultaneously, while the MAG aircrew uses IR or electro-optical cameras to identify a suspected drug carrying go-fast boat from a multitude of radar targets over a large area of the ocean. Once the suspected go-fast boat is identified, MAG aircrews use their on-board communications suite of radios and data links to pass the coordinates to operations centers that in turn relay the data to interdiction forces. MAG also can guide maritime interdiction forces to a moving go-fast target at night.

This maritime patrol effort is an example of an emerging trend in the contracting and acquisition world—that of leasing service-oriented expertise on a short-term basis instead

A Beechcraft King B200T Aircraft.
Photo by Momentum Aerospace Group

of investing up front on a longer-term hardware solution. The hardware or technology will need proper ISR-focused interpretive expertise and the systems themselves may become obsolete rather quickly in today's fast-changing global technological landscape, Bartlett said.

While private companies have experience leasing the latest in UAV and fixed-wing surveillance plane technology, their value add resides just as much in the combat-tested tactical experience of the senor operators and trainers they provide.

As a result of this focus, private ISR operators are adept at helping customers learn, master and maximize the value of their equipment and technology, Bartlett said.

"It is way more economical to hire a company like MAG with experienced crews. If you bring in a platform on a short-term contract, you are able to save millions. You are able to try, test, operate and understand the various equipment choices on the market before a long term organizational commitment is made. This way, organizations can understand the best equipment and techniques that are required to solve a problem before committing to a long-term acquisition," Bartlett added.

Bartlett explained that the idea is to afford customers the opportunity to experiment with what they need before formal requests for proposals are issued and major purchases are pursued. Such a strategy can help inform and refine requirements while providing a ready-made on-the-spot solution for pressing ISR needs.

Contract ISR operators often use their experience to train customers on a range of sensors, including a variety of electro-optical/infrared systems. In addition, contract ISR experts also work regularly with equipment provided by customers.

The idea is to blend the science and technical capability of the equipment with the art of human experience, perspective and understanding to create an overall intelligence picture of value for the customer. This includes blending an understanding of historical background information and pertinent recent developments to enable skilled operators to accomplish difficult missions.

"Tactical, operational, and strategic understanding is critical to ensuring the decision maker is receiving the right information at the right time—with the goal of trying to reduce the time needed between action and information," Bartlett said.

MAG personnel continue to support counter-narcotics operations. They use their ISR-focused tactical expertise to help intelligence collection managers know what to look for.

ISR Analysts and Operators

Many private ISR companies operate manned ISR aircraft, while others focus solely on unmanned operations. MAG operates both types of ISR platforms, from the Falco Unmanned Aerial Vehicle to light aircraft platforms such as Cessna 206 and 337, to Beechcraft King Air series aircraft, to larger DHC-8 aircraft. These surveillance aircraft are configured with cameras, sensors, moving map displays, radios and SIGINT collection technology, among other sensors.

Many contract ISR trainers and tactical operators have spent years operating in combat circumstances similar to those they support, Bartlett explained.

"A guy who has been in the same situation as the supported element before [in a previous career path] is more apt to deliver the appropriate product in the desired format quicker to the end user," he added.

Private companies such as MAG offer to help customers maximize their return on an ISR investment by focusing on acquiring service-oriented expertise rather than acquiring expensive and quickly outdated equipment. This enables customers to get the maximum value out of their platforms, technologies and sensors while minimizing expenses, Bartlett said. "Our goal is to train ourselves out of a job."

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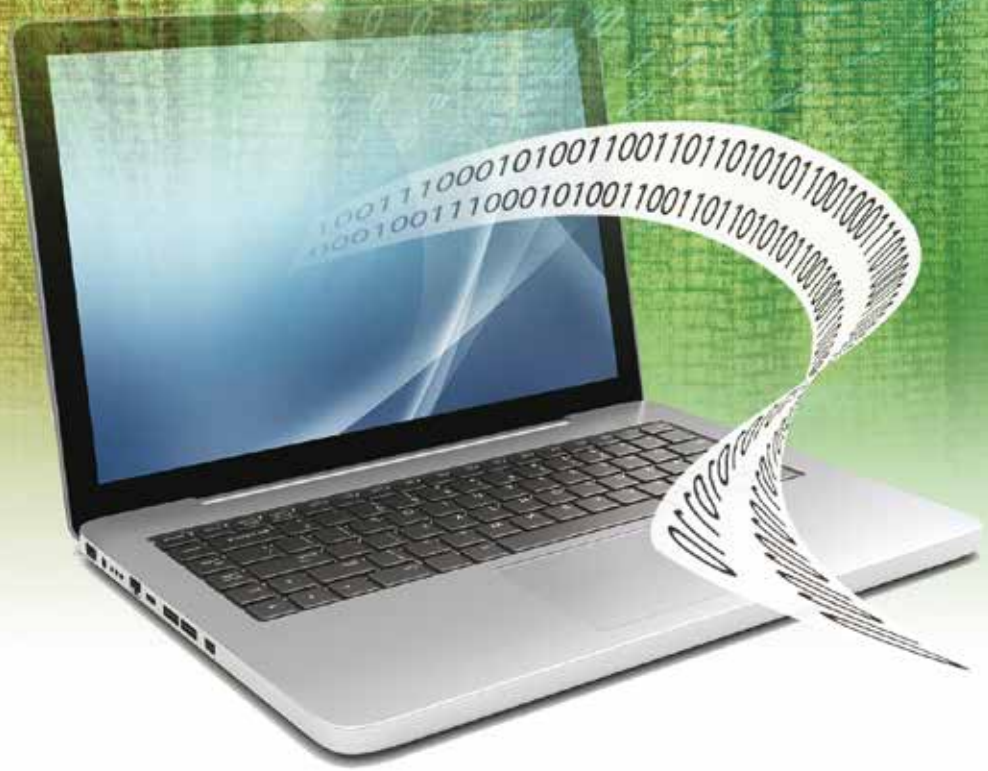
Data Requirements Review Boards
and Their Importance

David Adams



It's a fact. Every day we are inundated with data coming at us from all directions—from work and family—via the electronic gadgets we carry with us and our stationary computers. Data overload can be a problem, but in contracting between government and industry, it should be and needs to be manageable.

