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# ARMY AL&T

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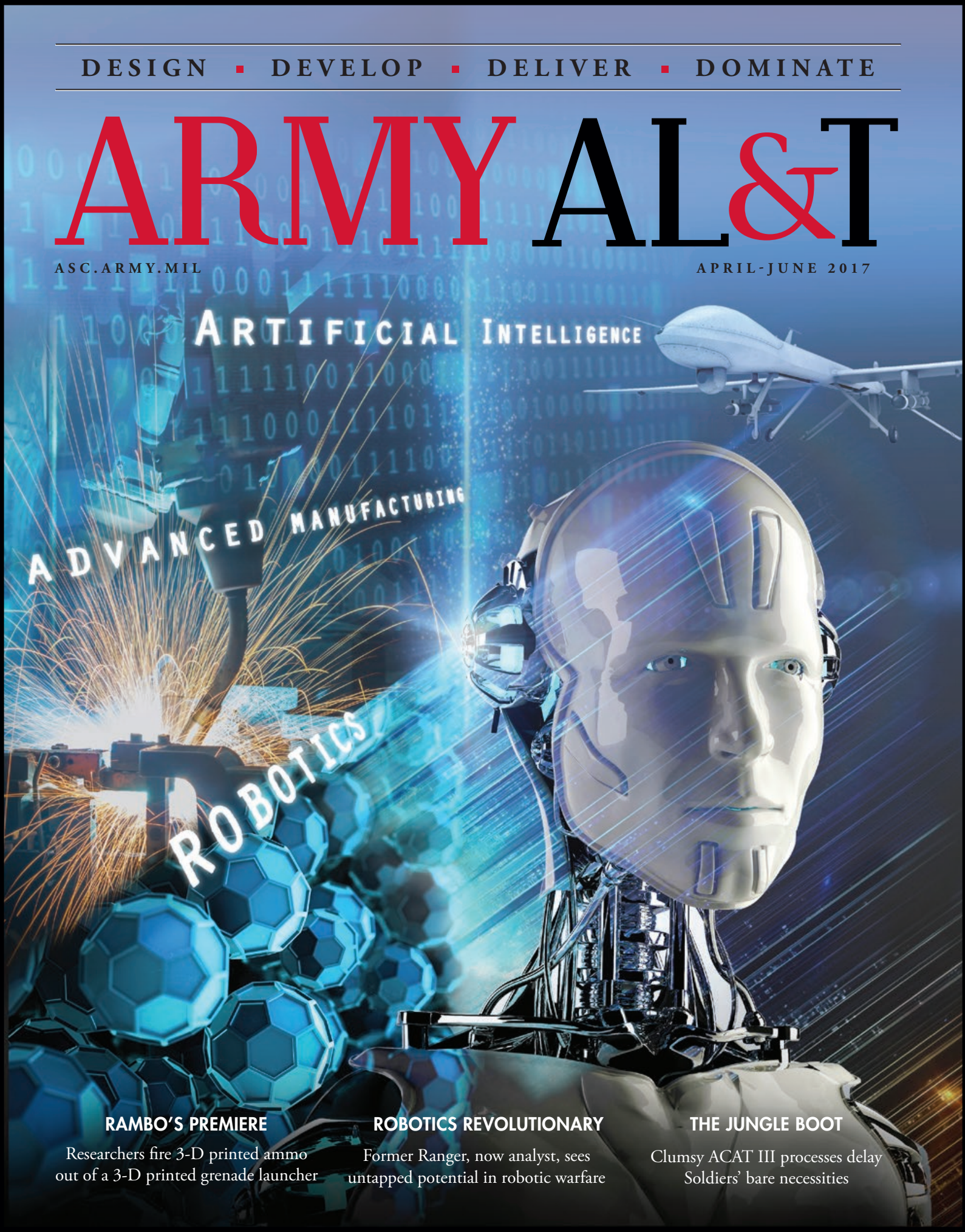
APRIL-JUNE 2017




**RAMBO'S PREMIERE**

Researchers fire 3-D printed ammo out of a 3-D printed grenade launcher

**ROBOTICS REVOLUTIONARY**

Former Ranger, now analyst, sees untapped potential in robotic warfare

**THE JUNGLE BOOT**

Clumsy ACAT III processes delay Soldiers' bare necessities

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APRIL-JUNE 2017



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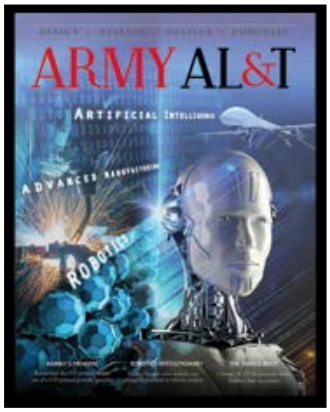


**ON THE COVER**
Rapid advances in robotics, artificial intelligence, additive manufacturing and autonomous weapon systems are changing the way the Army fights. (SOURCE: USAASC/iStock)



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## FEATURES



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## THEN & NOW





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By Dan Lafontaine


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From the Army DACM Office

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By Susan L. Follett

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Read more by the author of "**COLLABORATIVE AUTONOMY: A TACTICAL OFFSET STRATEGY**" in the April 2016 issue of Small Wars Journal, "Research and Vision for Intelligent Systems."

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# From the Editor-in-Chief

Robby the Robot, from the 1956 classic "Forbidden Planet"? Now that's robotics! Sure, Hollywood has created bigger, badder, more humanoid autonomous robots since then ("Terminator," "Transformers" and "Ex Machina"), but none captures the imagination quite like Robby.

What Hollywood glosses over, however, is that creating autonomous robotic systems, such as those depicted in so many blockbuster movies and television shows, is incredibly costly, time-consuming and not possible (yet) or even desirable. A full-fledged walking, talking, "thinking," learning machine is a ways off. No, robotics is an additive science, not an overnight success. It is a series of refinements layered one upon another, year after year, to automate redundant activities, create and increase efficiencies and, in the case of the U.S. Army, save Soldiers' lives.

Today's robotic systems complement human activities, and they are everywhere: in our homes (iRobot's Roomba), in high-end cars (self-driving) and on the battlefield (think drones), where they keep Soldiers from unnecessarily risking their lives. The Iraq and Afghanistan conflicts saw the first widespread use of robotic systems in modern warfare, initially focused on explosive ordnance disposal (EOD). They included, to name just a few, transportable "throwable" robots, equipped with surveillance cameras to support missions to clear buildings; Predator drones; and the Mini-EOD, referred to as "Devil Pup," a man-portable robot designed to locate, identify and disarm explosives.

Tomorrow's robots will be even more ubiquitous, and more autonomous—just how autonomous is very much up in the air. But, if it's anything like the Navy's "ghost ship," the Anti-submarine Warfare Continuous Trail Unmanned Vessel, the technology will be awesome. What is certain is that the development and refinement of many future systems will use a common set of technical standards to build robots that work with one another more seamlessly, and accept new technologies more easily as they emerge. Like military K-9 working dogs, who share a unique bond with their handlers, robots are becoming Soldiers' teammates in service.

Across the acquisition, logistics and technology communities, program executive offices and their research counterparts are brimming with advances in robotics, from new ways to produce systems in the laboratories and factories to the products they are creating for the Soldier. In this issue, read how the Project Manager for Maneuver Ammunition Systems is partnering with Army ManTech and the U.S. Army Armaments Research, Development and Engineering Center to develop advanced manufacturing systems, in "RAMBO's Premiere," Page 66: Need a grenade? Just print one. Print the launcher while you're at it.

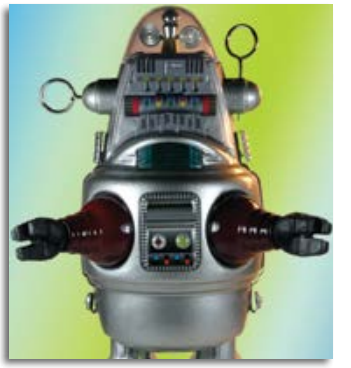


Photo by D J Shin/Wikimedia Commons

@ **Email Nelson McCouch III**
**ArmyALT@gmail.com**

Looking ahead to the potential uses of autonomous systems and artificial intelligence (AI) in line with the Pentagon's third offset strategy, read how technology could automate some of the more routine, data-driven tasks of mission command to save significant time in the decision-making process, in "Mission Command on Semi-Automatic," Page 50. The U.S. Army Communications-Electronics Research, Development and Engineering Center, the Army's home base for applied research and advanced technology development in mission command, is evaluating options to produce systems that would reflect the commander's intent in generating and presenting courses of action for human decision-making.

Of course, robotics and AI are not the only areas in which the U.S. military is making strides toward more complex and sophisticated capabilities to address current and future threats. In "X Marks the Spot," Page 39, see how the Army is using a battle management system developed by the Defense Advanced Research Projects Agency to gain a common operating picture of the cyber battlefield. In a similar vein, "Partnering at the Speed of Cyber," Page 44, looks at how elements of the assistant secretary of the Army for acquisition, logistics and technology, U.S. Army Test and Evaluation Command and Army cyber defenders are collaborating on innovations in operational testing and evaluation to keep up with the rapid rate of technological change in tactical networks and mission command in the contested domain of cyberspace.

Interestingly, the theme for this issue came from you, our readers. Our Editorial Advisory Board chose it from dozens of ideas submitted during a survey in which we asked what topics were of interest to you and what you would like to see us cover. (See, we do read your input.) So, if you have comments, suggestions or a great story you want to share, please contact the magazine at **ArmyALT@gmail.com**. Barring any robot uprising or zombie apocalypse, I'll be back this summer with the next edition.

