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Innovations in Program Management Training

The PMT 401 Experience

Distributed Leadership to Empower Acquisition Professionals

Today's Complexities Demand More Chefs, Fewer Cooks!

Adapting DAU to Change for the Warfighter

Did Our Budget Go Up or Down?

Using a Five-Arrows Budget Analysis

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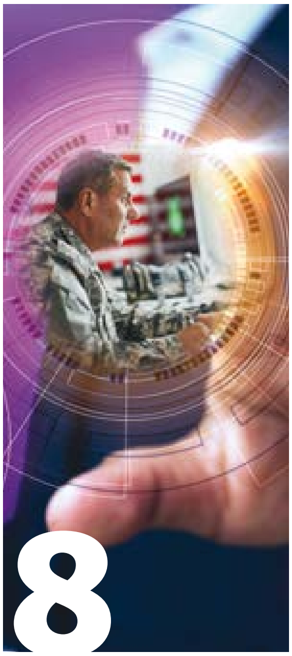

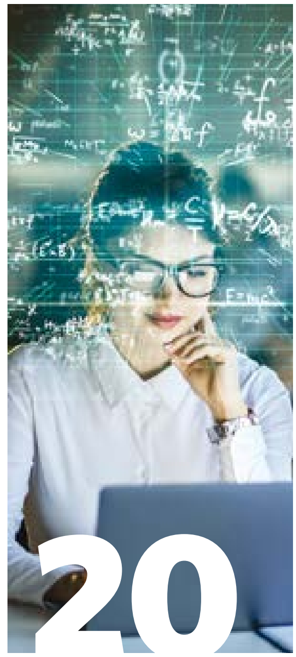

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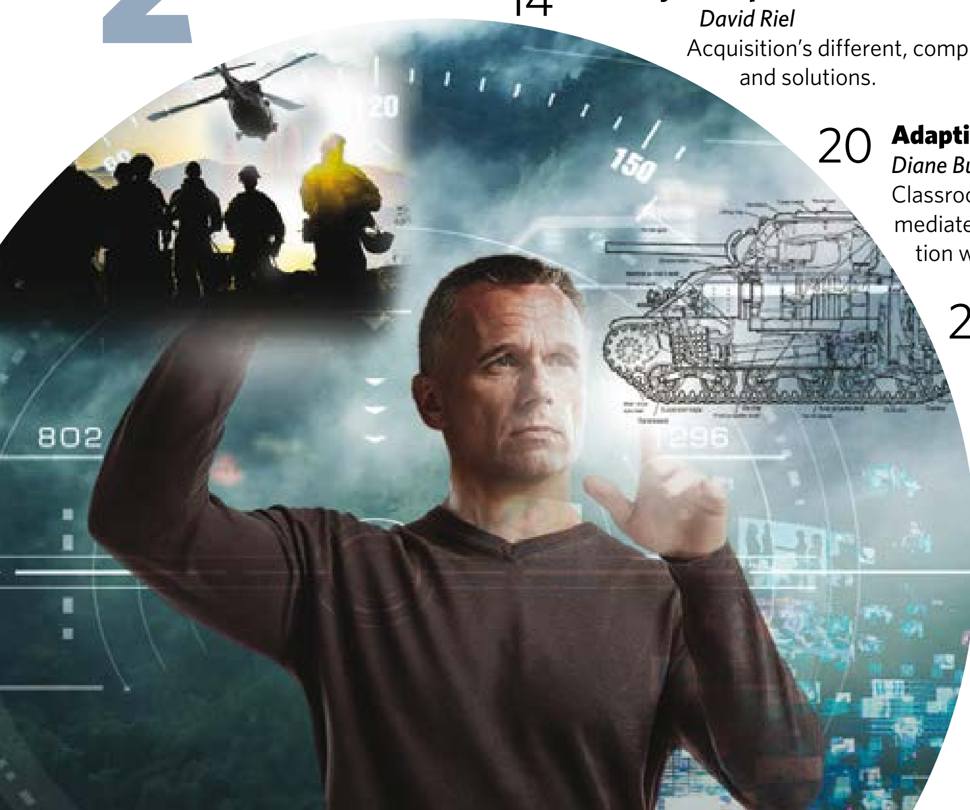

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Innovations in Program Management Training

The PMT 401 Experience

Owen Gadeken ■ Bobbie DeLeon

FROM ITS EARLIEST DAYS, THE DEFENSE ACQUISITION UNIVERSITY (DAU) HAS OFFERED A CAPSTONE program management course. Over the years, this course has evolved from lectures by subject-matter-expert faculty to a more interactive, team-based learning curriculum. Recent changes have been made to improve the sequencing and integration of key course themes, add more "hands on" learning exercises, strengthen the focus on program leadership, and provide more follow-up support to graduates as they return to the workplace. Let's look at the PMT 401 Program Manager's Course and highlights of the curriculum and delivery approaches now used in this course.

Critical Thinking

A major goal of PMT 401 is to hone students' critical thinking, problem-solving, and decision-making skills (see the goals in the sidebar). Program management is full of complex challenges and dilemmas requiring effective analysis

Gadeken *and* **DeLeon** *are professors at the Defense Acquisition University at Fort Belvoir, Virginia. Both have taught in the PMT 401 Program Manager's course for more than 10 years.*

and timely decisions. Individual decisions are based on how you think and process information. Critical thinking improves your decision-making abilities by raising your awareness about the influences on your thinking. While our students already have experience in analysis and decision making, we focus on practical skills to improve the quality of their thinking. We have observed that the more our learners understand how and why they think a certain way, the better they become at evaluating and improving their judgment in the acquisition environment.

Every aspect of the PMT 401 curriculum presents opportunities for critical thinking and decision making accompanied by time for reflection and feedback. This is illustrated in the following review of our case studies, simulations, and experiential exercises.

PMT 401 Student Learning Goals

- Improve your critical thinking
- Hone your problem-solving and decision-making skills
- Enhance your ability to lead in an acquisition environment
- Discover and develop best practices
- Embed a habit of reflection and life-long learning

Source: PMT 401 Orientation Briefing.

Case Studies

The PMT 401 course initially was based on the Harvard case study and analysis methodology and included more than 80 defense acquisition case studies written by DAU students and faculty. These case studies provide an opportunity to explore how program managers think and make decisions in a variety of acquisition scenarios. Our focus on real dilemmas facilitates a deeper understanding of management and leadership challenges in the acquisition environment. It also prompts students to reflect on how and why they think and make decisions on their own programs and to share best practices with the class. Case studies remain an important part of the PMT 401 curriculum, but we have cut in half the number of case discussions. We found that while the case method is still applicable, there is a limit to its effectiveness as a prevailing methodology. We also have carefully scheduled the sequence of cases to provide increasing skill development of our key frameworks and learning objectives. This takes the form of a "learn, practice, and apply" evolution where students become increasingly proficient in using the skill or framework as the course continues. As an example, students learn a framework and process for stakeholder management on an acquisition program starting in Week One. They practice using the framework in later case studies and then must apply the framework in our final simulation exercise and in their 90-day transition plans.

Simulations

As the number of case studies has decreased, the number of simulations and experiential exercises has increased. This has given a more "hands on" flavor to the PMT 401 experience. In addition to analyzing a written case study, students are required to "be" managers in live-action scenarios. These exercises typically are very engaging, competitive, and fast paced. We have integrated simulations throughout the course to replicate real-life scenarios that help students demonstrate their leadership skills and strategies in negotiating, communicating, and implementing solutions in different situations. These simulations provide firsthand benefits and consequences that result from their thinking, actions, and decisions. They also offer insight into how their peers work, think and act—insight that is invaluable in leading teams in the acquisition environment.

Everest and Judgment in a Crisis are two computer-based simulations from Harvard Business Publishing that are used in our curriculum. In the Everest leadership and team simulation, teams of students compete to reach the summit of Mount Everest. During the 6 simulated climbing days, participants face different individual and team challenges. We use this simulation as an "ice breaker" to allow our new student teams to practice critical thinking and decision making as well as group dynamics and leadership. Judgment in a Crisis is an organizational behavior simulation used in the critical thinking session to have students practice their thinking and response to a managerial crisis situation in order to gain a better understanding of several factors that impair judgment and decision making.

Our newest simulation is Harborco, a multi-role, multi-issue exercise designed to teach principles of coalition building and negotiation. The scenario features a consortium of developer, industry, and shipping concerns interested in building and operating a deep-water port. The negotiations include environmental, labor, economic, and government oversight issues. The simulation was developed by the Harvard Program on Negotiation.

Our most extensive exercise is the 2-day "tiger team" analysis of a simulated Program Executive Office that includes a family of unmanned aerial vehicles in different development stages. This simulation was created by two DAU faculty members (John Driessnack and Patrick Barker) to give students "hands-on" leadership experience in a more strategic portfolio management scenario. The simulation is based on real-world issues faced by current acquisition programs with a goal of helping students use the key frameworks and tools taught in PMT 401 to address these challenges. The simulation includes leadership roles where many students work on problems similar to those they will face back in their jobs, after which they brief a senior acquisition executive who acts as the service acquisition executive in this exercise. The simulation includes reflection periods and a debriefing where each student gets feedback on the student's contribution and personal skill development.

When students have developed strong bonds with our faculty, we are the first place they go when acquisition support of any kind is needed.

Experiential Exercises

Successful problem solving and decision making are at the heart of all effective teams. The exercises used in both small and large group settings require team members to analyze information, negotiate, and collaborate with one another. These activities encourage individuals and teams to develop their creative thinking, leadership, and communication skills, while building group cooperation and consensus.

One of the most impactful experiential exercises in PMT 401 is our peer feedback process. In the early PMT 401 offerings, faculty "graded" student contributions and provided individual feedback. This was discontinued in favor of a team or peer feedback process. The framework for this process is Situation-Behavior-Impact (SBI), which was developed by the Center for Creative Leadership. The SBI model is designed to elicit clearer and more direct feedback from a broader group of students and faculty members. Instead of feedback like "great comment you made in class this morning," a student might say, "When our discussion in the C-130 case seemed to wander off topic (Situation), you linked specific student comments as an example of stakeholder management (Behavior), which proved to be a key learning outcome from the case discussion (Impact)." After the SBI process is explained and demonstrated early in the course, we use existing student teams and faculty facilitators to provide feedback to each other. Use of the SBI process not only produces better feedback to students during the course, but it becomes a process students can take back to their workplace and use with members of their real-world project teams.

Our media workshop ranks as the most popular experiential exercise in our course. Each student is interviewed in a print, Skype and taped format. These interactions provide realistic acquisition scenarios with faculty role-playing as

A student outbriefing at a PMT 401 class graduation event last November.
Photo by Debbie Gonzalez, DAU Visual Arts and Press

media interviewers. To ensure that candid feedback and observations are received, video recordings are immediately reviewed with student groups who experienced the same scenario and with public affairs experts. One student commented, "My favorite part of the course. Being able to see yourself on camera, receive critiques and develop confidence in your ability to navigate the media was invaluable. Well organized and realistic."

A recent addition is each student's personal transition plan exercise to apply what they learned when they are back on the job. A simple template is provided for students to list their near-term goals along with 30-, 60- and 90-day action steps to accomplish the personal and organizational goals. Students discuss their plans with their team and faculty advisor to help clarify and improve their product. Faculty advisors then are asked to follow up with students 3 to 6 months after graduation to check on their progress and provide any help if needed. Examples of student comments include "excellent forcing function" and "it made me think of what my priorities would be and how to achieve them."

In addition to traditional analytical methods of problem solving, we now emphasize the more creative approach of design thinking. The focus of design thinking is human centered problem solving, innovative solutions, and early prototyping. After a session introducing key concepts in design thinking, each student group is chartered to work on a real world problem currently impacting one of their workplaces. This includes interviewing a broad range of workforce members affected by this problem. Student groups work on their projects during the last part of the PMT 401 course, then present their prototype solutions as part of their graduation exercise (see photo of student outbriefing).

Leadership Development

Acquisition programs require effective management of budget, schedule and risk, as well as leadership skills. Program leaders must clearly communicate their visions and plans, set high standards, and motivate, and guide team members to achieve positive acquisition outcomes. As PMT 401 has evolved, the curriculum has expanded from a primary focus on program cost, schedule and performance to a broader acquisition leadership emphasis. This shift was driven primarily by our students. In fact, they demanded it whenever we asked them what they most wanted to learn.

Once we got their message, we went to work to revise our curriculum. But rather than teach leadership, we chose to refocus our case studies and class exercises on the leadership issues and lessons inherent in each management dilemma. We just needed to make them a priority, and the success is now evident from recent student evaluations:

"First DAU course to really emphasize the leadership aspects and first leadership course which provided practical tools and frameworks."

"The utility of the course overall to enhance my ability to lead in an acquisition environment—which I think is the purpose of the course—is outstanding."

Residential Program

A key factor in the success of PMT 401 is the collaborative residential program that was designed for these senior acquisition leaders. As a change to its earlier history, the course has fewer lectures, guest speakers, and even case studies—and more interactive seminars, small group discussions, and one-on-one coaching from faculty and student peers. This decentralized approach to interaction in small groups was designed to promote greater skill building and behavior change.

While we use a variety of educational methods and update them frequently, it is the collaborative learning climate that really makes PMT 401 effective. Faculty members encourage student peer teaching and facilitate this reciprocal teaching in all learning activities. As the course continues, the faculty and students gradually merge into a learning community. This is evidenced by student comments from our most recent PMT 401 class:

"I learned much more about myself and vastly improved my acquisition knowledge ... primarily by learning from others."

"I have been blown away by the level of learning, teamwork and development that I have received in this course. I have made additional professional colleagues that I know I can reach out to in the future, and, for me, those connections are immeasurable."

"The true beauty of the course was the interaction with other senior acquisition professionals. Seeing and hearing how others would address an issue was invaluable. This is something that could never be done virtually."

The in-person relationship development between students and faculty in PMT 401 is unlike any other course we have experienced either at DAU or in academia. It is not uncommon for direct communication to continue between students and faculty for months or even years after their course was completed.

This community building also pays great dividends for DAU's other initiatives, such as mission assistance and executive coaching. Most of our workplace support (mission assistance) projects come directly from graduates of our 400-level executive courses, especially PMT 401. When students have developed strong bonds with our faculty, we are the first place they go when acquisition support of any kind is needed.

Continuous Improvement

The current construct of PMT 401 enables the faculty to rapidly prototype new content, methodology, and sequencing of learning events. Over the past year, the team has researched, piloted, and refined several learning activities to ensure that the course is relevant to acquisition professionals now and in their immediate future. After each course offering, the faculty and staff review and evaluate student feedback and faculty observations of each learning event. DAU's capstone Program Manager's Course must anticipate and make adjustments quickly while maintaining a constant pace of development to better serve the talented acquisition professionals who will lead our largest and most complex acquisition programs.

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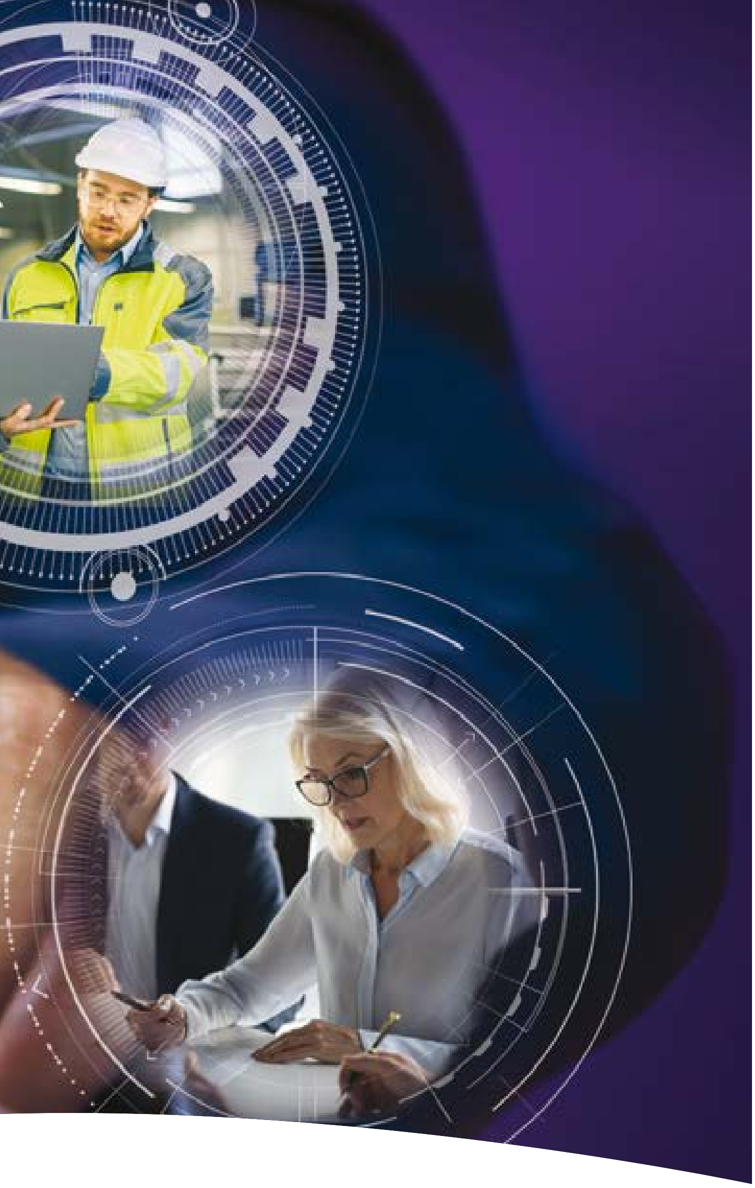
DISTRIBUTED LEADERSHIP **to Empower** Acquisition Professionals

W.A. Schleckser, D.Mgt.