There are different categories of data: technical data, which are recorded technical or scientific information (not including computer software), and contractual or financial and administrative data.

Data are ordered and procured using the DoD Directives Division Form 1423 Contracts Data Requirements List (CDRL). Technical data and Computer Software have two specific Defense Federal Acquisition Regulation Supplement (DFARS) clauses that should be inserted in the contract. These two clauses are Deferred Delivery of Technical Data and Computer Software (DFARS 252.227-7026) and Deferred Ordering of Technical Data or Computer Software (DFARS 252.227-7027).

> Deferred Delivery gives the government the right to require at any time during the performance of this contract, within two (2) years after either acceptance of all items (other than data or computer software) to be delivered under this contract or termination of this contract, whichever is later, delivery of any technical data or computer software

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The Main Functions of a Data Requirements Review Board

- Review all deliverable data requirements, ensuring that the intended users of the data are in agreement with the needs and requirements of the proposed acquisition and that the requirements conform to the applicable clauses of the Federal Acquisition Regulation (FAR) and the Defense Federal Acquisition Regulation Supplement (DFARS).
- Ensure that only the essential data in the most economical form is requested and defined; approval authority defined, if required; requirements and delivery dates defined; and deferred ordering or delivery of data are reasonable, consistent with the program's schedule, and have been properly documented on DD Form 1423 (CDRL form).
- Ensure adequate quality assurance data and/or warranty provisions have been identified in the contract schedule to guarantee that data produced and delivered shall meet its intended use.
- Ensure all data item descriptions (DIDs) referenced on the DD Form 1423 are listed in Acquisition Streamlining and Standardization Information System (ASSIST), or are newly approved one-time DIDs, appropriately tailored for contract application.
- Ensure all requirements for the format, content, preparation, media and delivery of the data either are referenced in the contract solicitation or on the DD Form 1423 to permit pricing.
- Ensure all data requirements are traceable to the contract reference in Block 5 of the DD Form 1423.
- Ensure all significant changes to DD Form 1423 are reviewed and approved.

item identified in this contract as "deferred delivery" data or computer software.

. . . Deferred Ordering gives the government the right to require, at any time during the performance of this contract or within a period of three (3) years after acceptance of all items (other than technical data or computer software) to be delivered under this contract or the termination of this contract, order any technical data or computer software generated in the performance of this contract or any subcontract hereunder.

On top of that, there is the topic of technical data rights both in noncommercial technical data (DFARS 252.227-7013) and commercial technical data rights (DFARS 252.227-7015). Data rights and Distribution Statements all must be considered when ordering data. It is highly recommended that these two DFARS clauses be studied and well understood along with DoD Instruction 5230.24 Distribution Statements on Technical Documents. The program's legal representative should understand these well, but it is essential that CDRL writers and data managers also understand them.

With all this information, the question becomes: How do we make it more manageable yet attain the data that we require in the form that we can use?

The optimal word is "require." We should not procure data that the government has no intention of using on current or future contracts. We only need to procure data that the government must have in order to manage the contract and the program as a whole. For data that is "nice to have," the government within the Statement of Work or Performance Work Statement, hereafter referred to as Work Statements, can have it stated that the government needs access to certain data that the contractor(s) need to accomplish. The trick is to determine if the data need to be procured or if it is enough to merely have access to the data. This sometimes is easier said than done.

Controlling the Data

Data Requirement Review Boards (DRRBs) are used to control the data requirements of a contract solicitation.

Naval Air Systems Command (NAVAIR), at Patuxent River, Maryland, previously held a centralized review board that all Program Management Airs (PMAs) utilized to present their data requirements, but was later eliminated, leaving the PMAs to manage their own processes for data reviews. Over time and with the transition of workforce, the basic knowledge of how to apply data management to contracts went by the wayside.

Some PMAs ended up just reviewing the CDRLs for accuracy. The Work Statement and the Procurement Initiation Document (PID) were not reviewed and vetted. This presented a problem because all the documents tied into one another—so if one was incorrect, it usually affected the others.

Having worked in Tactical Airlift Program Office (PMA-207) for several years, I was tasked to initiate and standardize the configuration management policies and processes within our office. This task took almost 2 years. Once it was completed, I was asked to tackle data management. In hindsight, this actually was more challenging than having the configuration management processes and policies put in place and followed. PMA-207 at the time had nine different platforms along with Contracted Air Services (CAS). Each team created its Work Statements and CDRLs differently and not necessarily in accordance with applicable policies and guidance documents.

Here are the steps that I found needed to be taken:

Obtain a Good Data Management Tool: We gained access to a good data management and CDRL tool from another program office, populated it with the appropriate people, role mapped and launched it to all users to begin learning. That took approximately one month to accomplish.