***Nelson McCouch III***
*Editor-in-Chief*

**HEADY POSSIBILITIES**

This virtual reality dome at the U.S. Army Natick Soldier Research, Development and Engineering Center (NSRDEC) allows researchers to assess environmental and equipment impacts on Soldier cognition, including decision-making, spatial memory and navigation. The research is part of the broader mission of the Center for Applied Brain and Cognitive Sciences, created jointly by NSRDEC and the Tufts University School of Engineering, which will also examine Soldier interactions with autonomous robotic platforms to augment and optimize human cognition, mood and physical capabilities. (Photo by David Kamm, U.S. Army Research, Development and Engineering Command)

FROM THE ARMY
ACQUISITION EXECUTIVE
MS. STEFFANIE B. EASTER

# MAKING THE SOLDIER THE DECISIVE EDGE

## Robotics, artificial intelligence and advanced manufacturing offer the warfighter new dimensions of survivability and lethality

*"Whatever overmatch we enjoyed militarily for the last 70 years is closing quickly, and the United States will be, in fact we already are, challenged in every domain of warfare: space, cyber, maritime, air and, of course, land."*

*—Gen. Mark A. Milley, U.S. Army chief of staff*

In the future, our Army will transcend an ever-expanding range of battlefield domains where Soldiers will face new, complex and constantly evolving threats. With technology becoming ever more dynamic, we are in a race with our adversaries to harness and field the best military applications of product innovation. Our need to access technology and talent drives the pursuit of collaborative human-machine battle networks through robotics, artificial intelligence (AI) and advanced manufacturing. This edition of Army AL&T explores our progress.

Throughout the history of warfare, Soldiers have come face to face with the enemy, exposing themselves to the high risks associated with combat. Over time, advances in robotics and other technologies have put distance between our Soldiers and potential threats, increasing survivability and improving success on the battlefield. As we continue to exploit emerging technologies with robotics and AI, we increase our ability to take Soldiers out of harm's way while simultaneously increasing their lethality. Our

intent is to achieve and maintain total combat superiority by leveraging autonomy and AI; expanding manned-unmanned combat teaming; and amplifying our advantage in munitions and equipment manufacturing.

## ROBOTICS AND AI—WHERE THE ARMY IS NOW

With a growing industry developing unmanned capabilities, the Army is constantly exploring new ways to use these technologies. To keep up with emerging threats on the multidomain battlefield—land, air, sea, space, cyberspace and the electromagnetic spectrum—the Army is supporting work in autonomous, self-learning technologies that can anticipate commander's intent and inform decision-making during missions.

Army labs are working, for example, on mission command systems that would require minimal human input to guide unmanned systems to execute missions, as computers learn the intent of commanders. These promising new initiatives cover a broad spectrum of applicability in maneuvers: from fires, logistics and intelligence, surveillance and reconnaissance, to data aggregation and filtering, the purpose in each case being to present the right information to the right person at the right time for the right decision.

Our overarching goal is to take the Soldier out of harm's way. Robotics have been instrumental in the recent combat missions in Iraq and Afghanistan against improvised explosive devices (IEDs). The capability to remotely search for and detect IEDs enables us to avoid putting Soldiers at risk. We are enhancing and using semiautonomous ground vehicles to put distance between the operator and potential threats as the robot navigates through dangerous terrain during interrogation and neutralization of explosive hazards. Additionally, we continue to push the envelope by experimenting with autonomous ground systems to strengthen our force protection capabilities and improve logistic efficiencies in theater, especially in supply and maintenance operations.

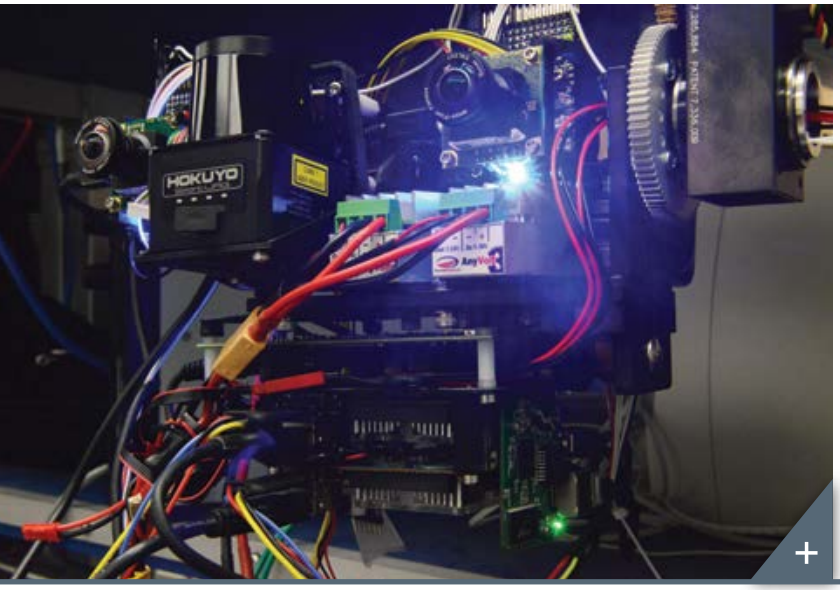
## COLLABORATION AND CROSS-FUNCTIONALITY

In Army acquisition, we recognize the importance of working more closely with other Army agencies and our sister services to facilitate effective, cooperative defenses in the cyber domain and to keep pace with real-world threats. Through collaboration, our robust robotic and AI applications undergo research, development, production and testing to ensure that the technologies we field have the efficacy and cross-functionality required to address threats across the multidomain battlefield.

Further, it is well understood that collaboration among organizations drives innovative thinking. The Army Rapid Capabilities Office, for example, draws on best practices from other organizations, such as the Office of the Secretary of Defense's Strategic Capabilities Office, the Defense Innovation Unit Experimental (DIUx) and other services' rapid capabilities offices, to engage with traditional and nontraditional developers and use creative contracting and collaboration mechanisms to encourage breakthroughs from the commercial sector.

## ADVANCED AND ADDITIVE MANUFACTURING

The Army's industrial base must develop and refine advanced manufacturing processes in order to provide higher-performance technologies to the Soldier. The Manufacturing Technology




**WIRED TO SUPPORT THE SOLDIER**

This platform, built by researchers at the U.S. Army Research Laboratory in Adelphi, Maryland, will enable the Army to test a greater degree of onboard perception and processing in robots, with the goal of enabling their use in a wider variety of mission scenarios, enhancing robustness and equipping the robots to gather real-time intelligence. Advances in robotic and other technologies hold ever-increasing promise to put distance between Soldiers and potential threats, keeping them safer while making them more lethal on the battlefield. (Photo by C. Todd Lopez, ARNEWS)

(ManTech) Program exists to improve production processes for critical technologies and to mitigate risks to schedule, budget and performance. One of the primary focuses of ManTech is careful investment in advanced manufacturing initiatives to develop critical capabilities that align with the Army science and technology strategy, which will benefit the entire enterprise.

Exploiting advanced equipment, processes and additive techniques such as 3-D printers can optimize the production of end items, allowing faster processes with higher quality. Critical resources and research in advanced and additive manufacturing are leading to faster fielding of ammunition, drones and other protective equipment to the warfighter at lower costs.

## CONCLUSION

Advances in modernization that benefit the American Soldier are possible, in large measure, because of the efforts of our Army Acquisition Workforce. Working closely with our counterparts in the industrial base, your efforts to find more ways to take the Soldier out of harm's way while increasing the Soldier's lethality and efficacy against current and evolving threats are more important now than ever.

Our Army acquisition team is moving forward to provide the current and future readiness needed to ensure undisputed dominance in every domain of modern and future warfare. Innovation, commitment to the mission and fearless pursuit of excellence are the drivers of our future force on the multidomain battlefield, and lie at the heart of our responsibilities for the Soldier's welfare. With every innovation we explore and technological advance we achieve today, we boldly move forward to meet and defeat the threats of tomorrow.

**FLYING TOWARD AUTOPILOT**

Spc. Edwin Polio, unmanned aircraft systems operator with the 3rd Brigade Combat Team, 25th Infantry Division (ID), flies a simulated unmanned aerial vehicle in September 2016 at Virtual Battlespace 3 in the Mission Training Complex on Schofield Barracks, Hawaii. The future of Army mission command promises unmanned systems that will require minimal human input to guide them while they exercise decision-making capabilities that reflect the intent of commanders. (U.S. Army photo by Staff Sgt. Armando R. Limon, 3rd Brigade Public Affairs, 25th ID)

**MUM-T IS THE WORD**

Soldiers of the 25th ID employ a Multipurpose Unmanned Tactical Transport, armed with an M2 .50-caliber machine gun, during the Pacific Manned Unmanned – Initiative at Marine Corps Training Area Bellows in July 2016. Expanding manned-unmanned teaming (MUM-T), for which the U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) has a leading role, is part of the U.S. military's strategy to achieve and maintain total combat superiority. MUM-T was one of the concepts identified as a focus for the Army Warfighting Assessment 17.1 in October 2016. (Photo by Kimberly Bratic, TARDEC Public Affairs)


## MS. STEFANIE A. "ALIX" GAYTON

**COMMAND/ORGANIZATION:**
Unmanned Aircraft Systems Project Office, Program Executive Office for Aviation

**TITLE:** Chief, Acquisition Management Branch; supervisory procurement analyst, Business Management Division

**YEARS OF SERVICE IN WORKFORCE:** 12

**YEARS OF SERVICE IN MILITARY:** 15

**DAWIA CERTIFICATIONS:** Level III in contracting

**EDUCATION:**
Master of public administration, Troy University; B.S. in business and communication, West Texas A&M University

**AWARDS:**
Superior Civilian Service Award; David Packard Excellence in Acquisition Award as a member of the Defense Energy Support Center's Operation Iraqi Freedom Bulk Helium Support Team; Defense Meritorious Service Medal; Air Force Meritorious Service Medals; Air Force Commendation Medals; Air Force Achievement Medals

# Maximizing career opportunities

Stefanie A. "Alix" Gayton got a lot out of the Senior Service College Fellowship (SSCF) program. In addition to honing skills that help with leadership, planning and decision-making, the program helped her find her current position: chief of the Acquisition Management Branch for the Unmanned Aircraft Systems (UAS) Project Office within the Program Executive Office for Aviation and supervisory procurement analyst in the Business Management Division.

SSCF coursework featured actual acquisition cases, including sessions on UAS. SSCF Director Diane Whitmore "said that previous fellows would 'leap tall buildings' for an opportunity to work for the UAS program office," said Gayton. So when a job there opened up, Gayton grabbed it. The office of the project manager (PM) for UAS is "the eyes of the Army," she said, "and it just doesn't get better for a career acquisition workforce member."