AFTER RETIRING FROM THE AIR FORCE, I secured a position as the Air Force's Rotary Weapon Systems Spares Manager. One aircraft we supported was the CV-22 Osprey. As spares manager, I was on the retail end of the acquisition process supporting the System Program Office (SPO) receiving spares and distributing them to the field. This was not my first time working directly with an SPO, but it was the first time I worked this closely with one. This closeness was necessary as we initially fielded the CV-22. This required coordinated synchronization of spares distribution as aircraft entered the field.

Schleckser *is a professor of Contract Management at Defense Acquisition University (DAU) in Huntsville, Alabama. He holds a Doctorate of Management from Webster University. He retired after 23 years from the U.S. Air Force where he served as a logistics manager. Prior to joining DAU, Schleckser served 12 years as a contracting officer and program manager for the United States Transportation Command.*



Although I was on the outside of the SPO looking in, my position gave me a good view on how an SPO worked. It was obvious that the program manager (PM) was large and in-charge. Everything was controlled by the PM, and, as is common in many Department of Defense (DoD) organizations, there tended to be a vertical organizational structure to the SPO from the component acquisition executive, program executive officer, division leadership, senior PMs, down to the junior PMs.

Fast forward a decade, and I am a contracting officer (CO) at a component command in charge of numerous contracts supporting Acquisition Category (ACAT) III programs. Again, the PMs were in charge, but I had a seat at the table as the CO. I held a contracting warrant and had what some academic texts call "expert power." Since few people outside the contracting profession understand government contracting, my experience, education, and authority held a level of influence within each of the supported programs. Again, we worked in a vertically structured organization with specific levels of responsibilities and authorities.

Fast forward another decade (yes, I'm that old), and I am the PM for three ACAT III programs. However, a funny thing happened to me somewhere on the way to the office … my perspective on leadership changed. Having previously served as a senior non-commissioned officer, I was educated on leadership models and styles and comfortable in transitioning between them. I found that it wasn't the models of leadership I needed to correct to succeed in my new role as PM. It was my perspective on leadership itself. The military had taught me to view leadership as a leader-centric activity. There are leaders and followers, period. Leaders lead and followers follow. Simple, right?

Digital Age and the New Leadership Environment

But it isn't that simple. Something changed from the conception of these leader-centric models. I'm not even sure my parents were aware at the time, but it all started 6 years prior to my birth when two Bell Lab engineers invented the metal-oxide-semiconductor field-effect transistor (MOSFET). The MOSFET is the basic building block of modern electronics. As the most widely manufactured device in history, it revolutionized the electronics industry, transformed our world economy, and allowed mankind to leap into the Digital Age.

In today's Digital Age, information has become ubiquitous and extremely portable. However, prior to invention of the MOSFET, this was not the case. Information took time and effort to distribute. For example, although the World War I armistice occurred on the poetic date of the 11th hour of the 11th day of the 11th month of 1918, fighting did not cease until Jan. 5, 1919. It took weeks to notify all of the German commanders that Germany had surrendered. Today, we could get that done in seconds with a tweet and a hashtag, thanks to the semiconductor.

When information was not easily accessible, it had the characteristics of currency—held by few, commanding by its presence, and tending to be leader-controlled. This coalescing of information among leader groups gave those communities great influence over follower groups. Conversely, in today's digital environment, information has the characteristics of an electrical current—made by many, quickly shared, and peer-controlled. This change in information dynamics has significantly affected our social and organizational cultures.

Within our social culture, print news is nearly extinct. Who reads a newspaper anymore? Information is now aggregated onto websites giving people easy access to information and much more data to consume. This new availability of information has led to information overload and the demand for "safe spaces" from opposing views. Access to information has become so powerful within today's world that American social media companies now work closely

Access to information has become so powerful within today's world that American social media companies now work closely with socialist regimes to limit the information allowed into the borders of certain socialist countries for fear people will rise up.

with socialist regimes to limit the information allowed into the borders of certain socialist countries for fear people will rise up. For example, in March 2019, revolutionaries in Hong Kong began developing grass-roots support almost exclusively through social media, demanding freedom from China. This single event may have changed how future uprisings and revolutions may be instigated and fought.

Armed with new information power, people are capable of and more likely to self-organize, challenge the status quo, and feel empowered to express their views. Individuals are now empowered to draw others to their cause and demand a voice in the conversation. Our workforce has also been affected by this new phenomenon and, as a result, been given more power.

Leading a New Workforce Within a New Culture

While I was an employee in a large DoD organization, our commander had an "Ask Us Anything" social media platform. And ask the commander anything is exactly what the people did. Instead of being a way to reach out to the masses, it became a way for the masses to voice discontent, whether relevant or not to the organization's goals. People started visiting the site just to see what astonishing query or demand was presented to the commander that day. This was not an uprising like the one in Hong Kong, but it was a similar opportunity for people to challenge the status quo, feel empowered and express their views. Regardless of the relevance or lack thereof to the organization's mission, they expressed their views. One person even demanded that the commander address an issue about the saltiness of the fries at the base Burger King. People became so emboldened by this new power that the site was eventually taken down.

Another phenomenon created by our interconnected world is the ability of people to learn from each other. For example, with nearly as much ease as turning on a light switch, you can go to YouTube and reveal videos that will enlighten you on just about anything. Type in "how to perform heart surgery" and dozens of videos are presented giving nearly step-by-step instructions. No matter how expensive healthcare gets, I wouldn't recommend this as an option for open heart surgery.

Professional organizations, employers, and educational institutions have recognized and embraced this new medium of teaching elevating the capabilities of the workforce and further distributing expert influence and competencies within our organizations. Information, flowing like electricity and easily distributed, has created a highly capable, well-educated, and broadly skilled labor force within our acquisition community. Although leadership models have tried to keep up, I am convinced that leading today's acquisition professionals requires more than customary modes and methods.

Our leadership styles and practices must advance to meet the evolving changes of our new culture and workforce. Therefore, it is essential for acquisition leaders to continually search out new leadership thought. One new leadership movement popular in educational circles over the past decade and potentially compatible with this new trend is Distributed Leadership.

Distributed Leadership Is Compatible with Digital Age

Distributed Leadership is still a nascent theory. Yet, an examination of it reveals promise in engaging with the current workplace culture. Leadership models and styles always will be important considerations, but unlike customary models that put the leader out front, Distributed Leadership highlights the practice of leadership at multiple points within the organization instead of the leaders themselves. Furthermore, Distributed Leadership is not a model or style. Rather, it is a "system" where responsibility for leadership stretches across the social framework of the organization with the recognition that there are numerous leadership activities in various situations occurring simultaneously within an organization. As a PM and CO, I found that our acquisition communities were populated with highly qualified professionals. They work with minimal supervision and have a high degree of technical ability. This creates an interesting dynamic within the organization as each of these professionals have a degree of information or 'expert' power to wield.

Furthermore, the acquisition profession has become extremely complex with the result that that leadership relies on mid-level acquisition professionals to be out front in major organizational muscle movements. This gives mid-level professionals significant influence because they control access and flow of information and, thereby, influence and help set organizational direction. This influence is anchored in the information they choose to discern, create, and document. These professionals and their teams, considering (or not) policy or governance, make or create nearly unilateral decisions at key decision points, through information they select and contextualize. The assumption that policy or governance is enough to influence direction of these efforts may no longer be valid. Policy and governance, in an effort to frame all situations, quickly lose influence in today's continuously evolving environment.

Consider the Government Accountability Office (GAO) denial of a recent protest (https://www.gao.gov/docket/B-417011.1) in a decision that supported skills development outreach and training programs as prototypes procurable under Other Transaction Authority (OTA). The prototype determination was supported by requirement documents promulgated by acquisition professionals who chose to categorize these requirements as prototypes. GAO's decision to deny the protest ultimately came down to a matter of semantics on how the requirement was defined, documented, and solicited by acquisition professionals. This may have set an interesting precedent for the future procurement of training programs by the organization involved.

So let's go back to my leadership transformation. Relatively new to the position as PM, I relied heavily on my team of acquisition professionals. This dependence naturally resulted in conjoint responsibility for our program's success. Completely unknown to me at the time and purely out of self-preservation, I began to practice distributed leadership. Although I was the PM, and was responsible for delivering my program, I turned leadership or influence over to technical or functional experts on certain aspects of the program. This is where the "system" of leadership can be witnessed among the variables of leader, follower, and situation. The Distributed Leadership "system" considers the interrelation between leader, follower, and situation, with the understanding that none of the three elements remain permanently static. In select situations, I voluntarily converted to follower where a technical staffer was more qualified to take the lead. I did not abdicate my position as PM, but knew that allowing others to have a significant hand in leading the program was necessary for our success.

Distributing Leadership = Distributing Power

The essence of Distributed Leadership is sharing leadership power. In an organization in which Distributed Leadership prevails, power is shared and lines of responsibility are broadly drawn and allowed to blur. Thus, leadership becomes an organizational quality instead of a bestowal on select members. This does not mean that there no longer is a place for formal leaders, but they must defer to others who have more expertise. However, in this deferrence, the formal leader has an active role in anticipation of eventual resumption of leadership responsibilities. This is empowerment at a basic level.

You may have seen facets of this in your acquisition organizations, but in some ways we have failed to fully embrace it. The call for less control and more empowerment has been heard at the highest levels. As a result, less measured methodologies like OTA and middle-tier acquisitions are gaining traction in our acquisition conversations. These activities reduce not only governance, but put decisions and influence in the hands of others.

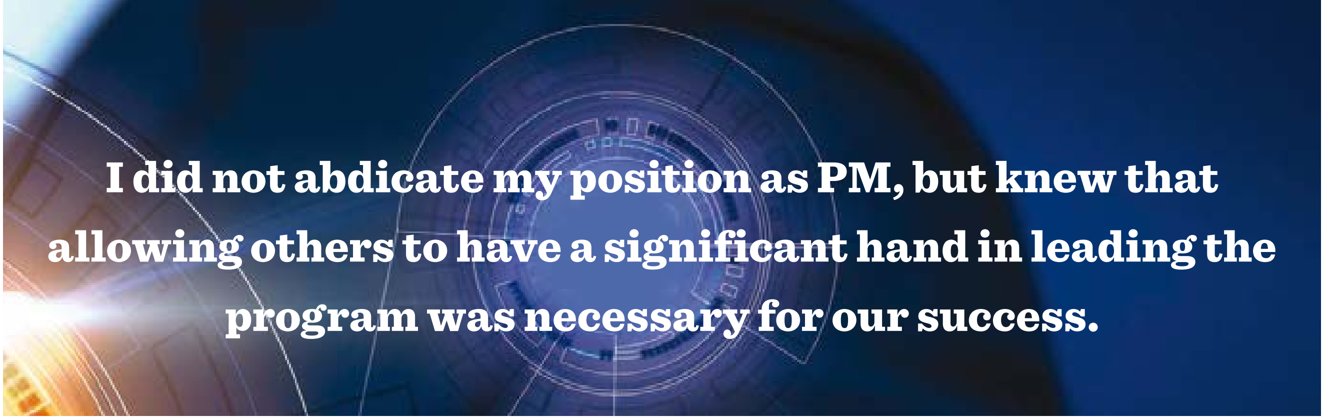
A May 2010 *Harvard Business Review* article, "Sharing Leadership to Maximize Talent," identified the following suggestions for sharing leadership that echoes Distributed Leadership practices.

- Give power away to the most qualified individuals to strengthen their capabilities.
- Define the limits of decision-making power.
- Cultivate a climate in which people feel free to take initiative on assignments.
- Give qualified people discretion and autonomy over their tasks and resources and encourage them to use these tools.
- Don't second guess the decisions of those you have empowered to do so.
- Consider yourself a resource rather than the manager.
- Set appropriate follow-up meetings to review progress and take corrective action if necessary.

Sharing Leadership Power Has Its Benefits

Sharing leadership and the information that accompanies it allows people in formal leadership positions to create positive inroads within the organization's network, while generating trust and flattening the organizational structure. A flatter structure shortens the information path to and from organizational members, creates opportunities, and generates trust necessary for members to recognize and tackle opportunities as they arise.

Leadership is not executed in a vacuum. Leadership behaviors affect the organization's interpersonal network. Watercooler talk still goes on. It's just done instantly and efficiently through channels like Skype or Snapchat. Leaders should consider tapping into these new mediums, sharing and creating information that drives initiative and empowerment. As organizational needs are generated with no obvious solution, perhaps a quick social media post or



I did not abdicate my position as PM, but knew that allowing others to have a significant hand in leading the program was necessary for our success.

instant message to the organization will produce an innovative solution. But leadership must be willing to share that information, receive the feedback, and allow organizational members to take leadership in developing the answer.

Leaders of organizations also must occupy key spaces in workplace networks, be sensitive to the situation, and influence information being distributed. Attempts like the "Ask Us Anything" website to occupy a key space in the information network fail because leadership allowed others to fill the vacuum of information and drive influence. In contrast, leadership must persistently inhabit the space and understand that information, like influence, is a shared resource.

Sharing leadership power may also reduce the walls of tribalism that can arise within our acquisition communities. We all understand that the PM is responsible for delivering desired capabilities, and the acquisition team supports that goal. Nevertheless, when one or more of the members of the acquisition team (PM, CO, test manager, etc. …) reaches for full and unrelenting control of the conversation, team members can become alienated and tribalism result. However if members feel empowered and consider themselves, regardless of rank or position, to be joint leaders within the organization, leadership is distributed together with a sense of responsibility.

Aspects of Distributed Leadership may already exist in various forms within your organization. Nevertheless, moving your organization to a fuller Distributed Leadership framework requires building leadership capacity within your workforce that will develop initiative and empowerment. There is hidden talent in our acquisition organizations that we need to tap into. Followers who possess hidden talent may be unfamiliar with acting in a leadership role and need instruction in how to recognize opportunities to lead, as well as on emerging leadership techniques.

The *Harvard Business Review* article suggested cultivating a climate in which people feel free to take the initiative. Instruction on recognizing those opportunities goes a long way in cultivating and/or exposing our hidden talent resources. Moreover, instruction in current leadership models, such as Transformational Leadership, and application within a "system" of leadership will prove invaluable. It will give members a leadership toolset to begin with.

Times, They Are a-Changin', and So Should We

As Bob Dylan sang in 1964, "The times they are a-changin.'" Leadership practices within our acquisition community must consider changing with them. Within today's networked, information-rich world, we must view information and influence like an electric current. It is made by many and should be quickly shared. Handling it any differently will lead to a lack of innovation, trust, and empowerment within your organization. To develop Distributed Leadership's culture, leadership power must be shared and leadership capacity increased. Broadly drawing lines of responsibility, permitting those lines to blur, giving power to qualified individuals, and providing wide decision-making freedom will develop a sense of empowerment among employees and expose hidden talent. Distributing leadership will make leadership an organizational quality and a sustainable competitive advantage within our acquisition community.

The author can be contacted at **William.Schleckser@dau.edu**.

MDAP/MAIS Program Manager Changes

With the assistance of the Office of the Secretary of Defense, *Defense Acquisition* magazine publishes the names of incoming and outgoing program managers for major defense acquisition programs (MDAPs) and major automated information system (MAIS) programs. This announcement lists such changes of leadership for both civilian and military program managers late in 2019.

Navy/Marine Corps

CAPT Jonathan C. Garcia relieved **CAPT John J. Keegan** as program manager for Surface Ship Weapons (PEO IWS 3.0) on Nov. 8, 2019.

CAPT Andrew J. Thomson relieved **CAPT Jonathan C. Garcia** as program manager for Command and Control (PEO IWS 6.0) on Nov. 27, 2019.

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DEFENSE ACQUISITION

ver 7/17/18

Today's Complexities Demand More Chefs, Fewer Cooks!

David Riel

IF YOU'RE A COOK, YOU HAD BETTER BECOME A CHEF! DO you know the difference? A cook can follow a recipe and prepare a nice meal, but a chef can take a variety of wide-ranging ingredients, understand how they complement each other, and create a gourmet feast. Have you ever watched "Chopped" on the Food Network? Each chef contestant is given a basket of eclectic ingredients and a challenging schedule to fix an epicurean dish that their customers, the judges, will fawn over. Sound familiar? We live in an increasingly complex acquisition world where just following a Department of Defense Instruction (DoDI) 5000.02 recipe will not suffice to provide your customer, the Warfighter, with the "dish" needed for success. For example, if you were to have taken the Defense Acquisition University's Intermediate Systems Acquisition course 10 years ago, you would have been shown a single, phased-approach model, the Defense Acquisition Management System (Figure 1).

Five years later, with a recognition that software is developed and procured differently than hardware, DoDI 5000.02's refresh would have exposed you to six different models, a combination of hardware and software-dominant paths. An appreciation that the break between phases is not a smooth process led to the revamping of the hardware model, as well (Figure 2).

Today, our acquisition world's complexity has expanded even more, recognizing that different situations require different urgencies, tools, and solutions. This has resulted in the Adaptive Acquisition Framework, whose latest draft includes the 2019 DoDI 5000.02 process as only one of the six potential paths to acquiring the best Warfighter solution (Figure 3).