Prepare Well-Written Work Statements: Over a 3-year period, we standardized the Work Statements practices as

In my opinion, writing a Work Statement is a science and an art. I also believe it is the most important document we create in the program office.

stated in *Military Handbook 245D*. We realized that without well-written Work Statements, the CDRL package was of little value. Therefore, conducting a DRRB on just the CDRLs also was of little value.

Teaching the program office personnel how to draft well-written Work Statements was not easy. PMA–207 has many Integrated Product Teams (IPTs), so it was a reiterative process that took a while to accomplish. In my opinion, writing a Work Statement is a science and an art. I also believe it is the most important document we create in the program office. It cannot be emphasized enough that reading the *DoD Handbook for Preparation of Statement of Work* multiple times and going to the workshops on this subject that are offered by the Defense Acquisition University are necessary if one is to learn how to write a good Work Statement.

It was recommended that the Integrated Product Team Leads (IPTL) develop Work Statements in a group forum. The goal is to produce an organized and legible document with little to no ambiguity for both the acquirer and the supplier, resulting in very little risk for both parties. This can be difficult, but it is best to do it is as a working group. Nobody knows every single task and requirement for the contractor to accomplish. Nobody!

Create a Diverse DRRB of Subject-Matter Experts: After emphasizing the importance of writing a standardized Work Statement, we need to establish a DRRB made up of experienced leads in our program office.

It is very important that the board membership is diverse and includes subject-matter experts in all fields. The board should have representatives from engineering, logistics, contracts, legal, business finance, test, and program management. A chair and vice chair are required along with a secretary to perform administrative tasks. This process is documented in the DRRB charter, which establishes the board members and the particular functions of these boards. Conducting DRRBs is required for all contracting actions that are greater than $10 million, in accordance with NAVAIR Instruction 4200.21E. PMA-207 conducts them for every contracting action that has a Work Statement, no matter the estimated value.

Review PID Packages: After conducting a few more DRRBs, we realized the need to review not only the Work Statements and CDRL packages, but also the PID package. In particular, Sections B and C were reviewed to ensure the contract line item number (CLIN) structure matched the tasks being written in the requirements section of the Work Statement. One change to the Work Statement can throw the other documents off. A change in the type of contract can change the Work Statement. Sections D through I also are reviewed to ensure accuracy and that contract clauses don't contradict the Work Statement.

Conducting DRRB Reviews

Today in PMA-207, the PID package, the Work Statement, and the CDRL package with a quick look at the request-for-proposal letter are all reviewed and corrected during the DRRB so it is more of an RFP review minus Sections L and M. PMA–207's process for conducting DRRBs is a good balance between the Naval Air Systems Command's previous centralized board and the other extreme of having no board at all.

It is true that DRRBs can take a bit of time, can be tedious, and can incite some differing opinions, but, in the end, the integrated product team and the DRRB board members better understand the task and data requirements, and a good product is released for the contractor(s) to understand and bid to. It also helps the program lawyers understand the requirements so that, when it comes time for the legal review board, they have the background to answer any questions that may arise.

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Driving Future Change

With Army Research, Collaboration and Prototyping

Jeffrey D. From ■ Debbie S. Couch ■ Calvin S. Johnson

The Mission Command Battle Lab (MCBL) works regularly with a variety of organizations pushing the technological envelope within the mission command warfighting function (WfF). This paper shares the MCBL's experience with the Army Regulation (AR) 5-5 study process and with using the study results while collaborating with other organizations to provide tangible benefits to the Army.

The MCBL, through collaboration and partnering with key organizations, helped drive the rapid development of a functioning prototype based on the study results. The resulting prototype provided a tangible, functioning mission command tool while facilitating experimentation and continued research. The Deputy Assistant Secretary of the Army for Research and Technology characterized these activities best in a 2014 presentation: "We will focus on maturing technology, reducing program risk, developing prototypes that can be used to better define requirements and conducting

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experimentation with soldiers to refine new operational concepts." The MCBL and its partners epitomize this statement, and this article documents only one critically important MCBL Science and Technology (S&T) activity.

The MCBL partnered with a number of organizations to move from an AR 5-5 study proposal to a working prototype in under 3 years. In the following paragraphs, we provide a quick overview of the study, including its preparation and sponsorship, while emphasizing the value of collaboration and the payoff from working across organizational boundaries.

In Fiscal Year (FY) 2013, the MCBL worked hand-in-hand with the Department of the Army (DA) Staff to formulate an AR 5-5 study focused on meeting the needs of Army commanders. Even in the study formulation phase, the critical importance of communicating and collaborating with the DA Staff cannot be overemphasized. After the MCBL exposed the draft study proposal to key deputy chief of staff (DCS) DA staff members, Michael Eixenberger (then the deputy director, Department of the Army Military Operations, LandWarNet/Mission Command [DAMO LM] Directorate) quickly recognized the value of a commander's toolkit and assumed an active sponsorship role. The DAMO LM team helped to ensure the message resonated with the AR 5-5 study scoring committee during the approval process.

The approved AR 5-5 study was titled the *Commander's Toolkit: System Inputs, Visualizations, and Impact on Leader Development* and was executed during the summer and fall of 2013. It hypothesized that there is no mission command system designed and developed for the commander. In working toward proving or disproving this hypothesis, the MCBL leveraged an existing contractual relationship between the U.S. Army Training and Doctrine Command (TRADOC) and the MITRE Corporation to bring MITRE onto the study team. MITRE formulated a comprehensive research protocol that included procedures and questions, while the MCBL provided oversight and coordinated for access to the serving Army commanders. In the early research phases, the MCBL team did not know that the study, with unfaltering support from the Communications-Electronics Research, Development and Engineering Center (CERDEC), would provide Army commanders with a working prototype in less than 3 years.