PM UAS supports five unmanned platforms, each with variants, as well as supporting system equipment, including Gray Eagle, Hunter, Warrior Alpha/Gray Eagle, Shadow, Raven and Puma, as well as the One System Remote Video Terminal, the Tactical Open Government Architecture Controller and the Universal Ground Control Station. Gayton leads a team that coordinates contract requirement packages and critical components of contract packages for more than 90 PM UAS requirements for seven products across five product offices. Those contracting requirements support research, development, test and life cycle efforts for the UAS family of systems, which totals approximately 8,200 unmanned aircraft.

For Gayton, gathering feedback is a vital part of her team's success—even if that feedback is collected in some unlikely places. Gayton was on hand recently when Jason Lucas, chief engineer for the Shadow UAS Product Office, demonstrated a Shadow Tactical UAS to visiting grade-schoolers. As the Shadow

launched and circled the area, Lucas explained the latest set of technical upgrades that Gayton and her team are working to place on contract and eventually field to the Soldier. "I could see through the demo how technical enhancements make a difference to those deployed in a war zone," she said.

She had the chance to gather Soldier feedback during an event commemorating the 2 millionth flight hour for the Hunter UAS. The Hunter has been used by Soldiers for more than 21 years, and although it's old compared with other UAVs, feedback indicates that Hunters are accessible, reliable and well-supported by the Army contractors deployed downrange. "I spoke with one Soldier who said that his unit could not get enough Hunters and Hunter flying hours," said Gayton. "Connecting my place in the mission and my team's contributions to the Soldier brings clarity to the choices we make, the passion we bring to the job and the focus we maintain toward achieving objectives."

Gayton got her start in military acquisition with the Air Force. After joining in 1984, her initial assignment was buying B-52 spares as a contracting officer with the Oklahoma Air Logistics Center at Tinker Air Force Base, Oklahoma. She transferred to the Air Force Medical Service Corps in 1990, working as a hospital resource manager, medical logistician and patient administration officer as well as awarding and improving the performance of medical contracts. She served for 15 years, culminating in a post as the base contracting officer for Ellsworth Air Force Base, South Dakota, during the B-1B bomber bed-down, the stand-up of the Strategic Warfare Center Bomb Scoring Range and the decommissioning of the Minuteman Missile Wing.

She retired from the Air Force as a major in 1999 and accepted her first civil service position as the deputy director for acquisition management at the Defense Health Agency in 2000. She moved to Army acquisition in 2009, starting as a procurement analyst for the U.S. Army Mission and Installation Contracting Command (MICC) at Fort Sam Houston, Texas, and chief of staff for MICC Director Dr. Carol Lowman. "When I first interviewed at MICC, I was incredibly impressed by Dr. Lowman's vision for the MICC as a learning organization. She described her goal to create a future where every workforce member is a leader; every leader continually expands their capacity to create the results they desire; and people are continually learning to see the whole picture together."

For Gayton, SSCF participation was a "fantastic opportunity" for developing her career. "Our SSCF advisers told my class that the coursework and introspection the class provides are intended to open the aperture of the leaders who complete the process. It worked—I loved the program." She noted that her career also benefited from positions to which she was assigned—positions she refers to as "not volunteered but volun-told." Most required her to backfill an unexpected retirement or vacancy and took her outside of her comfort zone. "I've grown more than I ever imagined" from those spots, she said. "It's a scary ride, but has always been well worth it."

**INTELLIGENCE GATHERING**

Gayton meets with members of her team in the UAS Project Office. From left, David Beddingfield, Lady Pollard, Gayton, Rebekah Massey and Sheila Triplett-Howard. (Photo by Bill Stern, PM UAS)

She's quick to note that mentors also have had a big role in her career development, including then-Brig. Gen. Kirk F. Vollmecke, who as commanding general of MICC nominated Gayton for the SSCF, and SSCF coaches and mentors Whitmore, Marian Guidry and Dr. Jerry Davis. "My current supervisor, David Lancaster, drives the PM UAS Business Management Division to take 'what is' and make it better," she said. She also noted the impact of Col. Courtney Cote, project manager for the UAS Project Office. "His philosophy is servant leadership, and he demonstrates it in his investment in long-term acquisition solutions, leader development and his mantra: 'Let's go do it for the Soldier.' "

She added, "One of my early mentors told my team that if we couldn't describe what we did to make a Soldier's life a little better every day, then we haven't earned our pay. For me, this is what leading and serving is all about."

***—MS. SUSAN L. FOLLETT***

**DEFINING ROLES**

Soldiers from the 3rd Brigade Combat Team, 82nd Airborne Division prepare an RQ7-B Shadow for flight at Fort A.P. Hill, Virginia, in October 2016. To properly integrate sensors or other additions into a system, the payload PM and the platform PM must have their roles and responsibilities clearly defined. (U.S. Army photo by Sgt. Steven Galimore, 82nd Combat Aviation Brigade)


# GROUND TRUTH

## Avoiding pitfalls when acquiring systems for unmanned and cyber warfare

*by Ms. Jill Iracki*

Today's ever-changing battlefield and rapid advances in technology call for systems that are more intelligent, independent and robust than ever. From robotics and manned-unmanned teaming to artificial intelligence to cyber and electromagnetic warfare, it is vital that the Army acquisition process effectively deliver technologically sophisticated systems to meet the threat. Equally important is an acquisition workforce that is fully aware of how to develop these systems for success—for example, by applying the necessary cyber protections and understanding the system's complexities before testing and training, and then providing the right training to the Soldier-user.

The Acquisition Lessons Learned Portal (ALLP) gives the Army acquisition community a forum to share lessons on how, specifically, to deliver successful systems and what pitfalls to avoid. The following lessons learned reflect the experiences and knowledge of project management office (PMO) staff and other acquisition stakeholders in unmanned systems and cybersecurity.

## TRAINING FOR UNMANNED SYSTEMS

**LL_241: As systems become more complex and interface with other systems, training is critical to fully and effectively employ the system on the battlefield.**

*Background*

The initial operational test and evaluation operators for one unmanned aircraft system (UAS) received general training on the system, but the training did not specify certain key aspects of effectively employing the system in executing the mission, such as how to conduct reconnaissance properly. Additionally, the training omitted how to interface with the ground unit the operators were supporting—that is, how to communicate what the UAS was seeing to someone on the ground.

**MAKING PRACTICE PERFECT**

Spc. Charles Shrontz of the 91st Cavalry Regiment, 173rd Airborne Brigade tracks and monitors flight hours for an RQ-11 Raven unmanned air vehicle. Effective training includes well-prepared test participants and clearly defined roles for all stakeholders. (U.S. Army photo by Visual Information Specialist Paolo Bovo, Training Support Activity Europe)

These training deficits, all of which were avoidable, had a measurable effect on mission success and made it harder to demonstrate hardware capabilities at a high operations tempo (OPTEMPO).

*Recommendation*

Establish clearly and in advance the types and levels of experience that Soldier participants will need to fully employ the system in testing and evaluation, such as missile range certification, radio communications and fundamentals of reconnaissance.

---

**LL_233: Use of ill-prepared test participants and immature systems can adversely affect test results and conclusions.**

*Background*

Trainee operators of an ancillary developmental system were ill-prepared under most circumstances to demonstrate tactically realistic interaction as a part of a system of systems. The operators did not communicate and interact effectively with other parts of the maneuver force, at times hindering the manned-unmanned teaming being demonstrated. Specifically, they often were unable to cooperatively perform surveillance, target detection, target acquisition and engagement, which unfairly biased the test results by suggesting inadequacies in the primary system under test. Only expert analysis made it clear that the results were an anomaly.

High OPTEMPO for operational units and scarcity of resources often create competing testing priorities. In such cases, it is necessary to determine the best possible alternative in terms of available tactical units and equipment.

*Recommendation*

Insist on using only test participants that are at readiness level 1 or fully mission-qualified in their respective roles, to obtain the most accurate and unbiased test results.

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**LL_838: The integration of a particular sensor on a UAS posed unique training challenges. Roles and responsibilities must be clearly defined between project managers (PMs) to avoid such challenges.**

*Background*

The acquisition strategy for the sensor specified that the training would be the responsibility of the platform PM with close support from the payload PM. The training strategy for the sensor consisted of UAS training packages provided by the payload

**WEIGHING THE ALTERNATIVES**

Pvt. Aleasha Stanley, an AIT student with the Maritime and Intermodal Training Department of the U.S. Army Combined Arms Support Command, operates a simulator in May 2016 at Fort Eustis, Virginia. Scarce resources and high OPTEMPO often mean competing testing priorities. When those conflicts arise, lessons-learned data indicate that it is necessary to identify the best available tactical units and equipment. (U.S. Air Force photo by Staff Sgt. Natasha Stannard, 633rd Air Base Wing)

PM for integration into new equipment training (NET) and institutional training center curriculum.

Over a year, the sensor team observed a decrease in the tactical use of the sensor. After-action reports from fielded units confirmed a limited understanding of how to operate the radar. This was a reflection of the limited sensor training provided to the payload operator—three hours of instruction in the UAS NET.

The sensor team that provided contractor training support to the UAS NET events had encountered difficulty getting dedicated resources, such as flight time, to conduct sensor training. The team observed that radar training for UAS operators was a lower priority than training for other aspects of operating the UAS and therefore was assigned a smaller window of opportunity, which poor weather could narrow further.

This training deficit at the UAS operator course for military occupational specialty 15W (unmanned aircraft systems operator) stemmed in part from an improper categorization of sensor system training tasks. The Army included them in the 2000 series; that meant they were taught exclusively through presentations in the academic setting of advanced individual training (AIT), where Soldiers received just an overview of the sensor instead of hands-on instruction in operating or commanding the payload in a realistic environment.

*Recommendation*

The payload PM needs to assert more emphasis on training rather than allowing the platform PM to direct sensor training activities. In particular, the payload PM should:

1. Continue to use embedded trainers to support NET activities.
2. Work with the platform PM to get dedicated sensor training time during NET.
3. Work with the platform PM to increase the amount of sensor training

conducted during fielding and possibly expand the current training curriculum.

4. Investigate and address current simulator shortfalls with the Program Executive Office for Simulation, Training and Instrumentation and all stakeholders, as incorporating the radar simulator may improve training.
5. Engage all stakeholders to address recategorizing sensor training tasks to series 1000 tasks, to enhance the Soldiers' sensor training experience in AIT.