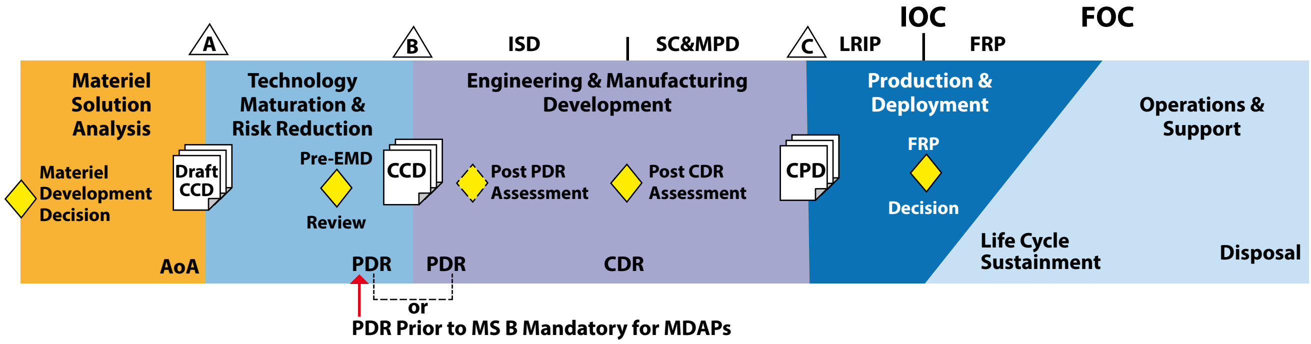
You need to become a chef! Gone are the days of being able to simply follow the prescribed Milestone A, B, C recipe. But how to make the change? First, you need to understand the circumstances presented to you. What is the "speed of relevance" for your program? How flexible and/or stable are the requirements? Have you established an enduring conversation with your customer to discuss requirements options? Then you will need to apply a thorough understanding of the major ingredients that will spell success or failure for any program. What are they? Let me suggest the following as a start.

Acquisition Pathway

Where does your effort fit into the new Adaptive Acquisition Framework? Are you trying to exploit some new innovative technology and provide the Warfighter with residual operational capabilities? Explore the Middle-Tier Acquisition (MTA) Rapid Prototyping path. Is there some

Riel *is professor of Acquisition Management at the Defense Acquisition University in Kettering, Ohio. He formerly had a 20-year career with the U.S. Air Force, including work with industry.*

Figure 1. Defense Acquisition Management System (2008–2013)

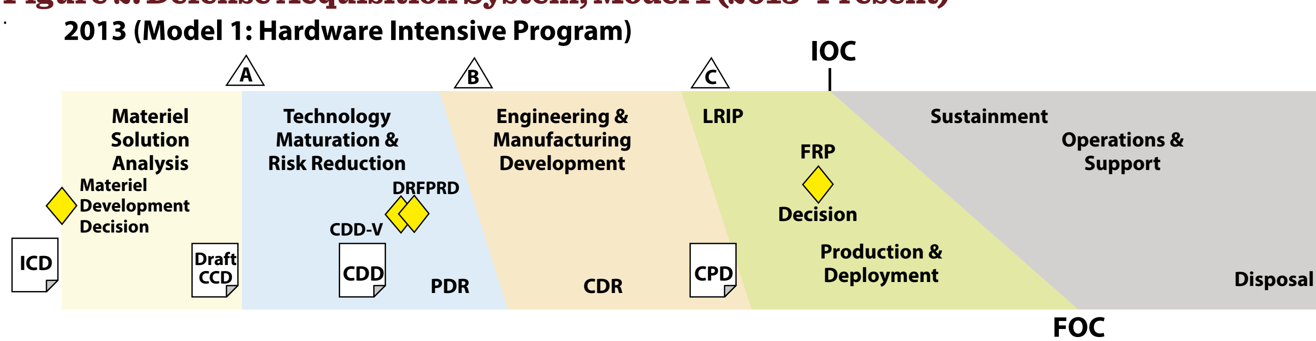


KEY TO ABBREVIATIONS, ALL FIGURES

AoA=Analysis of Alternatives; ATP=Authority to Proceed; CCD=Contract Completion Date (CCD-V=CCD-Verification); CDD=Capability Development Document (CDD-V=CDD-Validation); CDR=Critical Design Review; CPD=Capability Production Document; DD=Disposition Decision; DRFPRD=Decision Review, Preliminary Design Review; EMD=Engineering and Manufacturing Development; FOC=Full Operational Capability; FRP=Full-Rate Production; I=Iteration; ICD=Initial Capabilities Document; IOC=Initial Operational Capability; ISD=Integrated System Design; LCC=Life-Cycle Cost; LRIP=Low Rate Initial Production; MDAPs=Major Defense Acquisition Programs; MDD=Materiel Development Decision; MS=Milestone; MVCR=Minimum Viable Capability Release; MVP=Minimum Viable Product; MSC=Milestone C; O&S=Operations and Support; OD=Outcome Determination; PDR=Preliminary Design Review; R&D=Research and Develpment; SC&MPD=System Capability and Manufacturing Process Demonstration.

Source for Figures 1-3: DoD Instruction 5000.02.

Figure 2. Defense Acquisition System, Model 1 (2013–Present)

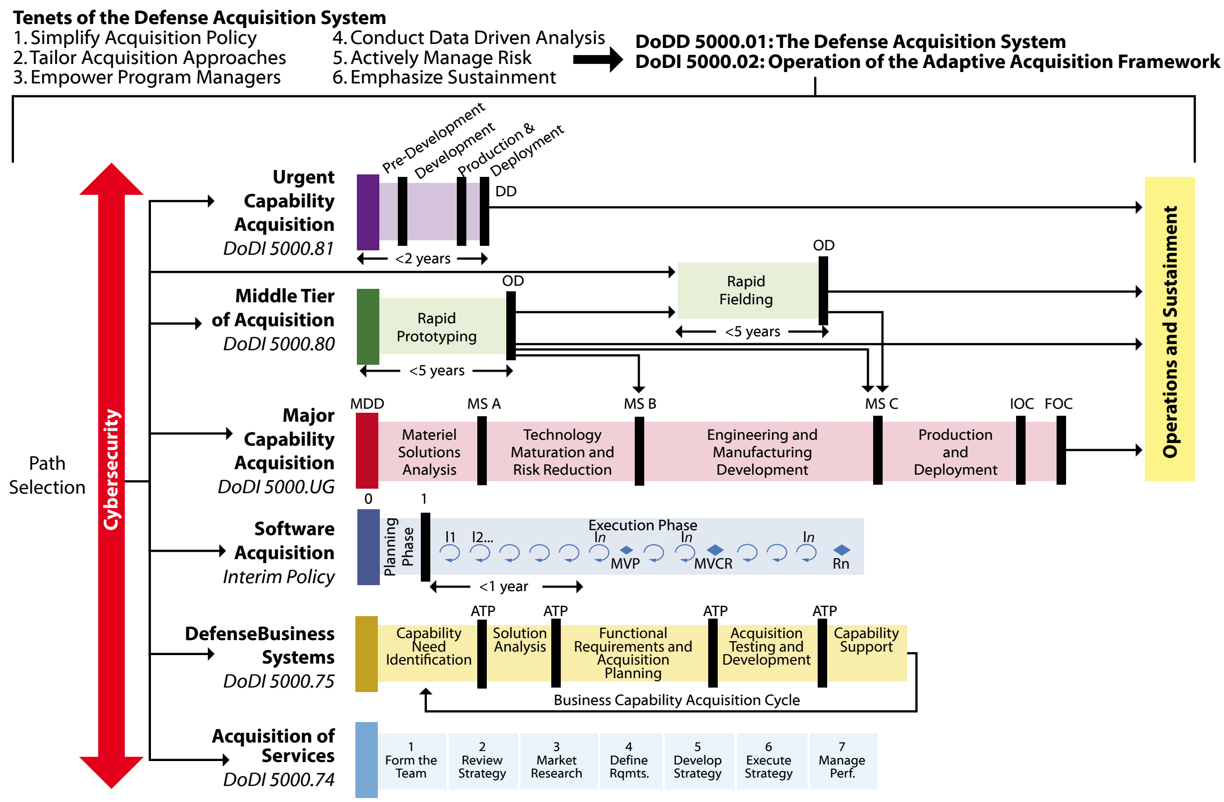


proven technology, perhaps exploiting a commercial use, that you can produce quickly and field within 5 years? If so, then, MTA's Rapid Fielding path might be right for you. Is software the major acquisition product, perhaps an upgrade to a command and control product? Why not follow the Software Acquisition path? Of course, there is nothing evil about the traditional Major Capability Acquisition path, which can and should be tailored to meet your specific needs. But it is crucial that you understand the requirements and benefits, along with the risks, of taking these different acquisition pathways, and then choose the pathway most appropriate for your program.

Contracting Strategy

Congress recently expanded some tools for finding and getting the right defense industry contractor on-board for our programs. Beyond traditional contracting vehicles based on the Federal Acquisition Regulation, Other Transactions (OTs), and Commercial Solutions Openings (CSOs) have provided some great additional options. Are they right for your program? Does your program meet the Three Ps of OTs—purpose, prototype, and participation? Many of your colleagues have embraced these contract vehicles, as evidenced by a rapid increase in OT use over the past several years. However, beware of statements that imply one contract vehicle is superior to all others. Some dishes need salt, and some need sugar. Just because both flavorings are white granular substances doesn't mean it is appropriate to use them interchangeably. A good understanding of contract strategy differences can mean the difference between success and failure. If risk is too high and you've demanded a fixed price contract, industry proposals will reflect that. In such a case, you can likely gain flexibility and save money using a cost-reimbursable vehicle. You can often save time using an OT, but not always. The experts say that if you're using OTs for the sole purpose of saving time, don't! Always remember the reason you choose a particular contracting vehicle is to properly incentivize the contractor to provide your end users with the product they need, when they need it.

Figure 3. Adaptive Acquisition Framework



Funding Strategy

How will you get the money to run your program? Beyond the traditional Planning, Programming, Budgeting and Execution (PPBE) system that requires 2 years of foresight for acquiring funds, are there other sources of more immediate funding? Are you aware that the DoD has a Rapid Prototyping Fund administered by the Under Secretary of Defense for Research and Engineering? Could that bridge the 2-year gap between a great technological opportunity now and establishing your long-term funding line through PPBE? If you can go faster via additional funds, have you explored getting on your service's Unfunded Requirements List or pursued Reprogramming Requests? You need a thorough grasp of all of your options to get the required money, in the right appropriations, at the right time. Depending on your total budget, you will have a variety of reporting and accountability requirements. Have you accounted for those in your timelines? Can they be waived, when appropriate? Understanding your program deeply enough to predict the funds needed, in the appropriations category needed, will allow your team to ensure the money is available in time.

System Engineering, Metrics, and Risk/Opportunity Management

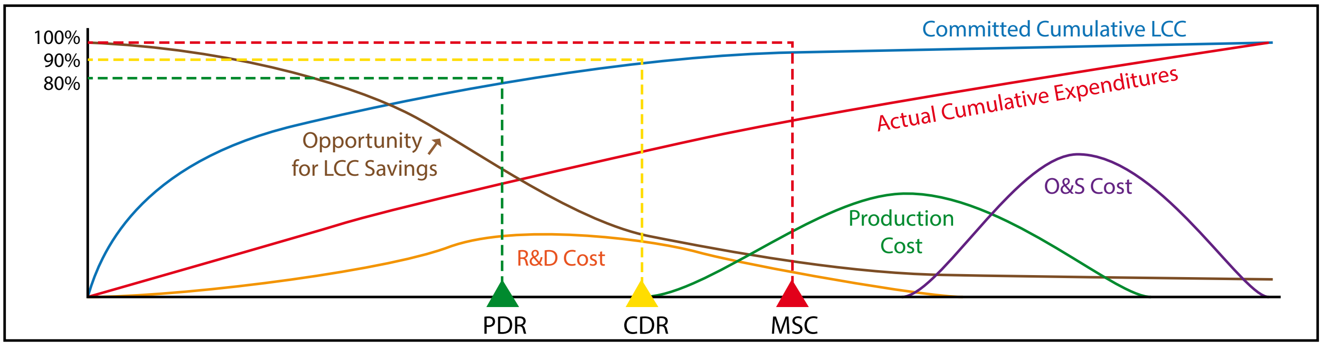
What is your path to getting the technical solution to work? Are you prototyping the hard stuff first—i.e., "the quickest path to failure," as Dr. Bruce Jette, the Army's Acquisition Executive would say. One of the most important system engineering tasks is to develop and maintain a rigorous risk and opportunity management plan. With today's need for products to be delivered at the speed of relevance, it is essential that your team thoroughly recognizes the risks facing the proposed solution. How can those risks be mitigated? Will they be assumed, transferred, controlled, or avoided? And don't forget about opportunities. Are any available that would increase speed or performance? What resources are needed to enable pursuit of those opportunities?

This risk/opportunity management plan is not to be built and put on a shelf, but to serve as a steady guide as the product matures. If your product is software, do you understand the Risk Management Framework and how to best exploit its virtues to improve your software product? Is agile software development the right methodology for getting your software matured and in the users' hands? If not, why not? A good strategy for developing the technical solution for the warfighter's requirement is essential to your program's success.

Integrated Testing

Employing a collaborative effort with the warfighter and tester, have you established a test and evaluation plan to ensure that your product meets that customer's needs? What

Figure 4. Life-Cycle Cost (LCC) Savings Opportunities



Source: Defense Acquisition University course: PGM 201B—Intermediate Production, Quality, and Manufacturing, Part B.

type of testing does your product and chosen acquisition path demand? A program manager's worst nightmare is to contract for a product and successfully execute that product, only for the warfighter or tester to find it inadequate. If you follow a rapid prototyping pathway, you should engage in a test-learn-fix-test approach with multiple user test points in a series of small, targeted events, while maximizing modeling and simulation to increase your speed. A Test and Evaluation Master Plan will be required for the traditional Major Capability Acquisition approach; however, you should tailor it to increase testing's influence on your development efforts. Like many of the functional offices, these vital activities can appear to program managers as impediments. However, they serve a vital role. Engaging with them early and developing a common understanding of schedule and technical requirements can foster an environment of mutual support toward the common goal of getting war-winning technology faster into the hands of the warfighters. Still, you also need to ensure that it stays in their hands. So, it is crucial that you track sustainment and producibility, starting early in the design process.

Sustainment and Producibility

One of the potential pitfalls of the rapid prototyping path could be the neglect of production and sustainment costs in the effort to ensure that the product reaches residual operational capability within the 5-year window dictated by Congress. Studies have shown that, by the time the Preliminary Design Review is conducted, approximately 80 percent of the program's life-cycle cost (LCC) is determined, even though only a small percentage of the program's cumulative costs has been spent. This early design work is the place where the team has the best opportunity to impact LCC. By the time of the Critical Design Review, the LCC commitment is approximately 90 percent (Figure 4).

Production, logistics, and other considerations must be exhaustively understood and prioritized early or your program could easily become unaffordable. Prototyping emphasizes an experimental philosophy in order to get innovative technology to work. Without a strong program manager emphasis, there is little incentive to focus on future LCC drivers—i.e., production, operations, and support. Also, award fee contracts, which allow for profit margins to be influenced subjectively, and to include consideration of items such as affordability and sustainability, are highly discouraged. This may dissuade the government/contractor team from paying much heed to these longer-term factors. Like a chef who has visualized the flavor and presentation of the final dish early in the cooking process, your team must emphasize sustainment and producibility early in the design process to ensure that the final product is technologically superior, producible, and affordably sustainable.

As a former senior manager of manufacturing at one of our industry partners, which produced the interiors of the canceled VH-71 Presidential Helicopter, I can testify how early design decisions can subvert manufacturing's ability to produce an affordable product.

Yes, a number of other factors must be decided on, managed, and tracked in order to produce a successful product for our warriors. Your team cannot forget to ensure the myriad other elements—such as environment, safety, and occupational health, spectrum certification, airworthiness, unique identifiers, energy policy, etc.—that must all be addressed for the program to succeed. However, the thorough understanding and vetting the above six major ingredients will allow you to master the complexities of today's acquisition world. With that mastery, you will no longer feel the need to open up the DoDI 5000.02 cookbook to find the recipe for creating a good product. Instead, when you open up the basket of ingredients that the requirements and acquisition community has handed you, you'll be able to create a gourmet, masterful acquisition strategy. Bon Appétit!

The author can be contacted at **David.Riel@dau.edu**.

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DEFENSE ACQUISITION

Adapting DAU to Change for the Warfighter

Diane Bublak

LEARNING IS A LIFELONG ADVENTURE, AND IT takes personal commitment. Adult learners increasingly return to the education arena for a plethora of personal, financial, and social reasons. Adult learners are defined as those over the age of 25. Andragogy is the methodology applied to adult learning.

Andragogy is the study of adult learning. Andragogy is important because the theory supports the needs of a student population that is no longer the traditional audience of fresh high-school graduates. Classrooms at the Defense Acquisition University (DAU) are populated by a mixture of prior or active-duty military, recently graduated adult and young learners, and adult learners returning to the workforce or reinventing themselves by entering a new career field.

Bublak *is the Learning Director for Contracting in the Foundational Learning Directorate of the Defense Acquisition University at Fort Belvoir, Virginia.*

Develop a passion for learning. If you do, you will never cease to grow.

—Anthony J. D'Angelo, author of *Inspiration for Resident Assistants*

Adult learners are self-directed with three generally accepted perspectives: humanistic, transformational, and emancipatory. However, workforce changes resulting from economical, societal, and global alterations allow the adult learners to gain additional education credentials. Adult learners want skill-oriented education. In 1995, less than 40 percent of employer training was remedial. Therefore, corporations have been spending money for adult education that provides for the highest financial returns from their financial investment. Institutions responded with various learning opportunities such as credential tracks, certification, and incentive badging. These learning tracks focus on one segment of a larger topic, such as Adult Learning Theories and Education, in the larger career track of Higher Education.

Adult learners bring to the classroom a wealth of knowledge based on lived experiences, lessons learned, best practices, and cultural behaviors. They add value to the class by expanding the knowledge through stories and experiences shared with other participants. Education institutions realize the impact of these experiences and consider these lessons through Prior Learning Assessments (PLAs). PLAs can take the form of an exam, a written exercise, or a hands-on demonstration that the knowledge meets the acceptable level of existing standards. Accredited universities provide college credit for this nonformula, informal, and workplace learning.