The team validated the study hypothesis through the comments and feedback from 13 brigade commanders serving at the time. Army commanders are the underserved members of the mission command team. The final report was published in December 2013 and highlighted the complexity of the commander's mission command environment. The research also identified a number of core needs within the following five broad themes:

- Information Operations and Knowledge Management
- Commander's Information Requirements and Decision Support Tools

- Next-Generation Mission Command (specifically using mobile technologies)
- Interpersonal Communications
- User Interaction with Mission Command (MC) Systems

Within those themes, the research provided broad guidance to ensure commanders receive the mission command functionality that they require. The guidance for the capability highlighted the need to:

- Focus on providing an intuitive and streamlined interface to deliver the commander the information he needs when he needs it.
- Leverage touch-screen gestures and future-looking modalities to best serve the commander.
- Provide functionality identified in commander interviews, including elements of Running Estimate, Common Operational Picture (COP), Combat Power Assessment, and Decision Support Matrix to create a "TOC [Tactical Operations Center] in a Pocket" for commanders on the move.
- Include alerts for Commander's Critical Information Requirements (CCIRs) and decision points, audio/video communication as well as a zoomable map with layers and onscreen drawing.

The study findings were embraced immediately by systems developers and user representatives across the Army. The CERDEC Command, Power, and Integration (CP&I) Directorate was one of those organizations. Its then-director, John Willison, recognized the value of the research and moved quickly to posture his organization to leverage the study findings. And the CP&I team established the Tactical

Army analysts examine the Commander's Toolkit shared workspace functionality during the User Jury with the 1st Infantry Division at Fort Riley, Kansas. They tested this function for assemblying multiple mobile tablets to expand collaboration space.
Mission Command Battle Lab's photos.

Computing Environment (TCE) program as the organization for constructing a prototype Commander's Toolkit. The TCE program is CP&I's alternative approach to the traditional model for transitioning S&T developments to the acquisition community. Instead of developing a complete system for transition to an Army product/program manager, the TCE program established a vehicle for researching, prototyping and experimenting with developing technologies that can be modularly transitioned to the acquisition community.

In January 2014, the MCBL and CERDEC CP&I also established a collaborative body to ensure both operational and technical (systems development) presence and oversight. The joint team was stood up rapidly, creating the programmatic structure to ensure adequate communications and collaboration. Through distributed collaboration (weekly teleconferences) and quarterly face-to-face sessions, the joint team was able to ensure that the brigade commanders' needs highlighted in the FY 2013 study were accounted for.

The lead TCE developers worked tirelessly over January 2014 to March 2015, while also working closely with the MCBL to bring the Commander's Toolkit prototype to life by using the TCE software. The development team focused on ensuring the functionality required and the needs of the commanders were present in the Commander's Toolkit prototype. The photo above shows the shared workspace functionality, or "extend" function, where, for example, multiple tablets can be arranged to expand the space in which commanders can collaborate with subordinate commanders and staff members.

On April 13, 2015, after a number of iterative builds and demonstrations with the Mission Command Center of Excellence (MCCoE) and the MCBL, the TCE project demonstrated a working Commander's Toolkit prototype to the MCBL, the TRADOC Capability Manager (TCM) for MC, and a member of the First Infantry Division (1ID). The prototype was met with overwhelming acceptance. COL John R. Cook, TCM MC/CP, said that he wanted to get the Commander's Toolkit into the

The user jury validated the prototype core functionality and interface design but also identified key refinements needed prior to participating in continued experimentation and assessment.

The Communications-Electronics Research, Development and Engineering Center's Tactical Computing Environment and the Mission Command Battle Lab team members observe the soldiers' use of the Commander's Toolkit collaboration functionality between small tablets and a larger display during the User Jury with the 1st Infantry Division at Fort Riley, Kansas.

hands of Army/1ID leaders as soon as possible. He added that the collaboration space and functionality "are precisely what commanders need." LTC Chuck Slagle, 1ID Deputy G3, reinforced the need for the Commander's Toolkit and coordinated and hosted a broader demonstration and user jury with key 1ID leaders on June 20–July 1, 2015.

The user jury was jointly planned and coordinated between the 1ID, the MCBL, CERDEC CP&I and the TCM Mission Command and Command Posts (MC/CP). The event was a welcome culmination to several months of collaboration, systems development, demonstrations and research.

The 1st Infantry Division provided soldiers with tactical deployment and leadership experience to participate in the 1½-day user jury. Ten operationally relevant vignettes were constructed to gather feedback from soldiers about the Commander's Toolkit prototype, core functionality and interface design. Analysts from the Army S&T and MC user communities participated, including MCBL, Army Research Laboratory (ARL), CERDEC and the TCM MC/CP. The results overwhelmingly supported the expanded use of mobile collaborative applications for Army commanders and leaders and their staffs. The user jury validated the prototype core functionality and interface design but also identified key refinements needed prior to participating in continued experimentation and assessment.

While at Fort Riley with the 1ID, one soldier stated that the Commander's Toolkit, or a Leader's Toolkit, should be available to all leaders,. Slagle described an environment where leaders from squad through corps could have a Commander's Toolkit tailored to their specific needs. Other user jury participants said that increased functionality could prove hugely beneficial in addressing the myriad tasks required of young leaders. One example was provided of digital range cards for squad leaders and platoon sergeants. As the group discussed these leader capabilities, the idea of a capability to integrate multiple range cards from multiple perimeters into a base defense plan was generated.