## CYBERSECURITY

**LL_540: Institute baseline cybersecurity requirements as a condition of contract award for appropriate acquisitions.**

*Background*

Baseline cybersecurity refers to first-level information security measures used to deter unauthorized disclosure and loss or compromise of information. Basic protections, such as updated virus protection, multiple-factor logical access, methods to ensure data confidentiality and current security software patches, are broadly accepted across the government and the private sector as ways to reduce a significant percentage of cyber risks. Ensuring that the people, processes and technology with access to at-risk assets are employing baseline requirements raises the level of cybersecurity across the federal enterprise.

Often, cybersecurity requirements are expressed in terms of compliance with broadly stated standards and are in a section of the contract that is not part of the technical description of the product or service. Doing so leaves too much ambiguity about which cybersecurity measures are actually required in the delivered item.

*Recommendation*

For acquisitions that present cyber risks, the government should do business only with organizations that meet such baseline requirements in both their own operations and the products and services they deliver.

The government should express the baseline in the technical requirements for the acquisition, and should include performance measures to ensure that the contractor maintains the baseline and identifies risks throughout the life span of the product or service acquired.

Because of resource constraints and the varying risk profiles of federal acquisitions, the government should take an incremental, risk-based approach to increasing cybersecurity requirements in its contracts beyond the baseline. As a preliminary matter, cybersecurity requirements need to be clearly and specifically articulated within the requirements of the contract. First-level protective measures are typically employed as part of the routine course of doing business. The cost of not using basic cybersecurity measures would be a significant detriment to contractor and federal business operations, resulting in reduced system performance and the potential loss of valuable information.

*Establish clearly and in advance the types and levels of experience that Soldier participants will need to fully employ the system in testing and evaluation.*

---

**LL_742: Per Army Regulation (AR) 25-2, information assurance (IA) certification is a requirement for information systems seeking to network in Army activities. Programs need to develop IA strategies very early during the design process to avoid cost and schedule impacts.**

*Background*

During the requirements development phase and subsequent build of an electronic warfare system, the developer did not address IA. Consequently, an IA assessment performed after the system was developed determined that the system's security posture did not meet Army IA regulations or National Security Agency (NSA) requirements. Had an IA subject matter expert (SME) engaged with the developer from the start, the SME would have determined that the operating system (OS) and the hardware and processor being developed and integrated into the system were not on the NSA preapproved list and lacked a validated encryption algorithm.

Not using the NSA preapproved OS or hardware does not preclude obtaining certification; however, it does mean that

**ENSURING INFORMATION ASSURANCE**

Information technology specialists, from left, Patrick Noel, Stephen Washicosky and Brian Medwetz configure and test a software support pilot system at Tobyhanna Army Depot, Pennsylvania. ALLP data recommend including IA and cybersecurity SMEs in the design and development team early on, to avoid inadequacies in IA and their potential cost and schedule risks. (Photo by Steve Grzezdzinski, Tobyhanna Army Depot)

NSA must evaluate and certify the system, which adds a significant amount of time to the schedule. In addition, NSA findings could require that the system undergo re-engineering to correct any encryption or OS security issues. This effort could result in invasive hardware changes or simple software modifications.

Consequently, the PMO expected the program to experience schedule delays, adding high risk to meeting program objectives. The PMO estimated that it would take six to 10 months to perform initial scans on the system and get chief information officer/G-6 validation. Getting into and through the NSA certification process with no issues could take up to 12 months, while any fixes required to achieve certification could add time to the schedule for implementation and testing. The original equipment manufacturer estimated that it could take 18-24 months to implement a hardware change. The system would then have to be re-evaluated, which could add another six to 12 months.

*Recommendation*

As soon as a networking requirement is determined for the system, IA and cybersecurity SMEs need to be active members of the design and development team. The IA SME will incorporate AR 25-2 requirements into the system design strategy and help determine the program's timeline for certification and accreditation (C&A) efforts for purposes of planning objectives. Validating IA controls (per DOD Instruction 8500.2 on IA implementation) during the system development phase benefits the program by reducing the need for re-engineering, allowing the successful completion of C&A efforts while meeting timeline objectives.

When using communication security (COMSEC) material, engage the PMO for network enablers (PMO Net E) in the initial development stages as directed by the assistant secretary of the Army for acquisition, logistics and technology to ensure that COMSEC methods are NSA-approved. PMO Net E, within the Program Executive Office for Command, Control and Communications – Tactical, is the designated technical expert, offering COMSEC-approved devices at no cost. Using technology that is not COMSEC-approved will require NSA certification, which could be a lengthy process. Not using the approved technology could pose a high risk to program objectives.

*For more information on these and other Army lessons learned within the ALLP, go to* ***https://apps.aep.army.mil/ALLP****; a Common Access Card is required to log in.*

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*MS. JILL IRACKI is an operations research analyst with the U.S. Army Materiel Systems Analysis Activity at Aberdeen Proving Ground, Maryland. She holds an M.S. in applied and computational mathematics from Johns Hopkins University and a B.A. in mathematics from Notre Dame of Maryland University. She is Level II certified in engineering.*


**TARGET IDENTIFIED**

Pfc. Charlie W. Hibbs III, an infantryman assigned to 2nd Battalion, 325th Airborne Infantry Regiment, 2nd Brigade Combat Team, 82nd Airborne Division, fires an M240L machine gun during the battalion's machine gun leaders' course held on Fort Bragg, North Carolina, in January 2016. Research efforts, led by PM MAS and ARDEC and supported in part by funding from ManTech, are looking at new manufacturing processes for producing lighter ammunition for the M240 that still meets the weapon's performance requirements. (Photo by Staff Sgt. Jason Hull, 82nd Airborne Division)

# A GREEN MACHINE SUCCESS

PM MAS secures ManTech and R&D funds that enable the industrial base to experiment with green machining to produce the next generation small caliber round.

*by Mrs. Marta Hess, Mr. Jeremy Lucid and Mr. Joseph Paras*

Until 2010, ammunition for small arms weapons had not kept up with evolving threats, and the performance of legacy ammunition had remained relatively stagnant since the early 1980s. Developed using Cold War-era technology, legacy ammunition has a number of deficiencies in providing warfighters with a definitive advantage against current and future threats. A large-scale effort to develop and field the next generation of small caliber ammunition—and with it, the overmatch capability that legacy ammunition does not provide—is underway, assigned to the product manager for small caliber ammunition under the project manager for maneuver ammunition systems (PM MAS) at Picatinny Arsenal, New Jersey.

This next generation of small caliber ammunition includes advanced technologies to improve lethality at greater distances, as well as alternate cartridge case materials to lighten a Soldier's standard combat ammunition load. PM MAS secured U.S. Army Manufacturing Technology (ManTech) Program funding to supplement existing research, development, testing and engineering (RDT&E) funds starting in FY15, to mature the manufacturing readiness level of improved materiel solutions. These additional resources have played an important role in reducing the manufacturing and cost risks as products transition to full-rate production, providing the warfighter with improved capability at the quantity needed to conduct training and combat operations. Without this crucial resource to advance manufacturing readiness, it would have been too costly for the ammunition industry to field enhanced capabilities in required quantities of small caliber ammunition.

## COMPONENT MANUFACTURING AND ASSEMBLY

The focus on improving small arms ammunition began in earnest around 2008, when the U.S. Army Maneuver Center of Excellence (MCOE), representing the voice of the user, received mixed reviews in post-combat surveys regarding legacy 5.56 mm and 7.62 mm ammunition. This triggered the MCOE to generate capability development documents for 5.56 mm, 7.62 mm and .50-caliber ammunition. These documents established the Army's requirements for small caliber ammunition to reduce or eliminate existing operational capability gaps and ensure overmatch in future combat environments through the foreseeable future. These requirements formed the basis for multiple research and development (R&D) programs to improve lethality, survivability, mobility and training flexibility.

As with many innovative products or systems, advances can result in price increases. Over the last decade, improvements in small caliber ammunition have required modifying critical projectile components with state-of-the-art designs and complex shapes, such as a modified projectile jacket with an exposed tip to achieve consistent soft-target effects, and advanced materials such as tungsten carbide to achieve enhanced hard-target terminal effects at greater distances. This, in turn, has required research in advanced manufacturing techniques including machining in a preformed state, called "green machining," advanced grinding and multistage projectile assembly operations that the ammunition industry previously was not required to use.

**GETTING TO THE POINT**

The green machining method demonstrated by PM MAS has produced more than 30,000 components as of the end of last year. The new method has brought about a reduction in manufacturing time—from 4 parts per hour to 120 parts per hour—and reduced the projected unit price to less than 25 percent of the original cost, yielding millions in savings over the life of the program. (Image courtesy of PM MAS)

By leveraging $5 million of multiyear RDT&E funding from ManTech, PM MAS, in partnership with the U.S. Army Armaments Research, Development and Engineering Center (ARDEC), funded two major initiatives to assist the industrial base in developing and refining advanced manufacturing processes to provide higher-performance ammunition to the warfighter at an affordable cost.

For example, PM MAS and ARDEC have been able to drive down the unit cost of tungsten carbide components by using ManTech resources. Because of the hardness of tungsten carbide, manufacturing it has historically involved lengthy grinding operations. Using these labor-intensive operations resulted in one part completed every 15 minutes, and the unit cost exceeded $20 per part, mainly because existing manufacturing methods for tungsten carbide material were not optimal for complex shapes and configurations.

Using ManTech funding, the team engaged with several small businesses, via market surveys and competitive bids, to incentivize development and improvements in novel and advanced tungsten carbide manufacturing techniques. This funding allowed the small businesses to invest in developing alternative manufacturing processes that have potential for other military applications as well as commercial ventures, all while reducing investment risk on their end.

Ultimately, PM MAS and ARDEC selected a green machining process as the most viable approach to drive down component costs. The process is a powder metallurgy technique where chalk-like preforms of tungsten carbide powder are shaped before sintering, a heat treatment process that binds the powder particles to produce a hard, dense material. Traditional tungsten carbide manufacturing involves sintering simple stock shapes, such as bars or rods, and then hard-grinding the final shape into the material.