How does andragogy help us understand adult learners? Studies proved that the art of teaching children differed greatly from the art of teaching adults. Adult learners may return to the educational environment with apprehension and anxiety. Some adults return after many years away from the classroom. Some adults experience online learning for the first time when returning to the workforce. As facilitators of adult learners, we need to understand what they need in order to cultivate the learning event. For instance, facilitators need to set a cooperative climate for learning—a safe learning environment. This includes identifying the needs and interests of the learners. One way to ensure that these criteria are met is through the student introductions. During the introductions, the facilitator may ask the students to specify their expectations for the learning event. Keeping the expectations visible throughout the week(s), enables the participants to see that their expectations are met.

... the consultant must be flexible and accept that the audience may not be the usual new hires or young learners who need to be lectured. They may be seasoned employees who want a refresh or quick on-demand learning experience to bring them up to date on regulations, policies, or procedures.

Meeting the expectations of a variety of learners can take any form and aids in changing a class from a lecture to an active learning experience. Active learning enables the students to enhance their current skills, improve their critical thinking skills, and gain new knowledge efficiently. This type of active learning demands a different type of presentation and does not involve lecture and rote memory exercises and exams. Therefore, traditional lectures are not always suitable and knowledge checks take unique forms such as capstones and knowledge assessment games. As we move from instructors to professors to consultants and facilitators, we need to expand our portfolio of experiences to didactic and problem-based learning techniques and practices.

In the past, the DAU focused on providing the career-oriented Defense Acquisition Workforce Initiative Act (DAWIA) certification curriculum for the Department of Defense workforce. However, as technology, demand for flexible courses, and the target audience's needs changed, the DAU responded by adjusting curriculum design and development. The university has focused on changing how the professors deliver training. For these and other reasons, the DAU has continued to revisit certification curriculum in an effort to reduce the time spent in the classroom and concentrate on immediate results for better performance in the workplace.

The reduced material allows the professors to engage more with the customers through Mission Assistance. During these events, the professors act as consultants rather than as traditional professors. Mission Assistance, unlike resident courses, should be client-centric and address the needs expressed by the client. In these situations, the consultant must be flexible and accept that the audience may not be the usual new hires or young learners who need to be lectured. They may be seasoned employees who want a refresh or quick on-demand learning experience to bring them up to date on regulations, policies, or procedures. Participants should not be considered as "students," per se, but instead as knowledgeable partners with valuable stories and experiences that can be shared for the benefit of others. Mission Assistance events help foster lasting relationships at a high level while closing the learners' knowledge gaps. Mission Assistance opportunities are compatible for adult learners, because they provide for self-directed, knowledge sharing, and skill-based training. Employers, for their part, realize an immediate return on their expectations.

In response to technological changes, the DAU encourages professors, course managers, and learning directors to seek instances in which technology can supplement or replace instructor-led courses. Resident courses converted to virtual instructor-led courses allow the learners to attend training at a time and place that is most convenient for them and their employers. Another instance where the DAU strives to keep pace with adult learning trends while appealing to the younger learner is in learning tracks similar to the certification programs of public institutions. The DAU has kept pace with technology by developing an iPhone and Android DAU smart application. Faculty, staff, and students can access their DAU assets from any smart device.

The DAU, like any university or training institution, must maintain a competitive edge, and this requires buy-in from the top to the bottom and vice versa. The institution must remain flexible and solicit creative ways to entice learners back into the education arena. Changes in delivery methods and varying opportunities help to ensure that the DAU can provide an equitable learning environment. Preparing the workforce to support the warfighter is our goal. In order to accomplish this goal, we must intimately know and understand our audience so we can offer accessible and sustainable training events. We also must reduce barriers to learning opportunities by stretching our use of technology.

The author can be contacted at **Diane.Bublak@dau.edu**.

Did Our Budget Go Up or Down?

Using a Five-Arrows Budget Analysis

George Cho
Don Jenkins

A FEW YEARS AGO, THE DIRECTOR OF THE NATIONAL SECURITY SPACE INTEGRATION OFFICE WAS briefing a room full of senior leaders in the Department of Defense (DoD), including the Executive Agent for Space and the Under Secretary of the Air Force, on the state of the space budget. He reported that the space budget was going up. The Director, Program Analysis and Evaluation (the predecessor to Cost Assessment and Program Evaluation or "CAPE") took exception and said, "No, your budget isn't going up ... it's going down!" Caught off guard, the director said that he would look into it and quickly moved on to the next slide in his briefing.

Back in his office after the briefing, the director summoned his budget analysts (i.e., the authors of this article) and said: "If that ever happens to me again, you're fired! Don't ever give me wrong data."

After retreating to our cubicles to assess the situation, we realized that our figures were in fact correct. But, we found that CAPE's figures also were correct. How could that be?

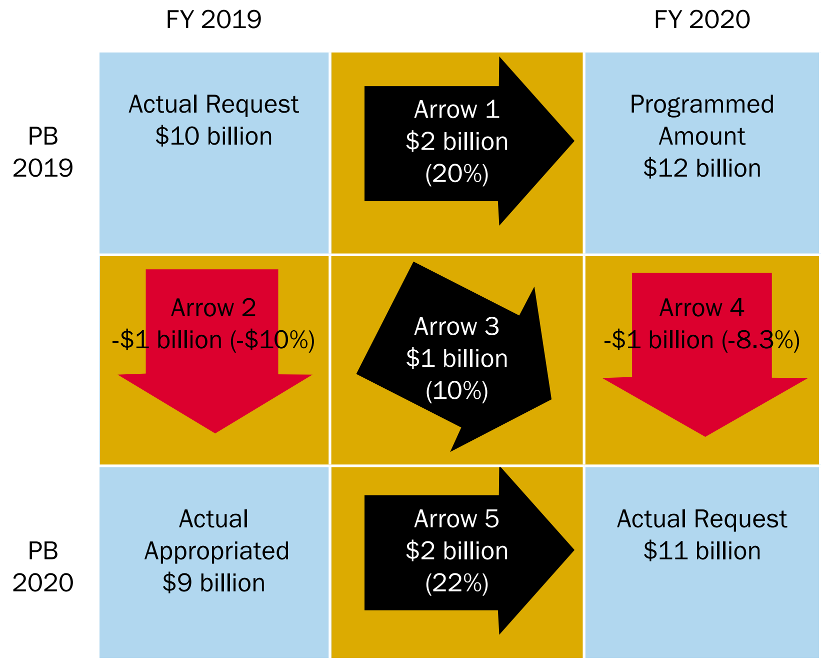
Cho *and* **Jenkins** *are budget analysts who developed the Five-Arrows technique of analyzing and reporting budget changes as well as software tools to aid the analysis for the Principal Assistant to the Secretary of the Air Force for Space. The views expressed are those of the authors and do not necessarily reflect the official policy or position of the Department of the Air Force or the U.S. Government. This presentation consists of SAIC general capabilities information that does not include controlled technical data as defined by the International Traffic in Arms (ITAR) Part 120.10 or Export Administration Regulations (EAR) Part 734.7-11.*

The answer was, both sets of figures were correct—depending on the point of view. We painstakingly put together some charts to show how both sets of figures were correct, even though they appeared to point to different trends.

We took some deep breaths, then went back into the director's office to show him the analysis. After some initial skepticism, he acknowledged the validity of our data and the explanation for the difference between his position and CAPE's. Feeling relieved—and vindicated—we made it a point to be ready for any future similar encounters by building what we call a "Five Arrows Budget Analysis" every time we compared one budget position to another. So, what is the Five Arrows Budget Analysis?

Consider this hypothetical example for space programs: The President's Budget (PB) for Fiscal Year (FY) 2019 requested $10 billion, and programmed (i.e., intended) $12 billion for FY 2020. The PB for FY 2020 showed that $9 billion was appropriated for FY 2019, and requested $11 billion for FY 2020. Setting the budget profiles in a grid for ease of comparison, we get the chart shown in figure 1.

Figure 1. Five-Arrows Chart



Key: PB=Presidential Budget; FY=Fiscal Year

Source of chart: The authors.

The budget comparisons we report on our Five-Arrows Chart are:

Arrow 1: How much we requested for last year versus how much we programmed for this year. This conveys that our intent was to expand or accelerate our space programs.

Arrow 2: How much we requested last year versus how much we actually received (i.e., appropriated). This indicates how well we justified our budget request to Congress, and how much Congress supports our space programs.

Arrow 3: How much we requested for last year versus how much we are requesting this year. This reflects our revised plans after taking into account congressional support and restrictions, as well as another year of program executions including fact-of-life perturbations.

Arrow 4: How much we programmed for this year versus how much we actually requested. This indicates how much our planned program was revised given the current level of congressional support and program changes.

Arrow 5: How much we actually received (i.e., how much was appropriated) last year versus how much we requested this year. This indicates how much support we hope to receive from Congress after factoring in their level of support in the previous year and how much additional support we need as we deal with program changes in the past year.

Notice that there can be large differences in budget changes depending upon which arrows we examine. In some cases, one arrow might be very positive (representing a budget increase), while another arrow might be very negative (representing a budget cut). In this example, the budget change could be described as being as much as a $2 billion (22 percent) increase, or a $1 billion (10 percent) decrease.

Our boss was reporting a $1 billion Arrow 3 increase in the budget, while the Director of CAPE was reporting a $1 billion Arrow 4 decrease. Both were right, but from different points of view.

So, which arrow is the "best" one to use? The answer is, as you might expect, "It depends." It depends upon your audience's frame of reference, and the message you are trying to convey to them. For example, if you are trying to show you are attempting to build on the programs that Congress approved and funded last year, then you probably would want to focus on Arrow 5. The budget changes

represented by Arrow 5 are influenced by the budget changes (either positive or negative) imposed by Congress. If Congress cut your budget and caused schedule delays, then your budget requests now will be driven by the new de facto schedule. The amount requested in the current PB would reflect that new budget requirement.

Or, if you are trying to explain the impacts to your programs as a result of programmatic changes since last year, then you probably would want to focus on Arrow 4 since those budget changes were probably driven at least in part by program execution issues and congressional marks. You would want to compare what you had programmed last year to what you are now requesting after taking into account all programmatic changes (including congressional marks) since last year.

The Principal Assistant to the Secretary of the Air Force for Space periodically publishes a "Space Budget Brainbook" that features our Five-Arrows analysis of the space budget. Included for each arrow are the programs that positively or negatively contributed to the changes. This makes it easy to see specifically which programs changed and by how much. In some cases, a decrease in budget is the result of a delay in schedule. But, there are instances where a budget decrease is good and expected. For example, a few years ago the procurement budget for the Evolved Expendable Launch Vehicle (EELV) showed a sharp decrease. But that was not a bad news story—it was a good news story. The Air Force finished procurement of the EELVs that it needed, so naturally there would be no need to continue funding EELV at historic levels. The drop in EELV's budget did not mean something was lost. In this case, it meant something positive happened.

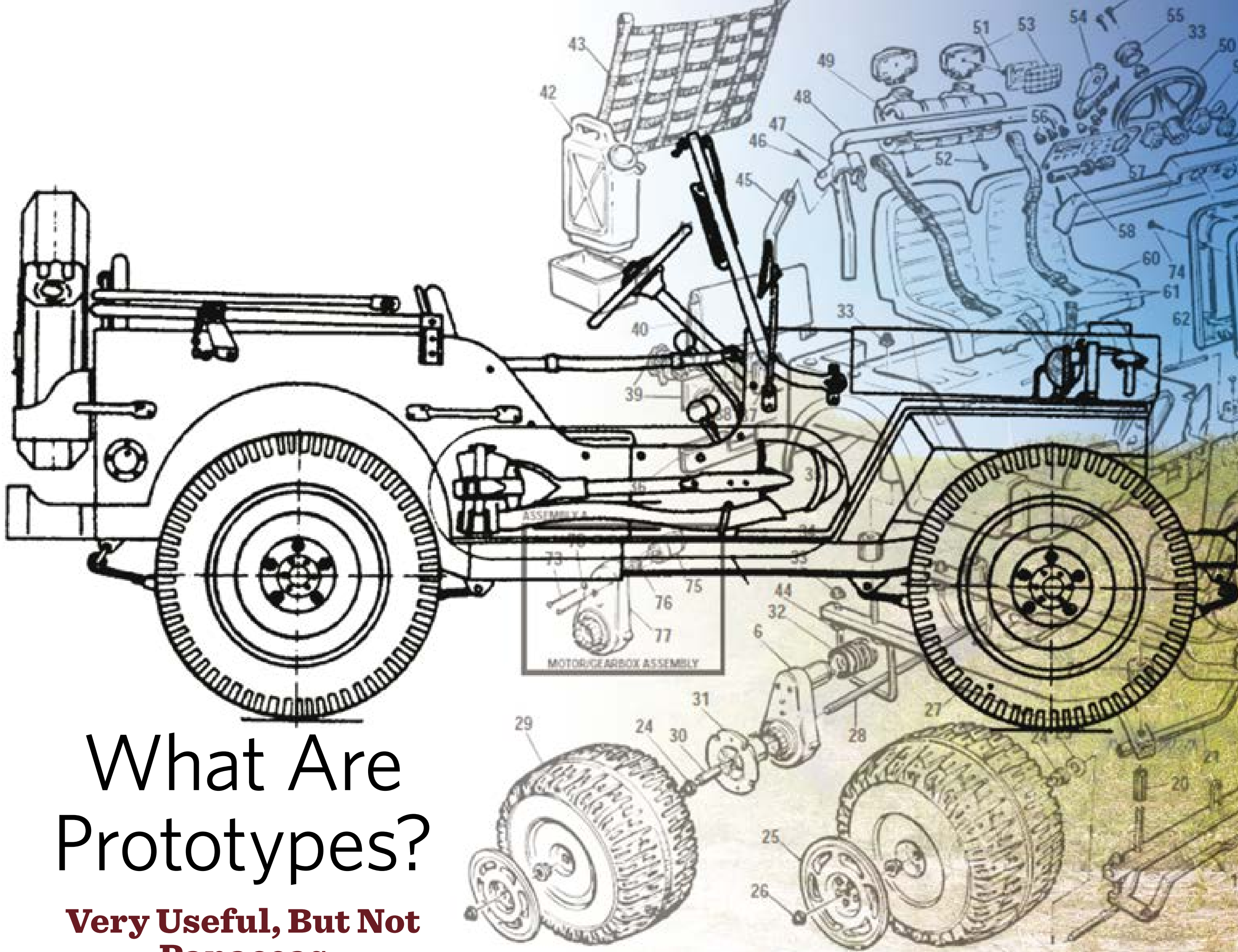
For completeness, in addition to the Five-Arrows analysis, we also include an Arrow 6 analysis that compares the budget for a range of years in one budget position to the same range of years in a different budget position. Typically, we use the common years in the Five Year Defense Program for both budget positions. In the scenario above, we would use FY 2020–FY 2023 as the range of years when comparing PB 2019 to PB 2020.

We produce the Space Budget Brainbook for every PB, Program Objective Memorandum and Budget Estimate Submission as they are published. Then, we are always prepared to recognize—and explain—different characterizations of what happened to the space budget.

Every year we are asked, "Did the space budget go up or down?" Our reply is always to ask, "Which comparison are you making?" This is not meant to confound anyone. We want to answer the correct question, which is not always obvious. After determining which Arrow analysis is being requested, we use CAPE's database and their Major Force Program for Space (MFP-12) list of programs to come up with the numbers. Any time another office comes up with different numbers our first questions are, "Are you using the MFP-12 list of programs?" and "What database did you use to get your numbers?" After ensuring that we are using a common set of budget data, any differences in the numbers are generally attributable to using different Arrow comparisons.

We have found the Five-Arrows analysis of budget positions to be useful throughout the year as we have discussions about our budgets both internally and externally. For example, we used this analysis when we met with congressional staffers and the Office of Management and Budget. This analysis enabled us to quickly focus on the exact budget comparisons of concern. We believe every office in DoD that needs to track, analyze, or report on its budgets would benefit from using a similar technique. If you would like more information about this topic, feel free to contact the authors at the e-mail addresses below.

The authors can be contacted at **george.cho.ctr@mail.mil** *and* **donald.l.jenkins28.ctr@mail.mil**.



What Are Prototypes?

Very Useful, But Not Panaceas

Brian Duddy

THERE IS CONSIDERABLE EXCITEMENT, INTEREST, ATTENTION, ANGST AND WHAT HAVE YOU IN Department of Defense (DoD) Acquisitions about new programs' use of prototypes, prototyping, and rapid prototyping. There also are some serious workforce misconceptions about what prototypes are and, most important, what they are not. Let me provide some context and expectation management about prototyping and prototypes as increasingly employed in early program stages.

The concept of prototyping defense systems is not new. The Army required delivery of prototype vehicles (called Pilot Models prior to World War II) for a competition that eventually resulted in the venerable "Jeep" vehicle. The prototypes delivered for that program in 1940—the "1/4 ton, 4x4 utility trucks"—bear only a general resemblance to the Willys MBs and Ford GPWs that were mass-produced as the standard Jeep design during the war. There were significant requirements changes (such as vehicle weight) and redesigning to move the Pilot Models to a producible wartime configuration. Fast forward to a more recent example, the Advanced Tactical Fighter (ATF) program also required delivery of two prototype aircraft from each competitor for a fly-off to decide the winner. Those two prototype aircraft, the YF-22 and YF-23, were evaluated by the Air Force and the YF-22 team was selected and proceeded to design and deliver the present-day F-22A.

Duddy, *a retired U.S. Air Force lieutenant colonel, now is a professor of Program Management at the Defense Acquisition University, where he teaches Program Management and Systems Engineering.*

So then what exactly is a prototype? Is the Bantam Reconnaissance Car the same as a Jeep, or the YF-22 the same as an F-22A? Not exactly. Prototyping is a part—but not the end state—of the design process. A prototype, or "first type" is the preliminary type, form, or instance of a system or system element that serves as a model for what comes later. Contractors, industry, and research organizations develop prototypes for many reasons. Prototypes are used to reduce technical risk, validate designs or cost estimates, evaluate manufacturing processes, refine requirements, or even explore new operational concepts. Risk reduction prototypes materially decrease Engineering and Manufacturing Development (EMD) risk at an acceptable cost. They can be a system such as the YF-22, or can focus on subsystems or components.