The Commander's Toolkit grew from a study proposal to a functioning prototype for hands-on user feedback in 2½ short years. In an environment with shrinking resources where systems development spans 10-plus years, this effort highlights the value of close collaboration and a unified effort to provide soldiers with improved capabilities. It also is an example of the value of the Army's TRADOC Battle Labs and Defense Labs working together to inform technology development cycles earlier and drive S&T innovation to better meet soldiers' needs. The prototype provides added value through its use in continued research, experimentation and development of mission command systems interfaces. Its transition path is yet to be determined, but it has already provided immeasurable value to the Army and helps the collaborative team (MCCoE/MCBL, CERDEC, 1ID, ARL and TCM MC/CP) fulfill the Army's S&T mission as stated by the deputy assistant secretary of the army for research and technology: "The Army's S&T mission is to foster discovery, innovation, demonstration and transition of knowledge and materiel solutions that enable future force capabilities and/or enhance current force systems. The Army counts on the S&T Enterprise to be seers of the future—to make informed investments now, ensuring our success for the future."

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Freedom of Information Act Requests

Six Keys to Handling Them

Michael A. Rodgers

When I worked at an Air Force major command, I noticed that receiving a Freedom of Information Act (FOIA) request consistently caused program and contracting personnel to become distracted from their mission. Today, the risk of distraction has increased alarmingly. Money and effort have been diverted from accomplishing tasks. According to the Department of Defense (DoD) *Chief FOIA Officer's Reports for Fiscal Years 2013 and 2014*, the DoD spent $166,542,828 ($166.5 million) to process 127,000 FOIA requests.

In hindsight, it now is clear to me that the distraction at the program and contracting offices was attributable to a lack of familiarity with such requests—people simply did not understand what an FOIA request represented or how to handle the request. Here are the keys to avoiding FOIA-induced distractions.

Recognize What an FOIA Request Represents

We work in a democracy and, as federal employees, we are answerable to the people. The first key is to recognize that the FOIA is a federal law that represents a mechanism for individuals to ask questions of the gov-

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ernment and federal agencies, such as the DoD. When those questions concern the manner in which DoD accomplishes its missions or how the DoD spends taxpayer dollars, then individuals are entitled by law to receive an answer. This is the essence of transparency and open government.

A DoD FOIA request is a written request for DoD records that reasonably describes the record sought and it may be made by any person, including a member of the public (U.S. or foreign citizen or entity), an organization or a business, that either explicitly or implicitly invokes the FOIA. Written requests may be received by postal mail or other commercial delivery means, by fax or electronically. The request is considered received and the 20-day clock to respond starts when the request arrives at the FOIA office of the component that is in possession of the records.

A Duty to Send the Request Forward

The second key is that program and contracting personnel have a duty to get the request to the FOIA office. I will admit that the location of that office is not always clear to someone buried deeply within a program or contracting office. As a result, I always have advised recipients of FOIA requests to get the requests to their servicing legal offices so that the lawyers can forward the requests to the relevant FOIA offices. Thus far, that advice has proven to be 100 percent accurate and effective.

Who Can Decide Against Release

Recognize that records requested under FOIA sometimes may be withheld from release. However, the decision to withhold records is not made in the program or contracting office.

The third key is that making decisions to withhold records is reserved for Initial Denial Authorities (IDA)—officials occupying specified positions within the DoD. The decision to withhold is proper only if one of nine exemptions apply to the records in question:

- They currently and properly are classified in the interest of national security.
- They relate solely to the internal personnel rules and practices of the DoD or any of the DoD Components.
- They are protected by another law that specifically exempts the information from public release.
- They include trade secrets and commercial or financial information obtained from a private source, and their disclosure would cause substantial competitive harm to the source.
- They are internal records that are deliberative in nature and are part of the decision-making process and contain opinions and recommendations.
- Their release would result in a clearly unwarranted invasion of personal privacy.
- They are investigatory records or information compiled for law-enforcement purposes.
- They are for the use of any agency responsible for the regulation or supervision of financial institutions.
- They contain geological and geophysical information (including maps) concerning wells.

When records are withheld, an FOIA requester can appeal the decision through administrative procedures within the DoD. Ultimately, the FOIA requester can sue in federal court and ask the judge to force the DoD to release the records. In making that determination, a federal judge will examine the process by which program or contracting personnel handled the FOIA request.

Recognize How to Handle a Request

For those of us in the DoD, FOIA requests are managed in accordance with DoD Directive 5400.07 "Department of Defense Freedom of Information Act Program," which establishes overall DoD FOIA policy and dictates the FOIA roles and responsibilities of DoD components. The actual procedural guidance concerning the processing of FOIA requests within the DoD is found in DoD Regulation 5400.7-R, "Department of Defense Freedom of Information Act Program." The fourth key is to follow these two guides faithfully. Doing so should greatly minimize the expense and effort spent on handling an FOIA request.

Typically, the FOIA manager or legal officer will send an email to all members of an organization directing that they search their electronic and paper files and forward any records subject to a particular FOIA request.

Take the FOIA Direction Seriously

It is imperative that you conduct a thorough search of files under your control as the fifth key so that the DoD can affirm in court that a complete search was performed.

To review files manually or by automated means is the essence of the term "search." The goal is to scrub DoD files for the purpose of locating those records responsive to the FOIA request. The search must be reasonably calculated to uncover all relevant documents. Again, agencies and individuals have a duty to search.