Green machining decreases the product cost by increasing the efficiency of producing complex shapes and configurations. More than 30,000 components were produced between October 2015 and December 2016 using this method. These

**PRECISELY ASSEMBLED**

Modified through a ManTech-funded R&D program, this new bullet assembly machine has a higher operational availability and lower scrap rates than predecessor equipment. Further, it provides more processor feedback and enables faster tooling changes. These improvements in precision translate to higher-quality ammunition, fielded faster and more cheaply. (Image courtesy of PM MAS)

improvements reduced manufacturing time from one part every 15 minutes to two parts every minute. It reduced the projected unit price to less than 25 percent of the original cost—resulting in a potential savings of more than $300 million over the expected 20-year life of the program.

Following the initial success in developing a more efficient and cost-effective manufacturing process for complex tungsten carbide components, PM MAS and ARDEC again leveraged ManTech resources to implement improvements in 7.62 mm bullet assembly. Typically, small caliber bullets are assembled on a bullet assembly machine (BAM), where a copper cup is drawn into a bullet jacket that encapsulates the other bullet components (penetrator and slug) and ultimately a small caliber projectile is produced. Because the design of small caliber ammunition has not changed since the early 1980s, legacy BAMs also have remained relatively unchanged, resulting in less-than-optimal operational availability, higher scrap rates and less flexibility in tooling changes for different ammunition types.

By leveraging ManTech funding, the team developed a new tooling package that uses a higher-precision BAM to eliminate many of these inefficiencies. This 21st-century BAM, with enhanced controls for precise assembly, is anticipated to maintain the existing rate of 60 parts per minute with higher operational availability, lower scrap rates, more process feedback to the operator and the ability to make faster tooling changes. More importantly, as the manufacturing equipment becomes available to the industrial base for full-rate production, the higher precision means better-quality ammunition delivered to the field, more quickly and at a lower cost.

## LIGHTWEIGHT CARTRIDGE CASES

The next endeavor the program office is tackling with ManTech support involves developing manufacturing and loading processes for lightweight cartridge cases. PM MAS, with support from ARDEC, is exploring new manufacturing processes that include injection-molding polymer or metal using multicavity molds; over-molding; thermal bonding; metal laser

edging; and rapid propellant loading of lightweight cases. All of these processes are new to the Army's small caliber ammunition production base. Lighter-weight cases reduce combat loads, resulting in greater mobility for Soldiers in combat as well as reduced weight for vehicular and aerial platforms. Using nontraditional cartridge case materials is key to realizing weight savings in small caliber ammunition.

PM MAS held an industry day on April 19, 2016, to inform industry partners of the desire to reduce the Soldier's load in small arms ammunition. The Army shared program requirements, industry opportunities and a planned schedule. The event also provided a forum for smaller nondefense businesses to meet with ammunition producers to discuss the challenges in satisfying the Army's needs. During the next five years, the main challenge will be designing and delivering the same quantities of current brass-cased 7.62 mm ammunition requirements in a lightweight case that meets the performance requirements of the M240 machine gun.

The Army encouraged companies to explore polymer, steel or hybrid metal designs, with the goal of reducing overall weight by 10 to 50 percent over existing brass-cased cartridges while ensuring proper function in weapon systems; the new design also needed to be produced at typical small caliber ammunition production rates of 75 to 125 million cartridges per year and at a comparable price. Several innovative small businesses have developed lightweight case prototypes but have difficulty meeting these production criteria because of their limited manufacturing capability. The team will use ManTech funding to improve the manufacturability of these innovative, lightweight cases while attempting to drive down manufacturing costs.

**MAKE IT LIGHTER, FASTER**

PM MAS worked with various manufacturers to assess their lightweight case concepts, including the PCP Ammunition case on the immediate left and General Dynamics Ordnance and Tactical Systems – Canada stainless steel case on the far left. Cutting cartridge weight has the potential to significantly reduce the burden on the Soldier—and on vehicular and aerial platforms as well. (Images courtesy of PCP Ammunition Co. and PM MAS)

## CONCLUSION

ManTech funding has enabled the development of a novel manufacturing capability at three companies with the ability to produce next-generation small caliber ammunition. As a result of the R&D effort, the program office has learned the importance of engaging with industry partners early in the RDT&E phase to develop and mature manufacturing processes concurrently with product development. Bringing industry's expertise in during product development allows program management to build more realistic schedules, reduce costs and field higher-performance ammunition that will provide overmatch capability to our warfighters. The ManTech Program is instrumental in developing and refining innovative manufacturing technologies that will transition to the industrial base in support of full-rate production—a win-win scenario that improves national security while preparing the industrial base for future needs.

*For more information about the work of ManTech and PM MAS on green machining, go to* ***http://www.armymantech.com/TCPACR.php****.*

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*MRS. MARTA HESS is a PM MAS project officer for the Lightweight Small Caliber Ammunition program within the Program Executive Office for Ammunition at Picatinny Arsenal. She holds an M.S. in mechanical engineering from the Stevens Institute of Technology and a B.S. in mechanical engineering from New Jersey Institute of Technology. She has been part of ARDEC's Quality Engineering and System Assurance Directorate for 13 years and is an Army Acquisition Corps (AAC) member. She is Level III certified in production, quality and manufacturing.*

*MR. JEREMY LUCID is a PM MAS project officer for multiple small caliber ammunition RDT&E initiatives. He holds an M.S. in mechanical engineering from the Stevens Institute of Technology and a B.S. in mechanical engineering from The College of New Jersey. He has worked for the federal government for 12 years and is Level III certified in project management and in engineering.*

*MR. JOSEPH PARAS is ARDEC's project officer for ManTech's Tungsten Carbide Penetrator & Assembly Cost Reduction Program. He holds a B.S. in ceramics and materials engineering from Rutgers University. He has been assigned to the Munitions Engineering and Technology Center's Armaments Engineering Analysis and Manufacturing Directorate for nine years. He is an AAC member and is Level III certified in engineering.*

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## MR. CLINTON E. SPRATLEY

**COMMAND/ORGANIZATION:**
Aircraft Survivability Equipment Project Management Office, Program Executive Office for Intelligence, Electronic Warfare and Sensors

**TITLE:** Lead systems engineer

**YEARS OF SERVICE IN WORKFORCE:** 10

**YEARS OF SERVICE IN MILITARY:** 3

**DAWIA CERTIFICATIONS:**
Level III in systems engineering; Level II in program management

**EDUCATION:**
Completing a dual MBA and master's degree in industrial and systems engineering, Auburn University (expected December); B.S. in physics, Baylor University

# Seeking heat at the ACAT I level

**PRIDE IN OWNERSHIP**
Spratley and Paul Lang, Northrop Grumman Corp. CIRCM manager, take delivery of the first CIRCM system in January 2013.
(U.S. Army photo by Sherry Dorner, PM ASE)

Clinton E. Spratley spent three years on active duty with the Air Force before lending his engineering background to the Army's efforts to improve aircraft survivability. After leaving the Air Force, he joined the Army Acquisition Workforce, first as a contractor and then as a civilian employee of the Program Executive Office for Intelligence, Electronic Warfare and Sensors (PEO IEW&S) in Huntsville, Alabama.

Spratley is lead systems engineer for the Infrared Countermeasures (IRCM) Product Office under the project manager for aircraft survivability equipment (PM ASE), working on systems that protect aircraft from infrared homing (heat-seeking) missiles by confusing the missiles' ability to read or lock on to the aircraft's infrared signature. "The IRCM family of systems are important to the warfighter because they provide protection from heat-seeking surface-to-air and air-to-air missiles," Spratley noted. "I always go home knowing that we are making a real difference in protecting our Soldiers' lives and are one step closer to bringing our troops home alive."

He supports two systems: the Acquisition Category (ACAT) I-C Advanced Threat (AT) IRCM system and the ACAT I-D Common IRCM system. ATIRCM is

currently fielded to a limited subset of aircraft that provide laser-based countermeasure protection to Army aircrews. Common Infrared Countermeasures (CIRCM), now in the engineering and manufacturing development phase, is the next-generation laser-based countermeasure system for DOD's rotary-wing, tilt-rotor and slow-moving fixed-wing fleet.

"I have had the opportunity to support an ACAT I-D program through two major phases of the acquisition life cycle as it moved from the competitive prototyping stage, past milestone [MS] A into the technology development phase, and past MS B into the engineering and manufacturing development phase," Spratley said. He credits his leadership, both uniformed and civilian, with giving him this opportunity, which he calls a high point of his career. "I have been very fortunate with the leadership I have served under. The most valuable mentor that I have had is my current supervisor, Jason Matheney, deputy product manager for infrared countermeasures. He has assigned me tasks that allowed me to stretch beyond my comfort zone while consistently being held to a high standard of quality on my products. I attribute much of my success so far to his mentorship."

As CIRCM moves from the lab to the airfield, Spratley has helped with the creation of two sets of milestone decision documents, two separate contract requirement packages, two source selection evaluation boards and three major program milestones (MS A, pre-request for proposal release decision point and MS B). Working on a major, high-dollar program with oversight from the Office of the Secretary of Defense as it moves through the decision-making process gave Spratley an appreciation for "the vast complexity of the acquisition process … and the non-technical activities," he noted.

Being involved with the aspects of programs that aren't related to engineering "has made me a better systems engineer," he said, and he recommends pursuing broader experience and perspective through classes or developmental assignments. "It is too easy to get caught up with just getting our daily job completed, but then we don't leave time for ourselves to grow. When your workload slows down, look for an opportunity outside your immediate comfort zone to temporarily help out."

While in the Air Force, Spratley served as acquisition officer at the Air Force Research Laboratory in the Space Vehicles Directorate at Kirtland Air Force Base, New Mexico. After leaving the Air Force, he knew he wanted to join the Army Acquisition Workforce "to have a greater influence on programs to make a lasting impact in warfighter survivability."

**TEAM ACCOMPLISHMENT**

Maj. Gen. Kirk F. Vollmecke, second from left, program executive officer for IEW&S, presents a certificate of appreciation in February to the IRCM product management team—from left, Col. Jong Lee, PM ASE; Vollmecke; Lt. Col Rodney Turner, product manager for IRCM; Jason Matheney, deputy product manager for IRCM; and Spratley. (U.S. Army photo by Sherry Dorner, PM ASE)

His transition to Army acquisition required a shift in mindset. "My Air Force experience was vastly different from the work I am doing now with Army aviation," he said. Working in an Army countermeasures office focuses on responding to adversaries' capabilities and responding directly to operational threats, Spratley explained. "This focus means having to understand how the Army fights, which is significantly different than Air Force operations, especially space-based operations."