Prototypes may not, and in most cases, do not, have all the features or capabilities of the fully designed system. They may not need to have all the features of the final system. Predominantly they are used to demonstrate the ability to achieve certain critical performance parameters, validate computer models or explore improved manufacturing processes. Prototypes are viewed as only a "temporary" step or to serve a specific purpose in the full design process. After they are fabricated, the design process continues evolving until the completed system is verified. Competitive prototypes are produced by two or more companies or teams competing for a contract award. The enduring problem with competitive prototypes, as many industry officials and financial analysts see it, is that the companies are required to spend huge sums of money upfront without any guarantees that they will be able to recoup their investments. So when they explore prototyping, companies limit their work to fabricating a system with the key features necessary to win a contract to proceed to the next acquisition phase.

Considerable design work is required before a prototype can even be constructed. The systems engineering process already is fully under way: Requirements generation and analysis, architecture design, functional baseline determinations—all must be done before even a prototype design can be communicated to a group that will fabricate the prototype. This process involves in-depth modeling and simulation in particular or what we now refer to as Digital Engineering. Design changes, particularly to facilitate

The systems engineering process already is fully under way: Requirements generation and analysis, architecture design, functional baseline determinations—all must be done before even a prototype design can be communicated to a group that will fabricate the prototype.

manufacturing, are a normal outgrowth of the prototyping process. Prototypes basically are things you learn from, not things you go to war with.

In the case of the ATF, the Air Force wanted demonstration of some key features through the prototype delivery and subsequent flight evaluations. Those features were stealth, super-cruise (ability to fly above Mach 1 without using an afterburner), maneuverability, handling qualities, and the ability to serve as testbeds for two different prototype engines. Conversely, there were many features that the prototype ATFs were not demonstrating, such as avionics maturity. These first aircraft were constructed with only enough avionics to ensure safety of flight. They did not incorporate fully mature and integrated avionics, but they didn't need to do so at that point in the design process. The prototypes delivered to the Air Force were sufficient, as intended, for selecting a design team to proceed into EMD.

How does prototyping actually work in practice for smaller subsystems? During my private-sector university research days, I led a team working on a design for a small internal-combustion engine for an unmanned aerial vehicle (UAV) that would run on so-called "heavy fuel" or JP-8. The Army was looking for a heavy-fuel engine to replace the 38-horsepower (hp) gasoline powerplant on the Shadow UAV. Under a grant from the Army Research Lab, my research team set about to find such an engine—or see if one could be modified to meet the Army requirements.

When no suitable off-the-shelf replacement engine could be found, we partnered with a small company that had an idea for converting small internal combustion engines from operating on gasoline to heavy fuel but had not yet proven the concept. The initial phase of our research was focused on the key Army requirement of demonstrating heavy fuel operation on an engine in the same power class as the existing engine. We selected an existing 20-hp, two-cylinder aircraft engine that we felt was adequate to use as a prototype testbed to validate the company's conversion process from gasoline to JP-8. If that initial demonstration succeeded, we planned to scale up the conversion to a larger, four-cylinder prototype version. The conversion parts were designed, fabricated, and installed on the 20-hp version at the same time an engine test stand/test cell was developed and constructed. My team demonstrated JP-8 heavy fuel operation on the 20-hp engine using the conversion design. We then migrated the concept to the four-cylinder, 40-hp prototype and again validated the heavy fuel operation and sufficient engine power for this to be considered as a suitable candidate replacement for the existing Shadow engine.

Although the two prototyping efforts were successful in the two key areas that the Army focused on, there were many other important design features and requirements we were not then able to explore during this early risk-reduction prototyping phase of the program. For example, while operating our test engines, our team experienced the difficulty of trying to tune four independent carburetors on the cylinders and began conceptual design of a fuel injection system that would replace the carburetors.

There were other limitations to what we could do with our prototypes. During further engine testing we experienced a failure of the main engine bearings due to the different orientation of the engine on a UAV versus a manned aircraft. We had no opportunity to do any detailed platform integration or installed performance testing with the Shadow itself, which would be an important next step after demonstrating the stand-alone engine performance. Important design considerations such as engine aerodynamic cooling, low-temperature or high-altitude performance could not be tested in our test cell.

We did not do any characterization of the acoustic or infrared signature of the modified engine. During testing, we realized extra warmup and start time would be required by the use of heavy fuel intended for turbine or compression-ignition engines. Although we were able to achieve the required engine operation time to pass a Federal Aviation Administration qualification test specified by the Army, there was no opportunity to evaluate the long-term reliability and maintainability of the engine and propeller in field conditions. Also no consideration was given to production of the future engine or eventual unit cost.

None of these system features and attributes were settled through the early prototyping, nor was that intended. Instead these requirements could be characterized or optimized only by system-level platform integration and a complete design and verification process. Our engine prototypes did their job as intended—they demonstrated key system capabilities—but they were only an intermediate step to a final design. The prototypes as we operated them would never be accepted as the configuration of the completed engine design. They were truly the first of their type, and much more work lay ahead.

So what are the full-up system articles used for development test and verification at the end of EMD? They are not, in the true sense, "prototypes." They are, in fact, full-up test articles that have all the features of the system design, but may not necessarily be made using mature production processes. These systems go by several names: qualification test articles, first articles, engineering development models, or EMD test articles. They are much more than prototypes and calling them that is a bit of a misnomer. As shown with previous examples, prototypes were used to demonstrate some, but not all, system requirements. In contrast, these EMD test articles must, by definition, meet all the requirements of the specification(s) in order to verify the final system design. In a perfect world, they would be made on the same line as the production articles, but they need not be. The key condition is that they need to work like production articles to be verified against the specification. The next step after verification is the fabrication of Low Rate Initial Production articles to be used for operational test. Those must, also by definition, be production representative.

Prototyping and competitive prototyping are very useful tools in design and acquisition, particularly for early decision making, but there are many other tools in the system-development process.

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Enabling **Software Innovation** Across the DoD

Jeremiah Robertson ■ Trey Bonner

THE GROWING CRITICALITY OF SOFTWARE across the Department of Defense (DoD) coupled with the progressive decline in software development performance and capability across prime defense contractors presents a critical need for a new strategy for software development and acquisition. Current development is plagued by schedule delays, cost overruns, and requirements creep due to long acquisition cycles and shifting priorities. Agencies across the DoD have highlighted this deficiency while the threat from near-peer adversaries continues to evolve rapidly, and major systems increasingly depend on software to maintain a technological advantage.

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Bonner *has 6 years of experience in developing and implementing successful operational strategies in highly complex environments from Development Operations transformations to factory flow optimization.*

The March 2019 Defense Innovation Board report, "Software Is Never Done: Refactoring the Acquisition Code for Competitive Advantage," stated:

> The need to meet future threats requires us to rethink how we develop, procure, assure, deploy, and continuously improve software. DoD's current procurement processes treat software programs like hardware programs, but DoD can no longer take years to develop software for its major systems. Software cannot be an afterthought to hardware, and it cannot be acquired, developed, and managed like hardware. DoD's acquisition and development approaches are increasingly antiquated and do not meet the timely demands of its missions.

A new strategy is needed to meet DoD objectives while practically merging principles from commercial software development and government acquisition realities. Development, Security and Operations (DevSecOps) and Agile have emerged as the preeminent strategies for developing higher-quality software in shorter timespans while lowering costs.

Numerous companies implemented an Agile or DevSecOps-like framework with results showing improved performance in development at a minimal additional cost. These success stories are great examples of identifying waste within a value stream and eliminating it to focus on the products and processes that provide the maximum business value to clients. However, Agile and DevSecOps worked for these companies for one extremely important reason: They identified the problems first and developed a specific process for overcoming them. After figuring out that they were developing too many software releases, they focused on a regular cadence. They realized that developers on different teams weren't communicating about dependencies and risks and then decided to incentivize communications among teams. Rather than implement new processes to continue addressing the symptoms, they identified the root causes to solve the problems "once and for all." These companies weren't successful because they implemented Agile or DevSecOps in name only; they were successful because they identified their problems and solved them by adhering to principles that provided practical solutions for overcoming their problems.

What's the Problem?

Nelson Repenning in 2016 shared a relevant story in "What Problem Are You Trying to Solve: An Introduction to Structured Problem Solving," published by the MIT Sloan School of Management. In the early 1990s, the manager of one of Harley-Davidson's engine manufacturing and assembly plants, Don Kieffer, hired Hajime Oba (the architect behind the famous Toyota production system) as a consultant. Kieffer wanted to implement the Toyota production system in his plant and believed Oba would be the perfect person to help do it. However, to his surprise, Oba told him to fix a problem in one specific area. Kieffer was upset, and Oba asked him, "What problem are you trying to solve?" Don replied, "The problem I'm trying to solve is that I want to implement the Toyota production system, and I don't know how." Oba replied, "If you want to implement the Toyota production system, tell me what problem you are trying to solve." The day did not end well, but the lesson from Oba is very clear: Kieffer assumed a solution (the Toyota production system) without first understanding what problem he was trying to solve.

Unfortunately, DoD may be in the same predicament. There is a widespread assumption that Agile and DevSecOps will produce high-quality software cheaper and faster than any other method. However, unless the root problems are directly addressed, DoD is implementing a solution and strategy that not only may fail to address the problems, but could make current software production worse as they address the symptoms rather than the cause. DevSecOps and Agile development processes were developed in order to adapt and capitalize on particular customer behaviors across the commercial markets in which they operate and capitalize on. In order to reach the DoD's objectives, a methodology must be specially tailored with specific processes for how software will be developed within the DoD acquisition and usage framework.

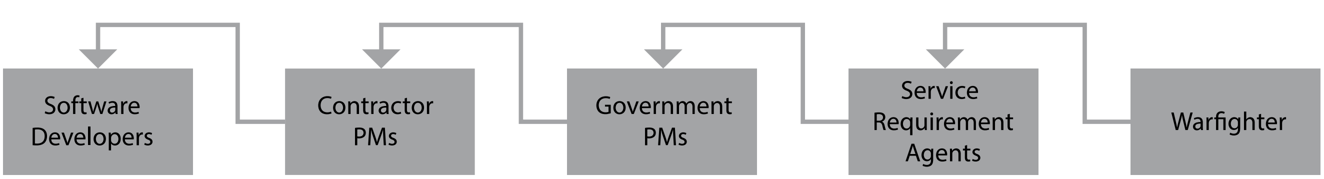
Problems Across DoD Software Development

Software development and acquisition face numerous challenges inherent in the DoD acquisition and operational framework. Integrating strategic planning and analysis of warfighter needs with executional realities will help solve the problems and not just address the symptoms.

Requirements churn is one fundamental problem that will require innovative approaches for more rapid delivery of capabilities to the warfighter. Hard-and-fast requirements have resulted in development focusing on completing requirements like a checklist instead of innovating the best approaches for providing value to the customer. Instead of having a strict set of capabilities that must be developed, the question needs to be continuously asked: What does the end user need the software to accomplish? Constantly asking this question enables innovation as it opens the aperture for the realm of the possible. This also produces an environment for funding the unknowable requirements of the future. The shift from detailed and firm requirements to requiring activities (i.e., describing the contextualized needs of the warfighter) will enable software development teams to produce highly effective software that more accurately meets true needs by eliminating the requirements flow as shown in Figure 1.

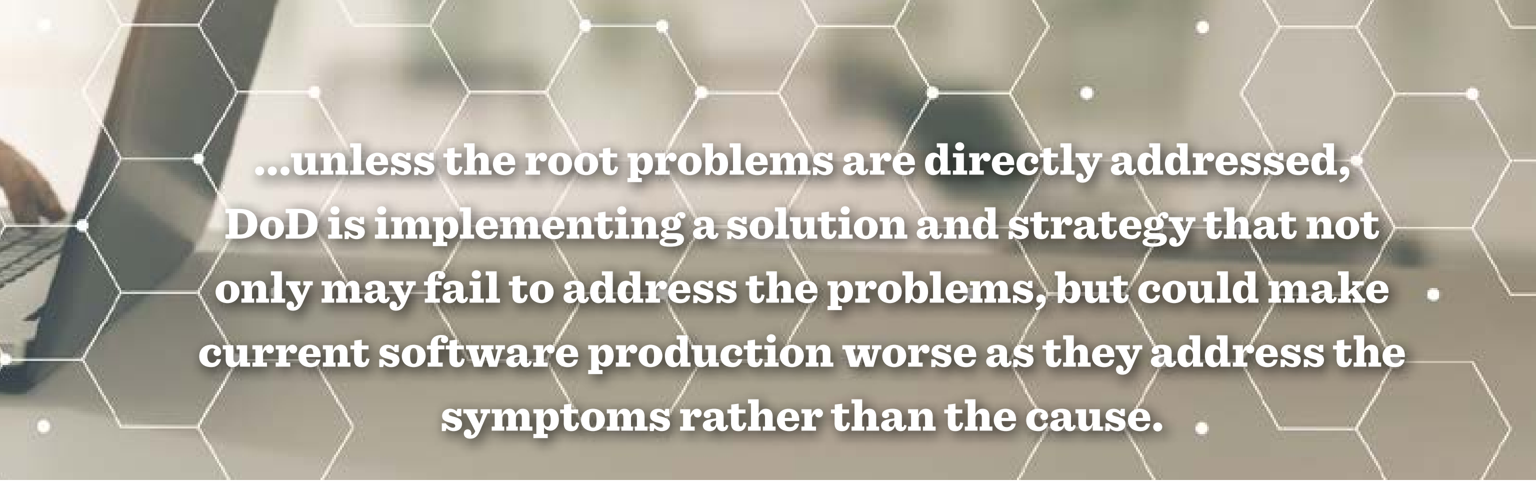
Each step within this process diminishes the potential for software developers to meet the warfighter's real needs. To prevent this degradation, DoD must streamline the flow of required activities to software developers. A greater number of process steps between the product developer and the user leads to a greater dilution of true requirements and limitations on innovations, requiring additional rework with a longer correction cycle time. Customer awareness of the cycle time and potential impacts of changing software needs can minimize the risks of too much iteration. Excessive iteration risks continuous churn of required activities and ongoing shifts in priorities as people keep changing their minds. This can result in shorter development cycle times and prove slower, costlier or more disruptive. Therefore, the customer must

Figure 1. Shift From Detailed and Firm Requirements to Requiring Activities



Key: PMs=Program Managers

Source of figures: The authors.



be aware of the cycle time and the impacts of changing software needs.

The pace of innovation of software development in the commercial sector now is faster than the requirements development and decomposition cycle. The long-range planning of requirements is not conducive to quick deployment of cutting-edge technology that is developed at a much faster pace. This means that adversaries with more centralized decision-making processes than those of the DoD could more effectively leverage this pace to drastically reduce the time to field capabilities and thereby erode the DoD's technological advantage. This requires new strategies and approaches for developing or acquiring software. The DoD must manage the development of new software to meet its objectives. This would require that the DoD become a highly skilled practitioner of various software development approaches and invest in the proper tools, processes, and people to cultivate innovation and bring the developer closer to the end user.

Develop or Acquire: Different Strategies

The DoD must establish a vision for future software investment and become a practitioner of DevSecOps. Investments will be needed in the proper tools, processes, training, and technology enablers to build the ability to innovate as fast as the commercial sector. For most current programs, this simply is not an option because of the program's magnitude, the relationship with current contractors, and the high stakes. In the future, the decision to create rather than buy must be made when developing program strategies and that decision will fundamentally dictate the operational framework for meeting DoD objectives.

In some software use cases, the DoD must be the developer as DoD builds and maintains the operating environment where platforms must integrate. This will be required to execute future strategies such as the Next Generation Air Dominance (NGAD) strategy and to ensure that hardware can innovate at the same rate as software across multiple contractors and vehicles. The NGAD strategy is paramount to reducing the cost and bureaucratic inefficiencies that have plagued the defense industry and every major program over the last 40 years, but will heavily rely on the U.S. Air Force (USAF) strategy for acquiring software. If multiple contractors are not able to work within the same development environment where USAF manages the software baseline and technical integration, NGAD will result in numerous platforms with limited interoperability and will ultimately fall short of its objectives.

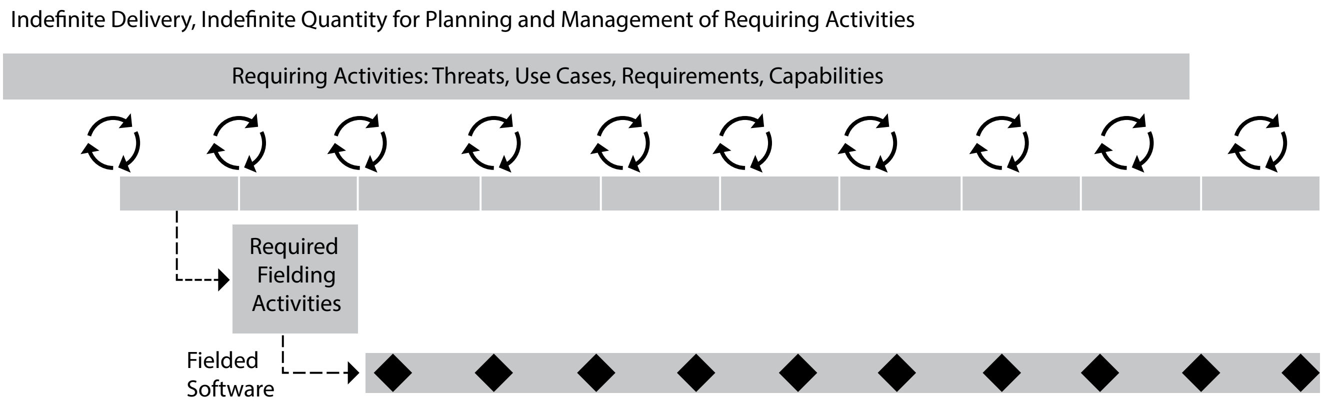
To effectively acquire software, on the other hand, a strategic approach requires the effective management of a contractor, or many contractors, to meet DoD objectives. The framework that enables this approach relies on the right acquisition strategy rather than the contractor's existing software development methodology. Acquiring software generally requires an acquisition authority that comes between the user and developer of the solutions with additional contracting requirements. This separation is inherently not Agile and requires an innovative strategy to meet DoD objectives rather than a silver bullet solution.