Figure 1. Department of Defense Chief FOIA Officer's Report to the Department of Justice Highlights

	FY 2013	FY 2014
Requests processed	67,679	59,321
Requests granted in full	24,368	20,888
Partial release	15,396	13,577
Program costs (including litigation)	$83,461,793	$83,081,035
Fees collected from requesters	$769,096	$545,414
Requests denied	5,183	3,267

Note: For requests denied Exemptions 6 & 7(c) were the most common exemptions. Exemption 6 protects information about individuals in personnel and medical files and similar files, while 7(c) protects personal information in law enforcement records.
http://open.defense.gov/Transparency/FOIA/DoDAnnualReportstoAG.aspx

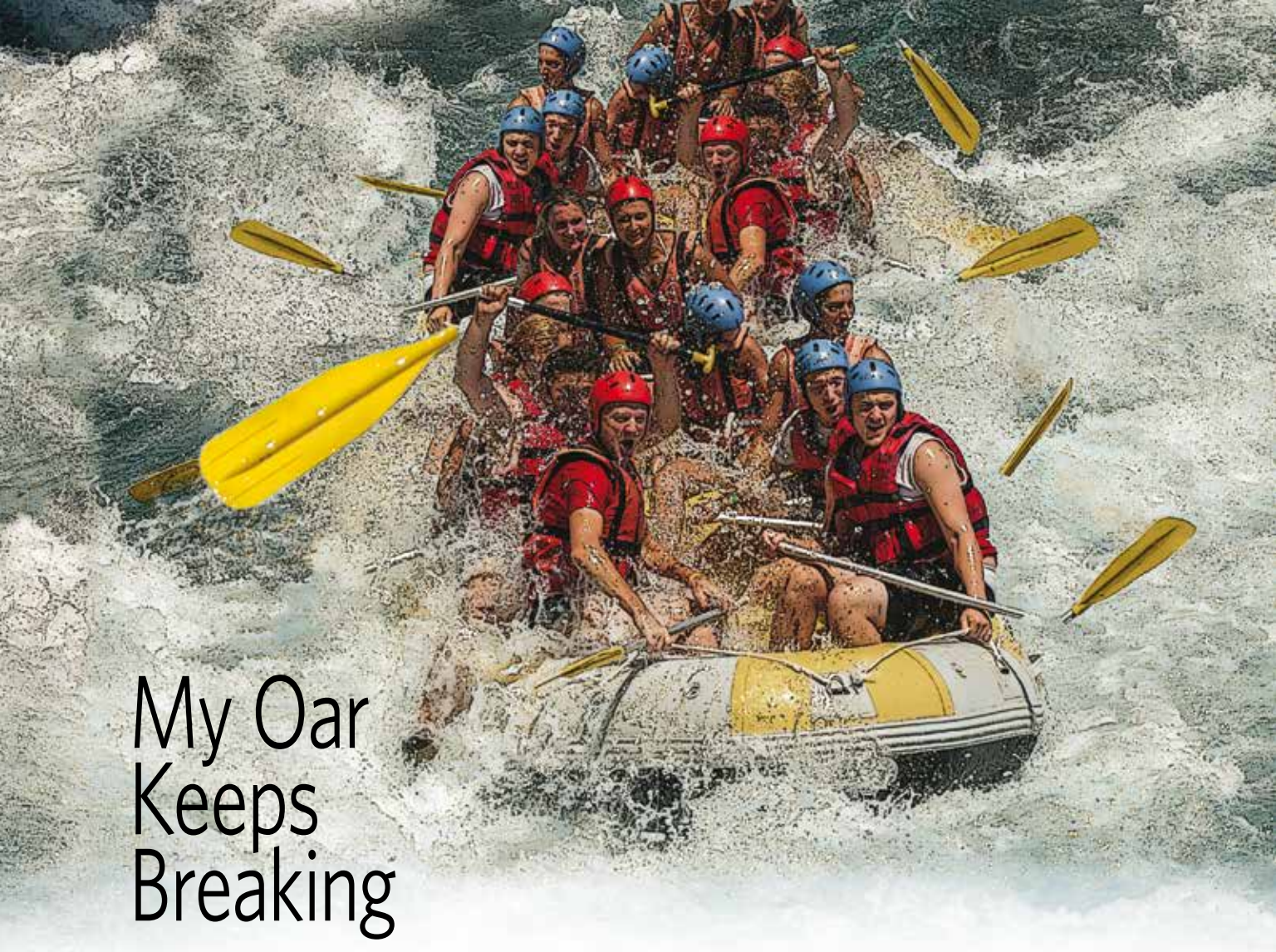
Redaction of Sensitive Information

The final and sixth key is to recognize that, although you may believe that a record should be withheld because it contains exempt information, the IDA very likely will segregate or redact the exempt information and release the remainder of the record. Unless it is found that indicating the extent of the deletion would harm an interest protected by an exemption, the amount of deleted information will be indicated on the released portion of paper records by use of brackets or darkened areas indicating that removal. Some organizations refer to this type of segregation as "redacting" information—but the result is the same. Finally, the FOIA requester is provided with a response letter that contains:

- Identification of responsive records
- Volume estimates of information withheld
- Identification of exemptions asserted
- Releasable records provided in the form requested "if readily reproducible"
- Administrative appeal rights

Responding to requests under the FOIA is an important part of your duties as members of the DoD workforce. Ensuring that you compile timely and complete responses not only serves the democracy that you defend but also reduces the risk that precious time and money will be diverted from your crucial mission tasks. Understanding and using the six steps and keys provided above will free you from FOIA-induced distractions.

The author can be contacted at **michael.rodgers@dau.mil**.