Joining Army acquisition, he had to learn about Army tactics, aircraft capabilities, command, control and communications, and other Army weapon systems. "Ultimately the acquisition structure is the same, with some slight variants in terminology, but how Army aviation programs move through the Pentagon for review and approval is different from space-based systems, with more focus on production, operations and sustainment costs," he said.

Feedback from Soldiers in the field validates his decision to switch. "Working on these systems brings me great pride because we work with Army aviators who have been in harm's way and benefited from the protections that our systems provide."

*—MS. MARY KATE AYLWARD*

**HIGHER PERSPECTIVE**

Logisticians from across the services and DOD agencies have the opportunity to spend a year at the Pentagon as OSD logistics fellows. Perks include a view of their career field from above, a stronger and wider professional network and the chance to see how different DOD and private-sector organizations approach logistics. (Photo by icholakov/iStock)

# A GLIMPSE *from* ABOVE

OSD logistics fellows take on staff assignments and training in a collaborative learning program that allows participants to view the DOD logistics enterprise in action from the highest level.

*by Mr. Bryan L. Jerkatis*

A friend and retired U.S. Air Force command chief often used an analogy with young troops to describe the differences between their worldviews and those of their leadership. "Your view of the ground [truth] depends upon the height of the branch in the tree upon which you are standing," he would say. Similarly, the parable of "The Blind Men and the Elephant" teaches us that seeing only one side of something poses limitations. Both are also true of a stovepiped career path.

For the nearly 3 million men and women who make up DOD, seldom is the opportunity available to spend invaluable time higher in the tree. Fortunately, the Office of the Assistant Secretary of Defense for Logistics and Materiel Readiness (OASD(L&MR)) has a fellows program for just that purpose, in which I participated from July 2015 to July 2016.

The Office of the Secretary of Defense (OSD) Logistics Fellows program provides the unique opportunity to be part of policy formulation and DOD-wide oversight. My time in the OSD focused on the oversight of supply chain policy and matters ranging from environmental sustainability to prepositioned war reserve materiel. Fellows are fortunate to travel and tour both the public and private sectors to observe, contrast and learn firsthand how logistics operations compare in private industry and to benchmark best practices.


**CLASS OF 2015-2016**

The author, second from left, was part of the OSD Logistics Fellows Class of 2015-2016, shown at the Pentagon in March 2016. Also photographed are, from left, Lt. Col. Edward Hogan, fellow, Office of the Deputy Assistant Secretary of Defense for Maintenance Policy and Programs (ODASD(MPP)); Col. Dennis Dabney, then-military deputy to the DASD(MPP); Paul Blackwell, ODASD for Supply Chain Integration (SCI) fellows program coordinator; Dee Reardon, DASD(SCI); Hon. David Berteau, then-ASD(L&MR); Lisa Roberts, deputy to the DASD for Transportation Policy (TP); Adam Yearwood, performing the duties of the DASD(TP) and fellows program coordinator; and fellows Renee Hubbard, Defense Logistics Agency, and Stanley McMillian, Defense Contract Management Agency. (U.S. Army photo by Eboni L. Everson-Myart)

Through visits to Congress, fellows gain exposure and insight into the legislative process. In addition, they attend national-level forums and engage in collaborative efforts with industry partners. I found these opportunities, focused predominantly on learning and growth, to be among the most valuable aspects of the program and unparalleled career experiences.

Depending on their assignments, fellows may have a chance to visit and become familiar with other government agencies as well. Perhaps even more important, the fellowship allows participants to observe and interact with appointed and career senior executives and flag officers, including one-on-one meetings with senior logistics leaders in the military departments, Joint Staff, OSD and agencies.

*The program provides the unique opportunity to be part of policy formulation and DOD-wide oversight.*

## LOGISTICS FELLOWS AS STAFF SPECIALISTS

The insights and "big picture" knowledge to be gained as a logistics fellow are virtually endless, and the fellows themselves determine much of their training and class agendas. When not directly engaged in a formal training event, a fellow's primary job is largely like that of any other staff specialist within the Office of the Undersecretary of Defense for Acquisition, Technology and Logistics, to whom the ASD(L&MR) reports. Fellows are selected, in part, based on experiential background and OSD needs, and they subsequently receive work assignments to carry out on DOD's behalf.

During my fellowship, I worked to resolve a longstanding DOD logistics policy challenge regarding prepositioned war reserve materiel. I had considerable leeway to gain needed expertise, formulate a recommendation and lead the organization to a DOD-wide solution. The assignment involved working closely with OSD staff and the Joint Staff, combatant commands, military services and agencies. I drafted a new DOD directive in accordance with the secretary's congressionally mandated obligation to provide prepositioning policy, then headed up its editing and staffing efforts across all DOD components.

Other fellows led financial accountability program initiatives, participated in department-level awards processes, led worldwide maintenance symposia and were part of source selection committees, among other DOD-level initiatives.

## INDIVIDUAL TRAINING PLANS

At the beginning of the program, fellows participate in the development of their individual training plans. They work within a predetermined budget to set priorities for training, conference attendance, field and site visits and other opportunities. Then they work with mentors who coach them to ensure that they meet their core objectives, and ultimately finalize their agendas and plans for approval.

Fellows have chosen to tour other DOD components, such as the U.S. Transportation Command, and to see the private-sector distribution hubs of leading companies such as FedEx Corp. and Wal-Mart Stores Inc., then compare their business practices with those of the Defense Logistics Agency or the services. Fellows also have chosen to attend public-private partnership courses such as those offered by the University of North Carolina at Chapel Hill and Georgetown University, among others.

Each class of fellows can tailor its individual training to its own unique needs and interests.

## FELLOWS FOR LIFE

The logistics fellows program lasts 12 months, but the fellowship continues. Fellows share a common bond for the duration of their careers and beyond, forming a support structure and facing many and diverse challenges together. The program creates lifelong friendships among logistics professionals and builds professional networks that continue for as long as they want.

I found the fellowship to be an opportunity to make new friends, reconnect with old ones and develop a vast network that I'll have for the rest of my career and life. Moreover, the fellows

## FELLOWS PROGRAM 101

**WHO:**
Highly motivated, self-starter logisticians with demonstrated promotion potential. Candidates must be field-grade officers (O-4 or O-5) or the DOD civilian equivalent (GS-13 or -14 or NH-03 or -04).

**WHAT:**
A one-year, unit-funded developmental assignment administered by OASD(L&MR) at the Pentagon.

**WHY:**
Learning, growth, professional development and experiential opportunities.

**WHEN:**
The OASD(L&MR) solicits nominations each December from the military services and agencies throughout DOD. Nominations are due in January. Selections are made in March, and fellows begin their year of training in July.

**WHERE:**
Fellows are physically assigned to both the Pentagon and the Mark Center Building in Alexandria, Virginia. Fellows whose permanent duty station is outside the National Capital Region may be authorized either a unit-funded long-term temporary duty assignment or temporary change of station.

**HOW:**
Logistics fellows are nominated by a general officer or a Senior Executive Service logistician through their respective service or agency. Each has its own tailored processes for responding to the annual OSD nomination call letter. Selections are based on a number of factors, including experience and existing OSD needs. Further program information, details and timelines are on the OASD(L&MR) website: **http://www.acq.osd.mil/log/LMR/fellows_program.html**.


**REVVING THE SUPPLY CHAIN**

Air Force Staff Sgt. Ray Medrano of the 39th Logistics Readiness Squadron moves cargo in October 2016 in the supply warehouse at Incirlik Air Base, Turkey. The author's self-directed study of supply chain policy culminated in a DOD directive on prepositioned war reserve materiel that he wrote and staffed throughout the agencies. (U.S. Air Force photo by Senior Airman John Nieves Camacho, 39th Air Base Wing)

**BONDS THAT LAST**

Having experienced together the heady challenges of DOD logistics policy and management at the highest levels, OSD Logistics Fellows form a professional and personal network that often extends well beyond their DOD service. (Image by LobodaPhoto/istock)

program has a decades-long history, giving the fellows an enduring place in OSD logistics tradition.

## CONCLUSION

Once they've completed the program, fellows return to their sponsoring organizations or follow-on assignments with stronger management skills, technical expertise and networks that span DOD logistics—not to mention the experience that each class gains of providing valuable feedback on how to improve the program and maximize its benefit for both DOD and the individual participants. Ultimately, training evaluations are used to convey what fellows have learned and achieved to their home organizations.

American journalist Norman Cousins, in reflecting upon the Apollo space program, was quoted as saying: "What was most significant about the lunar voyage was not that men set foot on the moon but that they set eye on the Earth." The OSD logistics fellows program provides DOD logisticians with not only a rich experiential odyssey but, perhaps more important, the chance to gain a deeper understanding of the OSD perspective and how it affects the entire enterprise.

*For more information, go to* ***http://www.acq.osd.mil/log/LMR/fellows_program.html****.*

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*MR. BRYAN L. JERKATIS is deputy director of logistics for the 635th Supply Chain Operations Wing, Scott Air Force Base, Illinois. He holds an M.S. in national security studies from Air University, a master of public administration from Troy University and a B.S. in business management from Southern Illinois University Carbondale.*








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## MS. JEANNIE L. SOMMER

**COMMAND/ORGANIZATION:**
Indirect Fire Protection Capability Increment 2 – Intercept Product Office; Cruise Missile Defense Systems Project Office; Program Executive Office for Missiles and Space (PEO MS)

**TITLE:** IFPC Inc 2-I Test Lead Engineer

**YEARS OF SERVICE IN WORKFORCE:** 6.5

**DAWIA CERTIFICATIONS:**
Level III in engineering and test and evaluation; Level I in program management

**EDUCATION:**
B.S. in computer science, Athens State University

**AWARDS:**
Hon. Dr. Claude Bolton Jr. Engineering and Systems Integration Professional of the Year; Outstanding Acquisition Performance Recognition from the Hon. Frank Kendall, undersecretary of defense for acquisition, technology and logistics; Honorable Order of Saint Barbara; "You Made It Happen" Recognition from PEO MS

*"A materiel developer has two customers: the warfighter and the taxpayer. As I develop test strategies, I keep both customers in mind."*

# T&E efforts cement battlefield success

Thanks to the efforts of Jeannie Sommer and her team at the Program Executive Office for Missiles and Space, Soldiers can be sure that missile defense systems work the way they're supposed to. Sommer is the test and engineering (T&E) team lead and the chief developmental tester for the Indirect Fire Protection Capability Increment 2 – Intercept (IFPC Inc 2-I) within the Cruise Missile Defense Systems (CMDS) Project Office, which manages the Army's short- and medium-range air defense systems.