Future Objectives, Strategies and Enablers

A strategic approach to implementing a specific development strategy (whether Waterfall, Agile or DevSecOps) through traditional contract relationships with industry while accelerating capability to the warfighter creates numerous issues throughout the software development and testing cycle. Critical enablers must be established before determining the best contracting strategy. First, a program must have an open, free flow of capital and resources. This would alleviate contracting and bureaucratic delays while maintaining accountability for the affordable, timely and predictable delivery of requirements and capabilities. Second, there are technological requirements that must be considered. To produce regular releases, specific hardware and software are needed for automated builds and to perform automated testing. Without the right tools, releases are difficult to produce, test and distribute to the field.

The bespoke or specially tailored acquisition strategy for effectively managing contractor behaviors relies on a mix of contracting activities that meet the needs of both the

Figure 2. Acquisition Framework That Meets Enablers and Can Deliver on DoD Objectives



Software Factory Contract:

- Multi-year, Firm Fixed Price Contract with fixed cost per fielded release.
- Include incentives for release accuracy, new functionality, and efficiencies.
- Use a Production Non-Recurring allocation for capital requirements to ensure efficient use of funding.

DoD and the contractor's corporate interests. To achieve DoD objectives, the acquisition strategy must account for all these enablers:

- Provide open, free flow of capital and resources to alleviate contracting and bureaucratic delays.
- Maintain accountability for the affordable delivery of requirements/required activities.
- Provide predictability for capability delivery.

A "Software Factory" approach allows the DoD to align objectives and manage contractor behaviors by assessing the various stages of the software development cycle and incentivizing the contractor when bottlenecks or inefficient behaviors become evident. Figure 2 depicts the acquisition framework that meets these enablers and can deliver on the DoD's objectives.

By assessing the software "factory" the DoD can gain insight and measure specific stages within the development cycle. In the same fashion that a traditional factory would be assessed, program managers are able to determine the capacity currently available to produce new software, where any bottlenecks occur, and potential investment in new tools or processes to increase the capacity. This is accomplished by carefully measuring the right performance areas across the development cycle and integrating them into a complete system. By leveraging data analytics and visualization, program managers are able to quickly see why release content is behind schedule or where teams are performing poorly. This allows program managers to devise incentive strategies to encourage innovation and decrease the time necessary to field new solutions.

Funding contractors by release provides a stable, predictable measure for cost over the course of the program, which allows for the use of longer-term contracts. Each release is firm fixed price (FFP); however, the content is based on specific performance criteria with incentives for delivering capability to the warfighter. Measures such as release accuracy versus plan, backlog cycle time of new features, or use-case fulfillment can be used to incentivize the contractor while ensuring that the DoD is getting the software needed. This activity maintains accountability for the affordable delivery of required activities while providing the long-range, free flow of the capital that contractors need to invest in performance improvements.

Other factors also must be examined, such as data rights and ownership of source code. The lack of ownership in source code is the greatest factor currently limiting DoD's ability to implement commercial best practices and leverage competition against incumbents on large programs. There is some additional concern about the organic depot and contractor dynamic. The DoD must maintain a future ability to support software dependent platforms when contractors do not provide the necessary support or modernization as they move on to new programs. DoD must develop a strategy that incentivizes innovation by the contractor as well as collaboration with software depot teams to organically develop capabilities across the Services.

Enabling the Future of Software Innovation

DevSecOps provides an exciting opportunity for the DoD to leverage principles that have been proven sound in the

... unless the root problems are directly addressed, DoD is implementing a solution and strategy that not only may fail to address the problems, but could make current software production worse as they address the symptoms rather than the cause.

commercial industry as ways to foster innovation. However, the success of future DoD software development programs more heavily depends on accurately setting objectives, confidently choosing between a make-or-buy path, and then developing a strategy for meeting those objectives. While DevSecOps provides excellent principles for improving DoD software development, implementing it without considering the DoD's execution realities can introduce more program risk than reward. Software development across the DoD will be enabled by the open, free flow of capital and resources to alleviate contracting and bureaucratic delays, the ability to maintain accountability for the affordable delivery of requirements/required activities, and predictability for capability delivery. By fulfilling the enablers for fostering software innovation and developing models for providing predictability into the software "factory," program managers can more rapidly meet program objectives, reduce time to field new capabilities, and improve the capability delivered to the warfighter.

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Defense Acquisition Magazine—
A MarCom Platinum Winner!

The *Defense Acquisition* magazine has once again won a Platinum Award—this time the top recognition of the 2019 MarCom Award from the Association of Marketing and Communications Professionals (AMCP). This latest in a series of awards won by the magazine was for the May-June 2019 issue and was the 12th award received in less than 5 years. The magazine won a Platinum Hermes Award for a 2018 issue, as well as a Gold MarCom Award. For 2019, *Defense Acquisition*'s sister publication, the *Defense Acquisition Research Journal* (*ARJ*), also received a Platinum Award.

The award is a tribute to the work not only of the Defense Acquisition University (DAU) Visual Arts and Press staff but also to the many subject-matter professionals, including members of the DAU faculty, the military Services, and industry partners who write for the magazine.

In a letter announcing the award, AMCP described itself and the awards as follows:

"MarCom Awards is an international creative competition that recognizes outstanding achievement by marketing and communication professionals. Entries come from corporate marketing and communication departments, advertising agencies, public relations firms, design shops, production companies, and freelancers.

"MarCom Awards is administered and judged by the [AMCP]. The international organization consists of several thousand creative professionals. The association oversees awards and recognition programs, provides judges, and sets standards for excellence.

"As part of its mission, AMCP fosters and supports the efforts of creative professionals who contribute their unique talents to public service and charitable organizations. Over the past few years, AMCP's Advisory Board has allocated more than $250,000 in grants and contributions to support philanthropic efforts. That money was used for marketing materials for homeless shelters, orphanages, day camps, community theaters, and art centers; and for programs for the elderly and disabled; child care; and educational endeavors for the underprivileged.

"Judges are industry professionals who look for companies and individuals whose talents exceed a high standard of excellence and whose work serves as a benchmark for the industry. There were more than 6,500 entries from 20 countries in the MarCom Awards 2019 competition. MarCom's Platinum Award is presented to those entries judged to be among the most outstanding entries in the competition. Platinum Winners are recognized for their excellence in terms of quality, creativity, and resourcefulness." The organization has judged more than 200,000 entries in the quarter-century since its 1994 formation.

Defense Acquisition staff specifically mentioned in the award include managing editor Benjamin Tyree and art director Tia Gray, who devote most of their working hours to the magazine. Named as well are the production, editorial and graphics teams of DAU's Visual Arts and Press department, which operates under the leadership of Norene L. Johnson. Staff contributors include Debbie Gonzalez and Michael Shoemaker (copy editing and proofreading); Frances Battle (production and press coordination); Nina Austin (online design and placement); Collie Johnson (online only content aggregator and editor); Noelia Gamboa (administrative and editorial support); with other final review contributions by other colleagues on the *ARJ* staff.

—The editor

THE NEW DEFENSE ACQUISITION WORKFORCE AWARDS

Recognizing the Importance of Software

Jeff Boleng ■ Maggie Sizer

U.S. national security increasingly relies on software to execute missions, integrate and collaborate with allies, and manage the defense enterprise. The ability to develop, procure, assure, deploy, and continuously improve software is thus central to national defense. At the same time, the threats that the United States faces are changing at an ever-increasing pace, and the Department of Defense's ability to adapt and respond, is now determined by its ability to develop and deploy software to the field rapidly.

—Defense Innovation Board, "Software Is Never Done: Refactoring the Acquisition Code for Competitive Advantage," (Washington, DC: Department of Defense, 2019).

SOFTWARE IS A CRITICAL AND ENDURING capability, but is the Department of Defense (DoD) acting quickly enough to embrace this reality? Software is a major component of business systems and weapons systems; in fact, software is an inescapable part of the daily lives of the entire defense workforce. Consequently, the development and deployment of modern software rapidly and securely to the field and across the DoD-wide enterprise is a key enabler for the United States to maintain the defense technological advantage over its adversaries. As announced in the January-February issue of *Defense Acquisition* (Page 44), Ellen Lord, Under Secretary of Defense for Acquisition and Sustainment, recently added "soft-

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The new awards also provide recognition to the DoD's lethality-essential software workforce and their innovative accomplishments in improving software development and software acquisition vital to military systems supporting the Warfighter.

ware" as a new category in the 2019 Defense Acquisition Workforce Awards. The category was added to recognize individuals and teams who are adopting modern software development approaches to meet the growing and ever-changing digital challenges.

The inclusion of software in the Defense Acquisition Workforce Awards does more than acknowledge individuals who are developing and delivering software capability to the Warfighter; the new awards also aim to encourage and energize the workforce to retain its internal software capability, including Service members. The new awards also provide recognition to the DoD's lethality-essential software workforce and their innovative accomplishments in improving software development and software acquisition vital to military systems supporting the Warfighter. Ultimately, only an informed and cohesive software workforce can work together to effectively change the culture around software.

As reported in the previous issue of *Defense Acquisition*, Kessel Run, an Air Force software factory, was awarded the Software Innovation Team Award. Kessel Run implements a DevSecOps culture (see https://software.af.mil/training/devops/). The team fielded 18 capabilities, including a tanker planning tool, by adopting an Agile software development approach, user-centered design, and lean startup methodologies. But let's share the love and take a closer look at the other worthy contenders for this award.

The Army nominated the Heads Up Display User Experience Team for their efforts in executing the Integrated Visual Augmentation System program, a 5-year program to integrate state-of-the-art night vision sensors with edge computing processors and myriad wireless network functionality. The team, in collaboration with non-traditional contractor Microsoft, used innovative collaboration tools and adopted an iterative software development approach to rapidly execute the first Soldier test within 4 months from contract award. The team's understanding of the Soldier threat environment and knowledge of emerging situational awareness technologies were also instrumental in properly articulating system requirements to Microsoft.

The Navy nominated the Naval Air Warfare Center Aircraft Division (NAWCAD) Software Engineering Department for supporting all NAVAIR (Naval Air Systems Command) programs, including the CH-53K helicopter. The team supports these programs using a very lean workforce of 135 civilian software engineers, staffing their programs quickly, at an affordable cost, and coordinating among team members and managers efficiently to ensure all software needs are met without disruption. NAWCAD was nominated for this horizontal sharing of its in-house expertise and processes across NAVAIR, which has greatly contributed to producing overall quality products to the fleet.

The Navy also nominated the U.S Marine Corps' Combined Arms Command and Control Trainer Upgrade System (CACCTUS) Acquisition Team. CACCTUS is a simulation training system; the scenario driven, simulated environment allows Marines to practice the teamwork required to command, control, and coordinate the use of supporting arms. The CACCTUS Acquisition Team was nominated for adopting agile development processes over a 5-year period to acquire the technology needed to change the traditional hardware architecture (desktops) to a thin client design.

The Missile Defense Agency (MDA) nominated the Aegis Ballistic Missile Defense Baseline 6.0 Team for leading a joint team consisting of members from two program offices to oversee the development of an intricate and complicated computer program to deliver a layered defense against advanced missile threats. This team successfully integrated a solid state radar and a shipboard computer program from competing industry partners to deliver a program that will be fielded on the Navy's Flight III AEGIS Destroyers.

The U.S. Special Operations Command (USSOCOM) nominated the Modi Software Convergence and Refactoring Team for merging multiple software code bases

By sharing their achievements and best practices, we will leverage proven successes for greater research, engineering, acquisition, and sustainment in support of the National Defense Strategy and the Warfighter.

used by USSOCOM, the Army, Marine Corps, and other government agencies. This monumental task was completed after the team successfully awarded a 24-month, $8 million contract to the prime vendor to refactor and re-architecture the entire Modi code base.

The Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)) nominated the BEES Joint Capability Technology Demonstration (JCTD) Integrated Management Team (IMT) for defining an autonomous architecture comprised of 22 specific system interfaces that flow from mission planning to mission execution. The most significant software innovation, which was flight demonstrated, is the Systems Intelligence Manager (SIGMA) collection management software. It was demonstrated while running with the Tasking, Positioning, and Orientation (TOP) autonomous system piloting software on flight compatible hardware. SIGMA was developed by Naval Research Laboratory; TOP is Georgia Technical Research Institute software that is foundational to several other DoD autonomy programs.

The High-altitude Attritable Link Offset (HALO) JCTD IMT was nominated by OUSD(R&E) for developing high-altitude communication relays on very low-cost balloon-platforms using small, attritable, ultrahigh frequency communication payloads (essentially low-cost, disposable balloons carrying low-cost transponders), with no sensitive data onboard, to mitigate adversary communications jamming in a contested environment. This solution is of tremendous benefit to the Warfighter, which merited the HALO JCTD IMT a nomination.

Software engineers on the Semi-Automated Counter Propaganda (SCP) JCTD IMTs were nominated by OUSD(R&E) for developing new software capabilities to enable SCP to operate undetected and allow the joint Warfighter to employ multiple social media entities in the information environment to disrupt and counter narratives posed by threat organizations. The capabilities delivered to USSOCOM for military information support operations directly supports the requirement to become more adept at parrying narratives aimed at undermining U.S. military power and disrupting U.S., allied, and partner, operations.

George Senger, a lead engineer supporting Project Manager Tactical Radios under the Army's Program Executive Office for Command, Control Communications-Tactical, was awarded the Individual Software Achievement Award for his efforts in leading a team that developed an application that revolutionizes the Soldiers Unit Task Reorganization process. But who were the other estimable nominees?

David Gay, the Test and Evaluation (T&E) Lead for the Navy's Strike Planning and Execution Program Office (PMA-281), was also nominated for the Individual Software Achievement Award. He has consistently conceived and implemented innovative software T&E strategies in support of accelerated acquisition efforts, reducing cost and schedule while exceeding expectations. His leadership and advocacy of automated software testing at the Naval Aviation Enterprise level has saved more than $2 million that he continues to apply to other programs.

The Navy also nominated Timothy Bergland for leading a cross-competency team that spanned two program management offices within Marine Corps Systems Command, as well as NAWCAD and Training and Education Command. Under his leadership, the team moved the Marine Corps Distance Learning Program from a larger server platform maintained at NAWCAD to the Amazon Web Service Cloud, reducing costs and risk of catastrophic failure due to site loss from natural or manmade causes.

Air Force Materiel Command nominated Col Enrique Oti for his leadership of Kessel Run. He was nominated for revolutioninzing how the Air Force develops and delivers software solutions. He transformed a traditional program office into a highly effective team of technologist and acquisition professionals that demonstrated the ability to continuously deliver valuable software to the Warfighter across multiple weapons systems.

We congratulate and recognize all the individuals and teams for being nominated for the 2019 Defense Acquisition Workforce Awards. By sharing their achievements and best practices, we will leverage proven successes for greater research, engineering, acquisition, and sustainment in support of the National Defense Strategy and the Warfighter.

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EVOLVING **Naval Mine Warfare** for the 2020s and Beyond

James Landreth, P.E.

IN HIS 2017 BOOK *SEAPOWER*, RETIRED U.S. NAVY (USN) ADM JAMES STAVRIDIS WOVE THE CORDS OF HIStory, current events, and potential future of the world's ageless oceans and strategic maritime features. In an odyssey circumnavigating the globe, Stavridis highlighted how conventional and emerging technologies may redefine the global balance of power.

In the 21st century, as depicted by Stavridis, proliferation of autonomous unmanned undersea vehicles (UUVs) will prompt aspiring naval powers to renew interests in naval mine warfare, mine countermeasures, and explosive ordinance disposal (EOD), as well as mining technologies, systems, and platforms. The naval powers that provide affordable and integrated solutions to existing fleets will establish meaningful gains in national strategic competition as well as freedom of maneuver at the operational level and overmatch at the tactical level of war.

A Rapidly Evolving Strategic Landscape

Unprecedentedly large concentrations of people in coastal urban centers are increasing the strategic significance of freedom of navigation. More than 90 percent of the world's traded goods transit the oceans between these dynamic port cities; therefore all nations have an increasing strategic interest in keeping the global commons secure. Since the demographic concentrations on small coastal areas create an ever-increasing strategic need to maintain critical maritime arteries open and safe, coastal countries must prepare for mine and UUV threats in the 2020s. As Robert Kaplan detailed

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in his books *Monsoon* and *Asia's Cauldron*, safe and continuous operation of critical maritime arteries will be essential for maintaining peace in the 2020s and beyond.

Beyond maritime shipping concerns in port cities, modern infrastructure that enabled large-scale commercialization of the undersea is vulnerable to mining and UUV threats. Colossal engineering projects such as Huawei's transoceanic undersea fiber optic cables and transportation links like the Channel Tunnel between Britain and France make the undersea domain an increasingly critical layer in the global infrastructure mesh. Furthermore, many over-sea projects such as the King Fahd Causeway (linking Saudi Arabia and Bahrain) and the proposed Bridge of the Horns (spanning the Bab-el-Mandeb strait between Yemen in Arabia and Djibouti and Eritrea on the Horn of Africa) require foundations in the seabed. All of these examples expose the vulnerability of the undersea domain, and the 2019 accident on the Russian submarine Losharik highlighted the will of nations to develop technologies to exploit these vulnerabilities.