My Oar Keeps Breaking

How to Move Your Part of the Program Forward

Chad Millette

As an instructor for the Air Force Institute of Technology's Intermediate Project Management class (IPM 301), I sometimes hear students express deep frustration with their seeming inability to make any positive progress on their programs. In a recent presentation, retired Air Force Lt. Col. Dan Ward fielded several questions from junior program managers (PMs) about what they could do to make a difference in their programs. Ward's responses echoed good advice I received during my career, which I was inspired to share.

As PMs in the Department of Defense (DoD), we often struggle with how much control we feel we have (or don't have) over our programs. Although we are project managers, we don't really manage the projects day to day; we hire defense contractors and rely on them to manage their projects. We often come into very large programs somewhere in mid-execution and, depending on our tenure in the program office, we often leave somewhere in mid-execution—with the program hopefully closer to completion than when we arrived. It can prove frustrating not to have been in at the beginning and to have to live with the results of decisions made earlier. The contractor often

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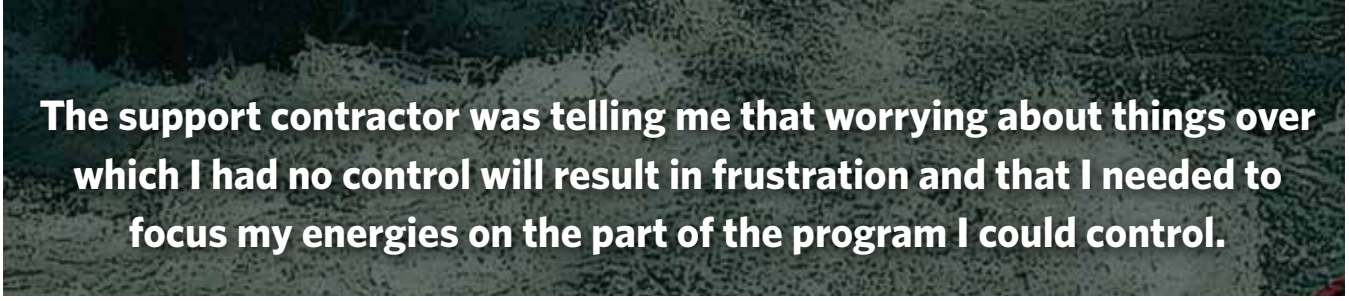

The support contractor was telling me that worrying about things over which I had no control will result in frustration and that I needed to focus my energies on the part of the program I could control.

seems unresponsive. The budget is in peril continuously. And no matter what we do, the program doesn't seem to improve. How is a PM to remain positive, upbeat and engaged?

I experienced just this type of frustration when I was a major assigned as a PM on a multibillion-dollar satellite system development program. This program could be considered both a Death March and a Death Star program. Edward Yourdon defines a Death March program as "one for which an unbiased, objective risk assessment determines that the likelihood of failure is > [greater than] 50 percent." Success, in this case, is defined by the traditional constraints of cost, schedule, and performance and quality—delivering the user's required capability on time and on cost. Ward says a Death Star program is "any enormous project that is brain-meltingly complex, ravenously consumes resources, and aims to deliver an Undefeatable Ultimate Weapon." (See Ward's article "Don't Come to the Dark Side," *Defense AT&L*, September–October 2011.) The program I was working on fit both of those definitions. And let me tell you, when the two most apt characterizations of your program include the word "death," it can make for a very frustrating experience.

Shortly after I arrived, the program experienced its second Nunn-McCurdy breach. (A Nunn-McCurdy breach occurs when an acquisition program experiences a 25 percent or greater increase over the current Acquisition Program Baseline (APB) objective and/or a 50 percent or greater increase over the original APB objective.) Several years behind schedule and millions of dollars over budget, the program seemed doomed to fail. The program originally was awarded as a total system performance responsibility (TSPR) contract, and the program office and contractor had what could best be described as a tense relationship. At one point, the government zeroed out the award fee on the contract.

I was not the program director (i.e., the overall PM); I was assigned subsystem management responsibilities (database, flight software and ultimately the spacecraft subsystem). However, as a junior, still-motivated PM, I desperately wanted to make a difference in turning the ship around. At one of my lowest points in terms of motivation, I expanded upon the idea of the ship analogy.

I had a whiteboard in my office. One day, I drew a large sailing ship with two masts and labeled the ship the S.S. Program. I drew water underneath the ship with a big arrow that showed the direction the water was taking us and I labeled the water as the contractor. I drew clouds in the sky above the ship with arrows indicating the wind and labeled this as Congress. I added a rudder to the back of the ship and labeled it the program director. Finally, I drew a porthole in the side of the ship with an oar sticking out of it, and I labeled that as me.

I would explain to visitors that the cartoon depicted how I felt about the program. The contractor takes the program along a strong current and seems to be the greatest determinant of where the program is going. Sometimes the political winds would change our direction or our speed. The program director can make programmatic course corrections and influence the direction we take (i.e., acts as the rudder). And finally, I'm the guy sticking his oar out into the water to influence the program's speed or direction. I would tell people that I felt like every time I stuck my oar in the water, it would break. I would then go back and get another one and stick it in the water, only to have it break again.

I was pretty proud of myself for coming up with such a powerful analogy that represented not only my frustrations, but apparently those of many colleagues as well. As people would stop by to hear my explanation of the drawing, I found that the analogy resonated with them. In fact, some even added to it. One of my co-workers drew the water ending at a steep waterfall and labeled it the "Cliffs of Insanity." Another drew rocks at the bottom of the waterfall showing how perilous would be the journey over the edge. Finally, another drew a little boat popping up out of the water and labeled it the alternative to our program that the Air Force was considering.