IFPC Inc 2-I is a mobile, ground-based system designed to acquire, track, engage and defeat unmanned aircraft systems and cruise missiles, as well as rockets, artillery and mortars. The system can be transported by common mobile platforms and uses the Army Integrated Air and Missile Defense (AIAMD) open systems architecture.

"I am responsible for the evaluation of systems under relevant conditions, measuring performance based on requirements," said Sommer. "It's very important to ensure that systems not only work properly, but that they work in the manner and under the conditions the warfighter intended. I get a great deal of satisfaction in knowing that my work ensures that systems are effective before they are fielded to the warfighter and that I've used taxpayer dollars wisely in doing so."

Late last year, Sommer received the Hon. Dr. Claude Bolton Jr. Engineering and Systems Integration Professional of the Year Award from the assistant secretary of the Army for acquisition,

logistics and technology (ASA(ALT)). Bolton, who died in 2015, served as ASA(ALT) from 2002 to 2008, and the award was established in 2016 to honor his service, character and sacrifice. Sommer was recognized for her work on an engineering demonstration that showcased the IFPC Inc 2-I capability and demonstrated its readiness to begin engineering and manufacturing development.

The demonstration involved the integration of the multimission launcher, the AIAMD battle command system and the Sentinel and PATRIOT radars, culminating in the firing of four different interceptors in a fully networked environment. Sommer established a test program that saved more than $30 million through the efficient use of test assets and range time. Her coordination and planning efforts generated additional efficiencies by synchronizing test activities with the AIAMD and Sentinel product offices.

"I was very surprised and humbled by the recognition," said Sommer. "There are many talented, hardworking engineers in the acquisition workforce, and to be recognized was quite an honor. I also reflected on the team behind my success and was very thankful for the amazing things they accomplish on a day-to-day basis. I'm blessed to be a part of such an amazing organization."

Sommer began her career as a software developer with the Missiles and Space Intelligence Center within the Defense Intelligence Agency. That work sparked her interest in system development, and in 2005 she accepted an acquisition position in T&E with the Joint Tactical Ground Station Product Office. She transitioned to the IAMD Project Office in 2009, and joined the CMDS Project Office four years later.

While with the IAMD Project Office, Sommer served as a DA systems coordinator—"a pivotal moment in my career," she said. That assignment broadened her thinking and changed the approach she takes when developing acquisition strategies and execution plans. "Prior to this assignment, I primarily focused on providing quality products to the warfighter. I now have a better understanding of how a program's budget should be managed and how important it is to ensure that taxpayer dollars are spent efficiently as well as developing quality products," she explained.

"A materiel developer has two customers: the warfighter and the taxpayer. As I develop test strategies, I keep both customers in mind, ensuring that I provide the best product to the warfighter while using taxpayer dollars wisely."

In addition to T&E managerial and oversight duties, Sommer serves as chair of the T&E Working Integrated Product Team and is responsible for bringing together stakeholders to develop, manage and execute the T&E strategy in the Test and Evaluation Master Plan. Stakeholders include the user community from the Fires Center of Excellence (FCOE), the U.S. Army Test and Evaluation Command (ATEC) and the Office of the Secretary of Defense (OSD).

"FCOE creates capabilities through developing requirements, ATEC conducts an independent operational assessment of the system and OSD evaluates whether the system has been adequately tested, confirming operational effectiveness and suitability of the system in combat use," she explained. Coordinating their expectations is not without its challenges, she noted. "Some of the challenges stem from different interpretations of the requirements and how we plan to test and evaluate the system's performance based on those requirements. I manage the expectations of the three organizations, developing a test strategy that addresses all stakeholders' concerns within the budget and schedule constraints of the program."

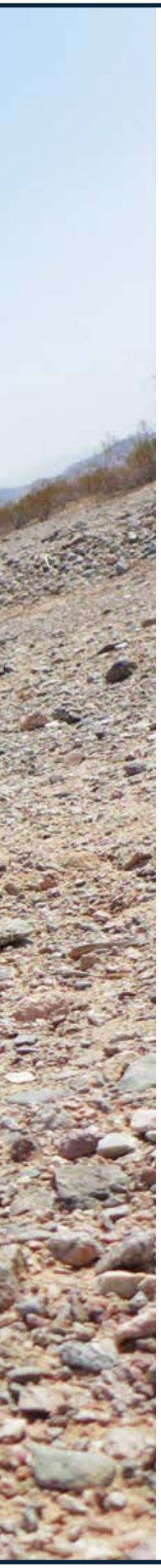
While serving as a test engineer at AIAMD, Sommer had the good fortune to work with senior leaders, who played pivotal roles in her career development. "Jaime Zapata, AIAMD test planning lead, had a significant impact on my career. He always provided an honest assessment of my abilities, letting me know where my strengths and weaknesses were, and provided opportunities for me to grow," Sommer said. "Col.(P) Rob Rasch, then-IAMD project manager, also played a large part in furthering my career by believing in my abilities, providing me career-broadening opportunities and increasing my level of responsibilities." Sommer continued, "My current supervisor," CMDS T&E Director Dan Jones, "continues to provide guidance and opportunities to further enhance my career development."

She's now in a position to mentor others, and she advises them to find a mentor early. "Find someone with the qualities you would like to develop in yourself and learn from them. Be willing to change through tough conversations and constructive criticism." She also recommends obtaining Defense Acquisition Workforce Improvement Act certifications in multiple career fields and exploring career development opportunities across functional areas to become well-rounded. And, she noted, "It's crucial to take leadership and communication classes for personal and professional development."

*—MS. SUSAN L. FOLLETT*

**SREHD SCANNING**

SREHD's onboard stereo camera helps it maneuver through urban or rough terrain with minimal input from the human operator. The robotic system provides Soldiers the freedom to maneuver on the battlefield and locate explosive hazards on or below the surface. It also reduces the number of Soldiers in harm's way by eliminating the need for Soldiers walking a route with a handheld sensor as well as the troops who protect them from enemy fire. (Photo courtesy of PM CCS)



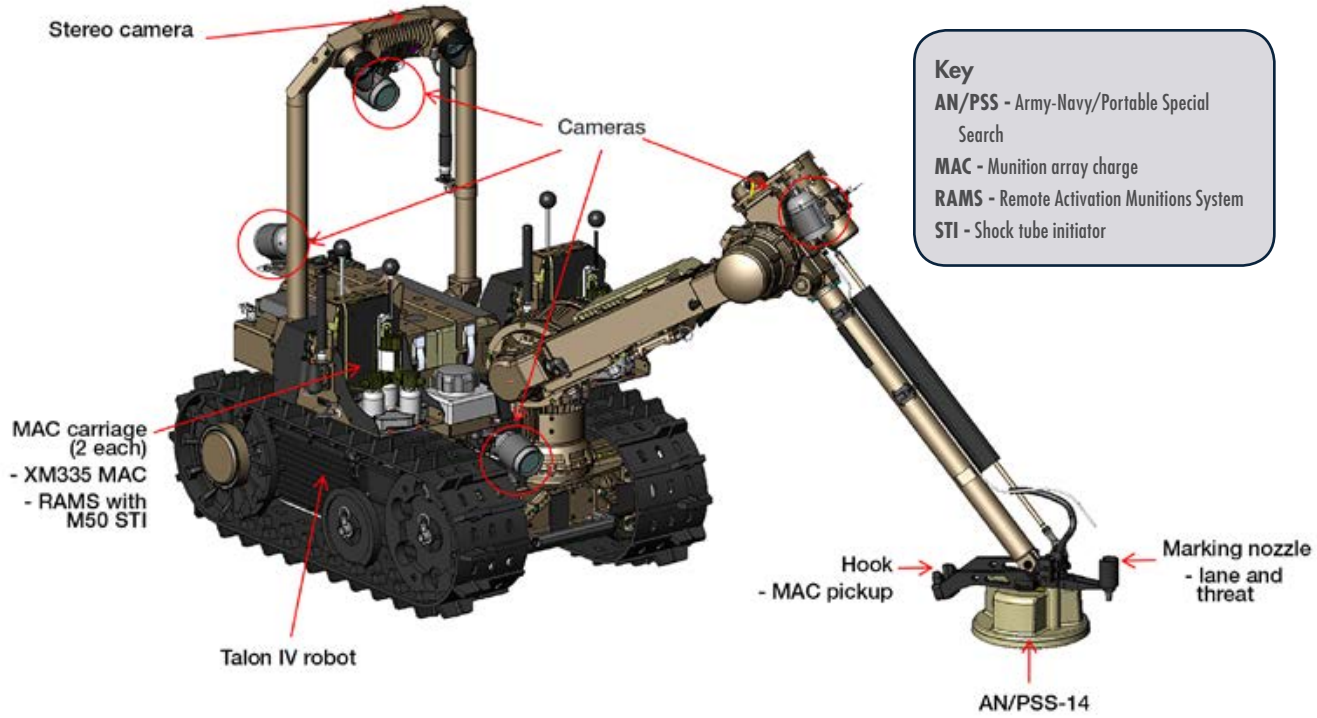
# SREHD **SHREDS** THE HANDHELD COMPETITION

PM CCS is using robots to detect, mark and neutralize explosive hazards while keeping Soldiers at a safe distance.

*by Maj. Lendrick James and Mr. Kwai-Fung Chan*

Searching for explosive hazards with handheld mine detectors can be both physically and mentally taxing. Explosive hazards can be buried underground, laid on the ground or placed flush with the ground's surface. There are a variety of techniques to emplace them, including scattering the devices on the ground or delivering them by vehicles or helicopters. The Project Manager for Close Combat Systems (PM CCS), within the Program Executive Office for Ammunition, has partnered with Carnegie Robotics LLC, a cutting-edge manufacturer of advanced robotic sensors and platforms, to pursue integration of sensors for detection and neutralization technology onto a robotic platform. The Army is moving quickly to provide Soldiers with this platform, known as the Standoff Robotic Explosive Hazard Detection System (SREHD).