Apart from infrastructure, the variety and complexity of undersea oil, gas, and mineral extraction continue to increase, and the specter of the 2010 Deepwater Horizon disaster of BP oil corporation provides a glimpse of the susceptibility of energy networks to mining and UUV threats. Deep sea hydrocarbon exploration will remain a particularly sensitive national security matter for net energy importers such as China. According to Tufts University researcher Daniel Brutlag, in 2011 more than 70 percent of Chinese crude oil imports sailed through the Strait of Malacca between Malaysia and Indonesia. Such a dependence on energy imports for the world's second-largest economy obviously will shape China's geopolitical engagement strategy. China's strategy is most visible in its flagship Belt and Road Initiative (BRI). Due to the importance of the BRI, China will exercise all elements of national power to ensure its continued access to energy resources as well as export markets.

Despite nations' and global markets' increasing susceptibility to mines and UUVs , legal frameworks governing the undersea are increasingly outdated—particularly in international waters or transition zones between different exclusive economic zones (EEZs). China's excessive territorial claims in the South China Sea provide an excellent example of an open challenge to existing undersea legal frameworks. Beyond legal negotiations, China's pressure on the undersea legal framework has triggered events like the Hai Yang Shi You 981 standoff (also known as the "2014 China-Vietnam Oil Rig Crisis"), which resulted from the deployment of a Chinese state-owned mobile deep-sea oil platform. The Hai Yang Shi You 981 deployed to a contested EEZ in Vietnam and performed months of exploration. Despite Vietnam's furious protests, the Chinese completed their mission and departed the contested EEZ before the international community could be fully mobilized to mount a credible legal intervention. In the future, plaintiff countries like Vietnam may choose to take action rather than wait for a slow and impotent response from the international legal system. Vietnam could credibly and cheaply deny such exploitation with low-cost mining and UUV technologies.

An increasingly globalized world amplifies the strategic nature of existing and future maritime choke points due to the increasing susceptibility to and desirability as targets for offensive mining technologies. Current oceanic traffic schemes burden critical arteries such as the Straits of Malacca and Hormuz with incredibly dense container and energy related traffic. As illustrated by the 2019 oil tanker attacks in the Persian Gulf, oceanic choke points possess the potential for great political standoffs with outcomes that may shape global norms for generations to come. And receding Arctic ice will create new narrow passages during certain months of the year for commercial traffic. While an increase in the number of available deep-water routes will provide some flexibility to the global transportation network, the security of these choke points from mining and UUV operations will remain a strategic concern.

Gaps and Solutions for the Operational Level of War

In an era when the United States enjoys a marginal lead in conventional military capabilities, asymmetric defense technologies continue proliferating globally on a dramatic scale. As a prime example, undersea capabilities such as submarines, defense-oriented undersea communication networks and UUVs have received massive investment. This revolutionary increase in undersea capabilities shapes the effectiveness of mine warfare at the strategic level of war, and thus requires a closer examination of the current operational level capabilities of the USN and its sister Sea Services.

The aging Avenger-class minesweeper warships (MCM) lack a dedicated replacement platform. This is largely due to focusing limited acquisition dollars on expensive multi-mission surface combatants, such as the $1.8 billion Arleigh Burke-class guided missile destroyers with ballistic missile defense capabilities and limited success with the Littoral Combat Ship's mission modules. Furthermore, 18 years of protracted land-based conflicts in the Near East and South Asia (NESA) focused the majority of USN EOD training and deployments on counter-improvised explosive device (IED) missions. While USN EOD technicians achieved great proficiency in NESA combat zones, the focus on IEDs in Iraq and Afghanistan may have created an opportunity for atrophy in more traditional underwater EOD competencies.

Though the USN faces a shortage of mine capable warships, several affordable paths exist to grow the USN's mine warfare capability at the operational level. USN submarines—while standing well clear of mined waters—can serve as covert launch platforms for UUVs equipped with mine or mine-clearance payloads. For example, the large ocean interface (LOI) of guided-missile submarines (SSGNs) allows for a variety of UUV payloads. For submarine classes that lack LOIs equivalent to the SSGN, torpedo tubes are capable of launching remotely piloted or autonomous UUVs. To enable submarines to help close the gaps at the operational level, existing programs such as the Long-term Mine Reconnaissance System (LMRS) must be brought to full maturity. Further, the USN should ensure that technical updates occur regularly to ensure the LMRS fleet is ready to meet the maximum number of scenarios.

Integrating other emerging technologies with undersea launched platforms could further bridge existing gaps in current operational frameworks while simultaneously enabling affordability. The USN could use existing programs like the Mission Reconfigurable UUV (MRUUV) as a platform to fuse the two acquisition priorities of UUVs and additive manufacturing. The USN could establish a metric for success such as "percentage of UUV that can be produced by a multi-medium 3-D printer on a deployed asset." In this way, a submarine could deploy with the fundamental building blocks for potentially thousands of MRUUV variants—including autonomous mines or mine clearance applications.

For decades, the USN marine mammal program (NMMP) has trained and deployed dolphins and sea lions for port security, mine detection, and mine-clearance operations. While marine mammals require a logistical footprint in theater, latent potential exists in the NMMP. By mirroring the success of man-animal-machine teaming in the special operations force's military working dog program, the NMMP could equip marine mammals with sensors and mine clearance tools that dramatically increase effectiveness. The NMMP could showcase these capabilities during combined exercises such as Artemis Trident 2019 that aimed to provide safe passage of humanitarian relief supplies through mined water. Using marine mammals brings many benefits such as distancing humans or expensive naval platforms from the mine field. Additionally, the NMMP provides an excellent platform for building partner capacity and host nation engagement since it does not require the acquisition or stationing of lethal military hardware.

While the NMMP inherently lacks the agility the global force desires, permanent investments in key locations such as Singapore (Malacca), Djibouti (Bab-el-Mandeb), and the United Arab Emirates (Hormuz) will add depth to existing defense strategies. Also, the NMMP could integrate with forward deployed squadrons such as MCM Squadron 5 in Bahrain during security crises.

Tactical Level Challenges and Considerations

In his book, *Wired for War: The Robotics Revolution and Conflict in the 21st Century*, P.W. Singer chronicles the Department of Defense's two decades of experience deploying unmanned aerial vehicles (UAVs) as a part of a "networked warfare" framework. However, as argued by LCDR Dave Barnhill in the March 2019 issue of *Proceedings*, the USN still lacks tactical employment frameworks for UAVs across the range of military operations (ROMO). Furthermore, while experience with UAVs provides some context for the employment of UUVs, significant differences in the physics of the air and sea domains pose added tactical challenges for successful employment of UUVs. Due to the rapid attenuation of light and electronic signals in the undersea domain, data exchange between platforms occurs at relatively low speeds over comparatively limited distances unless connected by wire. This means that—while not

An increasingly globalized world amplifies the strategic nature of existing and future maritime choke points due to the increasing susceptibility to and desirability as targets for offensive mining technologies.

impossible—multi-vehicle coordination is much more complicated undersea than in the air.

Despite challenges, former Chief of Naval Operations (CNO) ADM John Richardson has repeatedly expressed the priority of UUVs for the future of naval warfare. In his January 2019 report, "Design for Maintaining Maritime Superiority," Richardson highlighted the critical importance of unmanned systems to deliver kinetic and non-kinetic payloads in the 21st century. More than words, the CNO's actions to place UUVs in the "acquisition express lane" reveal the priority of UUVs in the emerging U.S. naval strategy. The Defense Science Board Taskforce's 2016 report on Next-Generation UUVs provides an unclassified roadmap of desired capabilities. To complement the acquisition programs, the Assistant Secretary of the Navy for Manpower and Reserve Affairs designated mine warfare in the Top 5 most critical skills for officer promotion boards to the grade of Commander (O-5) and Captain (O-6).

While senior leaders prioritized funding, the USN also recently established the first UUV squadron (UUVRON). UUVRON-1 reports directly to Submarine Development Squadron-5 (COMSUBDEVRON-5), which serves as the tactical development authority for UUVs as well as for undersea acoustic arrays and arctic warfare. Recognizing that much effort is still needed to fully integrate UUVs into tactical frameworks, the leadership at COMSUBDEVRON-5 must produce agile tactical guidance that empowers unit commanders to employ UUVs across the full ROMO. While working in a submariner-dominated command, COMSUBDEVRON-5 must guard against working in submarine centric silos and ensure that tactical doctrine possesses interoperability for a range of naval air, sea, undersea, and space platforms.

COMSUBDEVRON-5 Arctic warfare equities present an excellent example of how the USN can support its sister service, the U.S. Coast Guard (USCG), in developing mine and UUV security solutions. The six planned Polar Security Cutters will provide desperately needed relief for the USCG's one heavy icebreaker, Polar Star, which was commissioned in 1976. In order to improve executive and congressional support for the Polar Security Cutter acquisition, the Sea Services must jointly articulate a compelling narrative that links ice-capable ships with maritime security. A tangible way to tactically integrate the Polar Security Cutter acquisition with mine and UUV lines of effort is to ensure these hulls are prepared to operate with USN air mine counter measure assets such as the MH-60S and SH-60S. Beyond providing a helo-capable platform, Polar Security Cutters should provide the needed staging capability for systems such as the AN/AES-1 airborne laser mine detection system. Together, the Sea Services must strategically communicate that maritime security relies on open sea lanes, which necessitates investment in interoperable heavy ice-breaking Polar Security Cutters.

Are We Overselling the Threat?

At the outset of World War I, the British and French Allies possessed a preponderance of naval firepower, which they intended to use to establish supremacy over the maritime approaches to the heart of Asia. To achieve this objective, the Allies sailed an 18-ship fleet to the Eastern Mediterranean to assume control of the Dardanelles and the Bosporus Strait, thus solidifying the Allies' sea lines of communication from the Atlantic to the Black Sea. In response, an under-resourced Ottoman Empire mined the Dardanelles in order to prevent the Allies' fleet from an effective naval bombardment of land-based fortifications. The effective use of mines inflicted heavy casualties and repelled the Allies' fleet. Study of the Dardanelles Campaign underscores the asymmetric benefits of mine warfare, and it suggests that early 20th-century mine warfare bares striking similarities to more contemporary mine warfare. As a result, prudent naval strategists and budget analysts must objectively consider whether mine warfare in the 2020's and beyond will differ dramatically from the early 20th century.

Furthermore, proponents of modern and proposed technologies, such as space-based monitoring systems, suggest that most mining technologies are losing value as credible asymmetric tools. For more than a decade, China has sought to erode the perceived U.S. supremacy in the undersea domain—a key objective for China's anti-access area denial strategy in the South China Sea. China's "Project Guanlan" claims to monitor undersea systems to a depth of 500 meters, which greatly reduces the value and stealth of mining in littoral seas. When such space-based sensors combine with other ambitious projects like China's "Undersea Great Wall" of acoustic listening stations, the previously opaque undersea domain yields to greater transparency and reduces the asymmetric threat of naval mining. Thus, while mine warfare will remain affordable but dangerous, some argue the uncertainty and asymmetrical benefit of mining operations could diminish as the 21st-century advances.

Real Threats and Undersea Proliferation

The proliferation of affordable UUVs capable of delivering mines continues to grow faster than detection systems. Specifically, the low cost and increasing number of UUVs relative to space-based detection systems delegitimize claims that the world's oceans are now transparent for overhead satellites. Also, engineers optimized existing space-based systems to detect submarines—giant steel structures. UUVs constructed from plastics or composites will be all but invisible to instruments so optimized. Finally, economic theory and history suggest that low-cost UUVs will proliferate in a number of middle-to-low income coastal nations whereas only a few rich nations will pursue expensive satellite technologies.

Conclusion

In his 2018 article in the National Defense University's journal *PRISM*, "NATO's Adaptation in an Age of Complexity," France's Gen. Denis Mercier, the former Supreme Allied Commander Transformation for NATO, argues that the global security environment is transitioning from complicated to complex—with complexity denoted as an environment where the interacting factors are so numerous that it is impossible to accurately predict situational outcomes. The 2019 limpet mine attacks in the Persian Gulf demonstrate the correctness of Mercier's thesis. In the presence of the increasingly blurred lines of undersea responsibilities between national governments, multinational corporations and an inadequate legal apparatus for law of the sea, the asymmetric qualities of 21st-century mine warfare and UUV threats establish the exact sort of unpredictable nonlinear scenarios Mercier fears.

In such an uncertain future, naval powers capable of providing affordable and integrated solutions to existing fleets will establish meaningful gains in national strategic competition and ensure continued access to global markets. To secure a continued U.S. lead in conventional military capabilities, the national defense enterprise must understand the threat and develop appropriate solutions to not only mitigate the risk of mine warfare but remain capable of establishing local maritime superiority in areas susceptible to mining operations. With the support of political and military leaders who recognize the strategic importance of undersea security, solution providers must deliver capable and affordable technologies such as mine warfare platforms and autonomous UUVs. In parallel, military strategists must create frameworks that incorporate these capabilities in order to enable strategic, operational and tactical success.

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Challenges Facing Non-traditional Contractors

Communicating With a Redefined Industrial Base

Michael P. Fischetti

AS THE DEPARTMENT OF DEFENSE (DOD) FOCUSES ON reforming its acquisition system to move "at the speed of relevance," one critical goal is to better recruit and engage with "non-traditional contractors" to deliver the weaponry and services necessary to maintain our technological edge and national security. The DoD must understand why these firms are not interested in or aware of supplying and supporting new and cutting-edge products and services. What do we now need for the DoD to increase its business partnerships with non-traditional contractors, and thus bring more ideas, entrepreneurial spirit, and new products and services to the defense market sooner to maintain our military edge?

Today's defense acquisition system is under tremendous pressure to improve performance. Threats to national security change rapidly. As has been the case with many disrupted, former Fortune 500 and brick-and-mortar firms, business and consumer preferences in all forms of services and products continue changing for DoD, upending old economic models.

In this case, the customer is the U.S. citizen and the product is continued, unparalleled national defense. Success historically has depended on a powerful defense industrial base, which has been changed dramatically. The federal government formerly was a very significant contributor to research and development (R&D), including that leading to new weaponry. However, according to a National Science Foundation report, published by the American Association for the Advancement of Science, between 1965 and 2017, government's share of R&D spending dropped from 65 percent to 22 percent in constant dollars. The DoD therefore is not the same big player it once was in the overall economy.

Adversaries are making rapid progress. This means that America's best minds, who develop the technology that powers advances across our economy, increasingly must include national defense in their area of responsibility and work. DoD must reset how it conducts acquisition and learn to thrive by tapping into this new "industrial base" to find

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solutions from non-traditional contractors for providing the capabilities necessary to meet present and future security challenges.

Former Defense Secretary Ashton Carter highlighted this issue in a speech in Silicon Valley, California, in which he indicated that hardware and software being developed could support the DoD. Carter wished to reduce bureaucracy and increase research investment, by using the technical and entrepreneurial brains of this recent American technology success story. While those brains are not as involved in government-funded research as they used to be, partly because government does not invest in research as much as in the past, they are still patriotic. "They feel they too are public servants," Carter said, "and wish to have somebody in Washington they can connect to."

What issues surround this challenge, and what progress has been made? One view held by many is that existing acquisition rules and barriers to entry are too high. Government and the DoD acquisition regulations are cumbersome and complicated, discouraging non-traditional firms from competing for business against traditional defense contractors, as well as inside the Beltway think tanks and trade associations. Complicated contracting rules favor those who already understand and are established within the system. Other issues include the perception that the market is not large enough, that the effort isn't worth the hassle, that firms must give away their intellectual property, that new cost accounting and compliance systems are required, and that government personnel simply don't understand how industry works.

However, the defense market is increasing in size, which may at some point become more attractive to non-traditional contractors. The 2020 spending bill authorizes $738 billion in military spending, a $22 billion increase over 2019. While defense spending does not match the levels of past years, it is significant. These increases may make the DoD a more attractive, lucrative market for innovative, non-traditional commercial contractors, including those previously wary of federal contracting obligations and risk.

What exactly is a non-traditional contractor? As defined in statute and in the Defense Federal Acquisition Regulation Supplement (DFARS) 212.001, a "non-traditional defense contractor" is:

> an entity that is not currently performing and has not performed any contract or subcontract for DoD that is subject to full coverage under the cost accounting standards … for at least the 1-year period preceding the solicitation of sources by DoD for the procurement (10 United States Code 2302(9)).

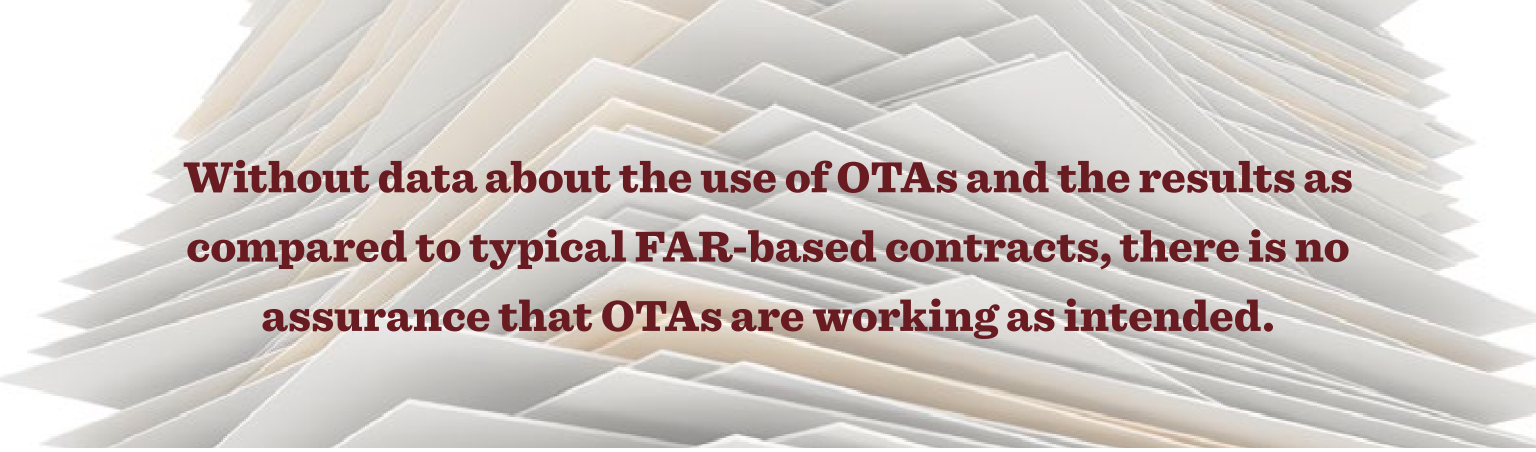
In addition, the Federal Acquisition Streamlining Act (FASA) of 1994 intended to lower procurement barriers by giving preference to commercial firms, products, and services, which the DoD includes in the DFARS definition of non-traditional contractors, including the reasons for it:

> iii) … contracting officers may treat supplies and services provided by non-traditional defense contractors as commercial items. This permissive authority is intended to enhance defense innovation and investment, enable DoD to acquire items that otherwise might not have been available, and create incentives for non-traditional defense contractors to do business with DoD.