This kind of dark humor is common in many program offices—and that is one reason "Dilbert" cartoons are featured prominently on so many cubicle walls. Wallowing in misery, however, isn't healthy. A telltale sign of a Death March project is when the humor gets to the depths of the graphic I drew on my whiteboard. I found I was retelling the narrative and adding to it frequently over the course of a month or so. I wasn't getting any closer to fixing the program or reducing my frustration, but explaining the graphic gave me an outlet and an ability to commiserate with my teammates. Ultimately, I was confronted by someone who didn't want to share my analogy but to put me on the right track.

A wise retired senior officer who was a support contractor for the program came in one day, looked at my whiteboard and shut the door. She had heard about the drawing and came to see it herself. She listened intently as I boasted about how closely the situation I had drawn on the board matched the real world in the program office. When I finished, I noticed she was scowling. What she said caught me a little off guard because of both her tone and direct approach. She said, "You

moron! Of course you can't change the direction of this program. This program is huge. Your job is to do the best you can with the part of the program that you are assigned. Worry about the cost, schedule and performance of your piece of the program and let the leadership deal with the bigger picture." She walked out chuckling and sarcastically muttering, "My oar keeps breaking ... give me a break."

I thought about what she said and realized she was right. Millette couldn't fix this program—moreover, doing so wasn't my job! My job was to ensure that my subsystem met the user's requirements affordably and was ready when the program needed it. The support contractor was telling me that worrying about things over which I had no control will result in frustration and that I needed to focus my energies on the part of the program I could control. I didn't connect the dots at the time, but I have come to realize that her advice was in concert with what Stephen Covey called the "Circle of Concern/Circle of Influence" in his seminal book *The 7 Habits of Highly Effective People*.

Within an acquisition program context, Covey's paradigm suggests that the broader scope of the entire program would be in our Circle of Concern—i.e., things we have no real control over and can't do anything about. Many PMs can feel trapped when they focus their energy in the Circle of Concern—things like the weaknesses of other people and problems in the program environment. PMs stuck here are characterized by negative attitudes and language and feelings of victimization. Constantly focusing on these areas increases feelings of helplessness. Such are the feelings expressed in the S.S. Program graphic on my whiteboard and those that my IPM 301 students describe when they bemoan their individual situations.

However, there is a smaller circle inside the Circle of Concern where we can make a difference because we do have the responsibility and authority; this is the Circle of Influence. My sage advisor was suggesting that, instead of being frustrated because of my inability to fix the program as a whole—certainly inside my Circle of Concern, but not in my Circle of Influence—I needed to focus on fixing the part of the program for which I did have responsibility, my own little subsystem.

Covey would suggest that PMs can recognize when they are in the Circle of Concern when they have thoughts such as: "If only I had clearer requirements," "I could do a better job if I had a more stable budget" or "if I had more time to mature the technology." Notice the tone; the Circle of Concern is filled with haves. On the other hand, the Circle of Influence is filled with be's: "I can be more engaged with my user," "I can be a positive influence on my contractor counterpart," "I can be the one to craft a flexible acquisition strategy."

Covey suggests that PMs have problems in one of three areas: direct control (problems involving our own behavior); indirect control (problems involving other people's behavior); or no control (problems we can do nothing about). PMs can solve the direct control problems by improving their habits—i.e., what they do. PMs don't solve indirect control problems themselves; rather, they change their methods of influence to work with people to solve the problem. Finally, PMs don't solve the "no control" problems at all; they resign themselves to "genuinely and peacefully accept these problems and learn to live with them," even though they don't like them (think of the Alcoholics Anonymous serenity prayer).

On my program, I dealt with my "direct control" problems through weekly discussions with my contractor counterpart about issues with our subsystem development. Also, I resigned myself to get smarter on earned value management and dig deeper into the earned value reporting we received. To handle "indirect control" problems, I got together with the other majors who were subsystem PMs and, rather than commiserating, we came up with integration forums where we could discuss key aspects of how our subsystem developments interacted with each other. Having been put on the right course by my sage counselor, I stopped fretting about aspects of the program outside my span of control (the "no control" problems). I kept aware of what was going on—but only as a means of being prepared in the event of an impact to my area.

When I first started on the program, there was talk that the satellite was 3 to 4 years from launch. I spent 4 years assigned to the program in various capacities—a tour I joke ought to make me eligible for the acquisition equivalent of the Purple Heart. When I left the program, it was still about 2 to 3 years from launch. In the end, the satellite did launch 2 years after I left. By all accounts, the satellite system is performing at or above the user's expectations. Although it was at times a very frustrating assignment, it was also incredibly rewarding. And looking back, my frustration could have been reduced—and ultimately was with the helpful advice of a veteran PM—with some perspective about what was and was not in my circle of control.

During that recent speaking engagement, Ward responded to a young PM's questions with advice similar to what I tell my students who ask what they can do when they feel increasingly frustrated. Ward reminded the PMs that no matter where in the life cycle their program is and how late or over budget it might be, there are decisions to be made about the future direction of their piece of the program. I tell my students that, with the added tools we provide them in IPM 301, they can now ask better questions and dig a little deeper into the program status and progress. It is the government PM's job to evaluate the situation and make decisions with the best chance of righting the portion of the ship for which they are responsible. I believe that, if this tack is taken by everyone in the program office, pretty soon, the Death March and Death Star dark humor talk around the program office will subside as all hands are motivated to do their part to help the program succeed.

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Defense AT&L

Writers' Guidelines in Brief

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

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

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

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

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

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

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

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