With current increased funding and statutory changes encouraging commercial contracting procedures, there is renewed interest in use of "Other Transaction Authority (OTA)," a contract method seen as a means to get the complicated and restrictive Federal Acquisition Regulation (FAR) out of the way under certain circumstances. OTA creates a "blank slate," as few statutes and rules apply. The Fiscal Year (FY) 2016 National Defense Authorization Act (NDAA) allowed transitioning of DoD programs from R&D and successful prototype to production by using OTA non-competitively. Contracting risk may increase for individually developed OT mitigating terms and conditions. The FAR conversely prescribes various solicitation provisions and contract clauses to use, depending on the circumstances.

The DoD typically awards OTs to companies directly, or through a consortium, which are then subcontracted to a member company or companies. Recent data indicated that, of $5.8 billion thus obligated, a third ($1.9 billion) went to individual companies and the remaining $3.8 billion went to consortia or consortium management companies. These figures look very small compared with total DoD annual contract obligations of more than $300 billion, but OTA is increasing rapidly. The Government Accountability Office (GAO) Report 20-84 documents OTA use increasing from 248 in FY 2016 to 618 in FY 2018.

However, the evidence is inconclusive thus far whether OTA use is increasing non-traditional contractor participation. OTA spending increased from $845 million to $3.98 billion between 2015 and 2018, with 93 percent of that from the DoD. Growth came from extending DoD's OTAs and redefining non-traditional contractors, including doubling prototype project ceilings from $250 million to $500 million. Of 148 awards from 2015 to 2017, non-traditionals received 98, but only $7.4 billion of $21 billion in funding. The nonprofit Rand Corporation expressed concerns about OTA results and risks back in 2002, concluding that it was unable to quantify OTA results. Most recent Government Accountability Office data (GAO 20-84) indicates that



Without data about the use of OTAs and the results as compared to typical FAR-based contracts, there is no assurance that OTAs are working as intended.

"companies that typically did not do business with DoD participated to a significant extent on 88 percent of the transactions awarded during this time."

OTs limit DoD's ability to access financial records to verify properly stated contractor costs and limited intellectual property rights from projects. In 2017, Defense Innovation Unit Experiential (DIUx, now DIU) awarded 48 prototype contracts, of which two went to production, with no fieldable systems, according to a congressional staff member.

> Without data about the use of OTAs and the results as compared to typical FAR-based contracts, there is no assurance that OTAs are working as intended. Are agencies working with truly non-traditional contractors, are innovative products and services being produced, is the government saving money, and are the deals involving the intellectual property rights protecting the appropriate party?

The Trusted Capital Marketplace (TCM) is a new DoD initiative under the current administration with similar goals of enlisting non-traditionals, in response to Executive Order 13629 (signed in 2012), calling for public-private partnerships; and Sect. 1711 of the FY 2018 NDAA, calling for a "Pilot program on strengthening manufacturing in the defense industrial base."

> The SecDef [Secretary of Defense] must carry out a pilot program whose activities include: contracts, grants, or OTAs to support capabilities of small and medium sized firms; purchase goods or equipment for testing; "purchase commitments… including cost sharing with funding from nongovernmental sources"; issuing or guaranteeing loans; and "giving awards to third party entities to support investments in small and medium sized manufacturers working in areas of national security interest, including activities to support debt and equity investments. …

As discussed in an article by Lt Col Mark Massaro, USAF, TCM intends to connect innovative defense and technology companies with trusted investors, helping them find capital and funding to continue research, development, or operations, thus precluding their engaging with "adverse actors." TCM would aim to bring together innovation sources and investors without incurring adverse foreign influence.

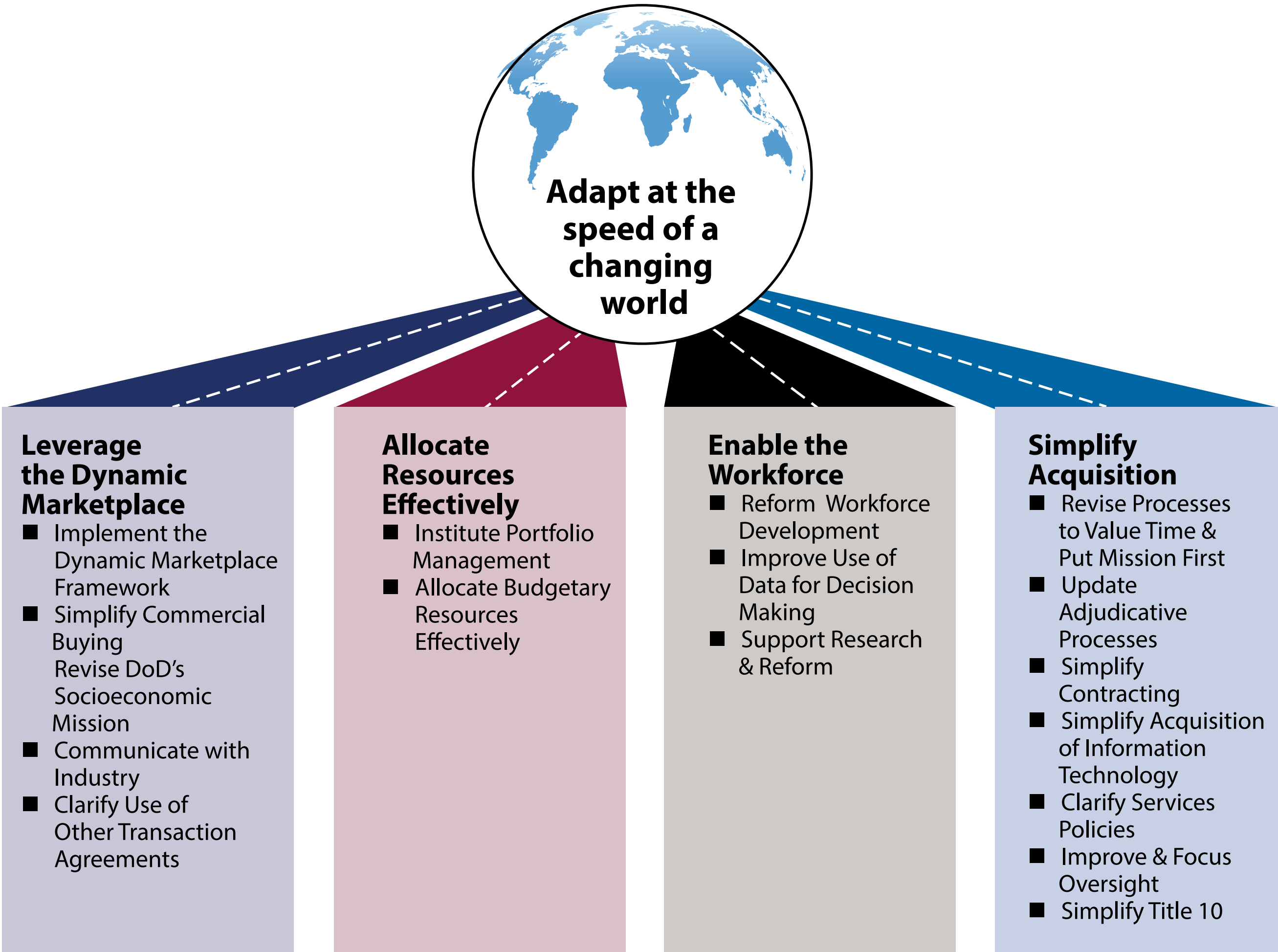
Recently, the Commerce Department added Chinese telecom Huawei Technologies to the "Entity List," making it harder for Huawei to buy and sell with U.S. companies. Last year's NDAA banned government Huawei and ZTE product use. Those two firms are among other banned high-profile Chinese companies. TCM might allow non-traditional firms to identify investment sources without worrying about their origins.

However, why is venture capital not already investing in firms that the DoD finds important? Many emerging technologies come from lower-tier subcontractors to major prime contractors. As in large weapon systems contracts, primes normally find components and suppliers to integrate with, matching a trusted source of capital investment, like TCM. Will primes buy up promising firms or not fund emerging technology if ineligible for use on a weapon system, focusing instead on protecting their current programs?

Any efforts to attract non-traditionals must also include a reexamination of the FAR itself as an impediment. Are expanded definitions of non-traditionals within commercial contracting and FAR Part 12 enough? The recent Section 809 Panel covered this in their July 2019 Final Report, under "Dynamic Marketplace Framework." The panel believes that the DoD's commercial buying is flawed, starting with its narrow commercial product or service definitions, and recommended replacing those authorities with new ones.

The panel believes that competition improves through documented market research (not currently required), because readily available market products and services exist through existing private-sector tools. The market already sets consumer prices, since they are publicly available for comparison and evaluation. Replacing public advertising, contracting officers (COs) could use market research and competition and waive some requirements for small and

Figure 1. The Section 809 Panel's Roadmap to Success



Source: The Section 809 Panel. (See https://section809panel.org/)

non-traditional contractors, which would make it easier to do business with the DoD.

The panel recommended removing some FAR-based government commercial buying clauses, asking instead that Congress clarify which laws apply to commercial prime and subcontracts, therefore reducing the commercial subcontractor burden on DoD prime contracts, as intended by FASA.

The report adds that today's domestic-origin requirements are not aligned with modern, global supply chains, resulting in increased costs, barriers to entry for some U.S. businesses, and innovation disincentives. Products bought under both the Buy American Act and the Berry Amendment can result in high pricing for DoD. Exempting domestic purchasing preferences for commercial goods could permit innovative products regardless of origin, yet still protect a defense-unique supply base.

Additionally, DoD buying-offices are hard to find, physically and organizationally, making it difficult for potential new suppliers to create customer relationships. A recommended "Market Liaison" would help non-traditional and other suppliers navigate the process and improve accessibility by answering questions and connecting industry to the right officials.

While existing FAR market research guidance is not an impediment, it should go further to create effective DoD-industry communication according to the panel. Clearer definitions and improved guidance would ensure that DoD employees better understand and use tools to enhance industry coordination in developing market research. A current reluctance to communicate creates an information barrier impeding the use of technological opportunities to expand industry participation. As a result, the DoD lacks knowledge of emerging industry technologies and capabilities.

Simplified procedures provide far more flexibility to solicit and contract nontraditionals for the right products and services.

Finally, the panel believes that many contracting officers are comfortable using FAR Part 15 source-selection procedures, versus Simplified Acquisition Procedures under FAR Part 13, a preference that creates unnecessary complexity. Simplified procedures provide far more flexibility to solicit and contract non-traditionals for the right products and services.

A 2013 University of Maryland report, *Non-Traditional Commercial Defense Contractors*, authored by the late Jacques S. Gansler (former Under Secretary of Defense for Acquisition, Technology, and Logistics) and scholars William C. Greenwalt, and William Lucyshyn, documented similar barriers to non-traditional participation. One example given was a reliance on cost data for determining price reasonableness, versus commercial pricing. Commercial items are exempt from Cost Accounting Standards and the Truth in Negotiations Act because those firms do not have government-unique accounting compliance systems. The authors also documented various domestic source restrictions, which create a complicated process misaligned with today's commercial supply chain. A 1996 Logistics Management Institute study stated that such domestic preference mandates are not in the commercial world.

The report also discussed the increase in FAR (and DFARS) Part 12 contract clauses applicable to commercial contracting since FASA. These government-unique regulations cause commercial companies either to expand compliance costs or refuse prime contracts.

> Non-traditional commercial contractors have played a significant role in supporting U.S. national security … despite initial successes, commercial acquisition has not become ingrained in the DoD acquisition culture and faces severe pushback on many fronts. …

The report recommended:

- Combat instances of requirements "gold-plating" … military-unique requirements, standards, and practices. …
- Re-establish incentives to … use existing authorities to access commercial firms for more than just COTS [commercial off-the-shelf] solutions.
- Ensure that the DoD rapid acquisition organizations … are maintained and fully utilized as a means to field solutions (especially commercial ones) faster.
- Identify and implement "best commercial acquisition practices" (by commercial sector and DoD application) … .
- Encourage the establishment of "non-traditional commercial entities" in private sector firms that are exempt from unique government and DoD rules and oversight.
- Expand the use of Other Transaction Authority (OTA) agreements … and to access non-traditional commercial subcontractors under a FAR Part 15 contract with a traditional defense prime contractor.
- Improve market research … to better understand what commercial capabilities are available … .
- Plan for a path to commerciality for non-traditional contractors when leveraging the commercial market for DoD-unique requirements.
- Establish a new Section 800 Panel to recommend specific … changes that inhibit the acquisition of commercial items.
- Periodically benchmark costs of compliance with government and military-unique requirements, laws, regulations, practices, certifications, and standards.

Thus far, DoD has had mixed success in gaining the participation of non-traditional contractors to improve its acquisition outcomes:

- Increased acquisition funding has not yet created a significant increase in DoD contracting participation by non-traditional contractors, beyond OTA.
- Statutory encouragement for commercial sources and expanding the commerciality definition to non-traditional contractors has failed to achieve the anticipated success.
- The TCM initiative is new, so results do not yet exist. Given its limited use of investor financing, a dramatic increase in non-traditional contracting participation is not expected.
- Increased use of OTA is still small compared to overall DoD contracting obligations, and it remains specialized in nature. Data indicate traditional contractors may realize most financial benefits, nonquantifiable program outcomes, and potentially higher contract risk compared to FAR-based contracts.


Only very recently have terms such as "category management" or "supply chain" entered the lexicon of government contracting officers.

- Cited report recommendations, particularly related to market research, are most meritorious moving forward. As the DoD relies increasingly on commercial products, services, technology and experts, we must learn and engage with industry, particularly non-traditional contractors.

Next Steps

There must be increased proactive DoD engagement and wider communication and understanding of business practices and motivations through improved market research of an expanded view of industry. Current interaction between government and industry is often between the DoD and DoD-unique (traditional) contractors—but not today's non-traditional, commercial industry. Necessary continuous monitoring of existing and fast-changing industry products and services by defense program and contracting officials is largely limited to government's traditional contractors. This may leave out those firms developing technology for commercial or non-defense markets. DoD program and contracting officials, from top to bottom, must learn through all available means to continuously and routinely apply strategic and tactically oriented market research practices from industry. Existing commercial contracting authorities and market research tools to meet mission needs must be redisseminated and reemphasized to DoD's acquisition workforce. We must all learn how to appreciate market research to achieve short-term results, as well as the long-term program acquisition strategies necessary to acquire DoD technological and mission superiority.

Understanding who and where they are and their motivations is crucial to developing requirements and acquisition strategies that will attract participation by non-traditional contractors. Traditional contractors supporting the DoD are far different from those in the commercial sector. Contracting officers today learn about the FAR and contracting principles, policy, and procedures, but little about industry best practices. Only very recently have terms such as "category management" or "supply chain" entered the lexicon of government contracting officers.

It may be simple common sense to realize that, just as most of us in our personal lives generally acquire products and services from firms that did not exist just a few years ago, the DoD acquisition system must expand its sources beyond the same (and ever-decreasing and consolidating) traditional contractors it has come to rely on. This requires a cultural change and reorientation for DoD acquisition professionals. But it also requires giving DoD acquisition professionals the resources, including the time to learn, adjust, and engage with an expanded view of industry in aligning DoD requirements to the best technological warfighter tools that American industry offers.

The sources of market research relied on today requires reconsideration. For example, the professional associations of government acquisition members are themselves segmented along government and industry sectors, leaving little cross-communication. Attend each of them (as I have done) and you realize that no overlap exists between their members or expertise. The various association communities are oriented along defined niches, for government and its contractors, with other forums designed for commercial firms and their supply chain. Similarly, supply chain managers within industry know very little about and have little interest in how government works. The cultures and eco-systems, from entry-level to chief executive in both industry and government, too often have little understanding of each other's practices and motivations. To the extent that there is government-industry cross-training or communication, it occurs between government acquisition staff and, typically, prior government staff now working for a traditional contractor. This internal, closed system has limited the view of potential capabilities offered by the wider commercial sector. The DoD must learn how to recruit the many new, commercial firms potentially capable of meeting defense needs.

Statutory and regulatory change may be necessary to optimize the integration of commercial industry, including small business, and open the door to today's non-traditional contractors. But DoD program and contracting officials must expand their view of national capabilities and proactively engage with industry communities with which they are unfamiliar.

Defense program outcomes will improve, as always, through better market research prior to acquisition planning. We must increase robust market research to find true commercial, non-traditional providers, and then align government requirements to leverage their developments. Let's get started!

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DEFENSE**ACQUISITION**
WRITERS' GUIDELINES IN BRIEF

Purpose

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

Submission Procedures

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

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

Deadlines

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

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

Audience

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

Style

Defense Acquisition 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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