SREHD is capable of detecting, marking and neutralizing explosive hazards—landmines, improvised explosive devices and unexploded ordnance—without requiring Soldiers to endanger themselves while operating the system. SREHD can be used in confined areas to support full-spectrum military operations, the simultaneous and continuous combination of offensive, defensive, stability and civil support operations. It provides freedom to maneuver on the battlefield as well as the layer of protection Soldiers need to precisely detect, mark and neutralize explosive hazards so that they can carry out missions as planned, without interruption and with a lower risk of injuries.




**HOW IT ALL COMES TOGETHER**

SREHD integrates new and existing capabilities on the Talon IV robotic platform, chosen in part for its ability to move through rough terrain. Capabilities include stereoscopic imaging, the AN/PSS-14's dual GPR and EMI sensor, and a MAC integrated with RAMS to neutralize explosive hazards. (SOURCE: Carnegie Robotics LLC)

This semiautonomous system combines new and existing modular capabilities integrated onto an unmanned ground vehicle. The Soldier stays out of harm's way while he or she is focused on clearing explosive hazards. SREHD is integrated with TALON IV robotic platforms, which are maneuverable on rough terrain. The system uses state-of-the-art stereoscopic, 3-D imaging that accurately determines distances and elevation between objects. The stereo camera provides obstacle avoidance to ensure that SREHD does not go over a cliff or hit a rock during detection. This allows the system to maneuver through complex terrain—urban or rural, irrigated or unirrigated—with minimal input from the operator.

SREHD is an important step toward providing today's Soldiers with tomorrow's technology. The development and use of semiautonomous robotic systems such as this one will lead to more advanced, fully autonomous robots that Soldiers can leverage in the future.

## DETECTING A GAP IN DETECTION

The requirement for SREHD dates to 2009, when the U.S. Army Maneuver Support Center of Excellence identified a capability gap: a way to protect Soldiers conducting detection and neutralization missions. Explosive hazards present a multitude of challenges to the Soldier in terms of operations tempo, extensive exposure to potential enemy fires and vulnerability to secondary attacks. In addition, explosive hazards are often found in areas where only handheld detection techniques can be used, further increasing the risks Soldiers face. Standoff capability provides the protection Soldiers need while they perform tasks such as clearing vehicles at chokepoints, roadsides and intersections.

In recent years, the Army has increased its emphasis on combined arms maneuver and wide-area security, so it was critical for PM CCS to align SREHD's capabilities to support combat engineers' route clearance missions. To achieve maximum effectiveness, SREHD leverages existing technologies such as:

- The Remote Activation Munitions System (RAMS), a secure, radio-controlled

**COME THIS WAY**
Combat engineers follow SREHD during a route clearance mission. SREHD's capabilities are in line with the Army's renewed focus on the broad range of wide-area security work that builds on the gains made during combined arms maneuver—which SREHD also enables. (Photo courtesy of PM CCS)

system to remotely initiate demolition charges.
- Ground-penetrating radar (GPR), a technology that provides 3-D analysis of buried objects.
- Electromagnetic induction (EMI), metal detection and neutralization that renders explosive hazards incapable of detonating on a target.

SREHD is also integrated with the Army's program-of-record handheld explosive hazard detector, the Army-Navy/Portable Special Search (AN/PSS)-14. The AN/PSS-14 is a portable, battery-powered, lightweight detector that uses both the GPR and EMI sensors. The system, operated by one person, is designed to locate a variety of mines. It provides SREHD with GPR and metal detection, and the munition array charge integrates with RAMS to neutralize the hazard.

## CURRENT CHALLENGES

A challenge with handheld detectors is their false alarm rate. EMI handheld detectors encounter about 200 false targets to every anti-personnel mine. For the GPR handhelds, clutter under or on the ground poses a major problem—electronic and physical rubble and other obstructions can cause false alarms. Instead of seeing a clear image of an explosive on the threat map of the operator control unit (OCU), the operator sees a lot of red dots or specks that make it difficult to find the real explosive on the screen.

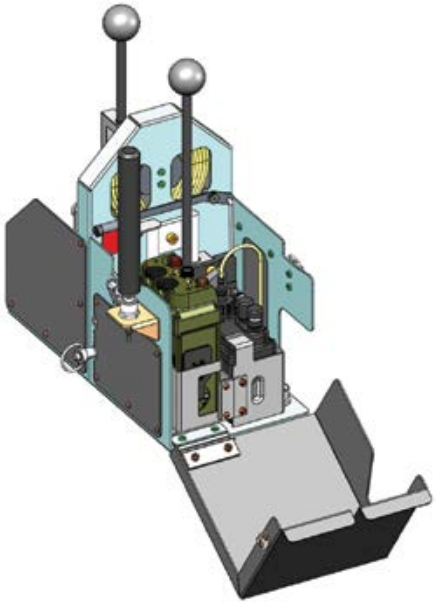
Clutter can completely obscure the buried explosive hazard, which makes searching with handheld mine detectors not only grueling but life-threatening. PM CCS has developed SREHD to alleviate some of these physical and mental demands. The Army is currently investigating technology for a new GPR that can detect hazards across a larger area and at greater depth, faster and with better signal-to-noise ratios and improved user interface displays.

## BRIDGING THE GAP

Explosive hazards have been a constant danger to Soldiers during conflict and to innocent people years after conflicts end, causing thousands of deaths and injuries each year. SREHD provides multiple lifesaving improvements over handheld mine detectors, such as standoff capability, visual and audio detection through the use of an OCU, closer-to-pinpoint accuracy in detecting landmine locations, reduced operator workload and decreased training requirements.

The OCU is a vital component of the system and is the only interface between the operator and SREHD. The SREHD OCU has a display tablet, computer and radio, and allows the operator to switch among different screens and views. In addition, the tablet allows the operator to maneuver SREHD and see where it is going through the use of both stereoscopic imaging and conventional cameras. Intuitive and easy to use, the OCU makes training on the SREHD faster than the training required for some other types of explosive hazard equipment.

SREHD's unique and critical marking capability helps operators identify the locations of potential explosive hazards



**INSIDE AND OUTSIDE**

These internal and external views show the explosive hazard neutralization payload of the carriage and MAC. The MAC provides the neutralization capability, and the carriage holds the remote capability that makes it possible for the Soldier to initiate the neutralization at a safe remove from the explosion. (SOURCE: Carnegie Robotics LLC)

during breaching and clearing operations. The system uses a blue highlight-marking chemical to mark a suspected explosive hazard and enable effective neutralization. Marking the explosive hazard gives every person involved situational awareness of where hazards are and improves efficiency by reducing the amount of rework—because it eliminates the need to search again when shifts change and new Soldiers arrive.

SREHD is, in sum, a safer system for keeping the Soldier and the platform out of harm's way. Handheld detectors lack marking and neutralization capabilities, so a single error or failure to detect a hazard jeopardizes Soldiers engaged in the countermine operation.

Furthermore, loss of proficiency occurs when there is an extended period between original training on new countermine equipment and operational use. In the near future, Soldiers will be able to train on SREHD in both virtual and physical environments across many scenarios, meaning more frequent training. The training will simulate explosive hazard removal with the operator using a laptop computer or will be conducted live using the OCU with the robot.

## CONCLUSION

Nothing is more important than the freedom to safely operate and conduct missions wherever required on the battlefield. Standoff capability is important because it allows operators to detect, mark and neutralize explosive hazards while enabling the Soldier to remain in a defensive posture and evade potential threats such as direct enemy fire. It also relieves other Soldiers from providing additional security for clearance missions.

Detecting, marking and neutralizing explosive hazards that impede movement demand a complete spectrum of countermine solutions that is currently unavailable. SREHD will meet this need. The system has completed thorough product qualification testing at Yuma Proving Ground, Arizona, and has performed well in each of its key performance parameters: system and cyber survivability, training, transportability, detection, marking and neutralization.

Upcoming events for SREHD include milestone C approval by July 2017, low-rate initial production throughout the first half of FY18, and initial operational test and evaluation during the second quarter of FY19.

*For more information, contact Maj. Lendrick James at* ***lendrick.y.james.mil@mail.mil*** *or go to the PM CCS website at* ***http://www.pica.army.mil/pmccs/MainSite.html****.*

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# X MARKS *the* SPOT

Imagine trying to create a picture of the internet. Even if you could, it'd be out of date in seconds. Trying to visualize the cyber battlefield is roughly like that—and that's just the beginning of planning and executing mission command for Army cyber operations. These problems aren't just hard, they're 'DARPA hard.'

*by Lt. Col. John Bushman, Mr. Jack Dillon, Mr. Michael Padden and Mr. Frank Pound*

Portraying maneuver warfare in the cyber domain is a difficult thing to do. After all, how can you show maneuver in cyberspace? There are no tangible flanks to defend, no rivers to cross and no visible military camps to target or avoid. But cyberspace presents our forces with vulnerabilities that nonetheless are critical to protect.

Providing Soldiers with a common operating picture (COP) in cyberspace is imperative to planning, integrating and executing cyber operations. This so-called cyber COP must display the status of weapons, provide situational awareness of friendly and enemy cyber activity, enable command and control of cyber effects and allow collaboration between commanders. Until recently, this picture was not only tough to portray—it didn't exist.

Now, by merging computer science with military science, the cyber COP is becoming viable through a battle management system known as PlanX. With PlanX, commanders can see the cyber terrain in much the same way they would view a battlefield and synchronize cyberspace effects with key related warfighting functions such as fires, intelligence, signal, information operations and electronic warfare.

The Defense Advanced Research Projects Agency (DARPA) developed the PlanX platform and plans to transition it to the Army in the next fiscal year. The platform and accompanying strategy aim for balance between equipping the cyber force with off-the-shelf capabilities to satisfy immediate operational needs and knowing that some capabilities will need to push the envelope so the Army is not buying yesterday's technology to meet current and emerging threats. Unlike the myriad individual tools the cyber force has received to date, PlanX lays a common foundation that captures the essence of the military decision-making process and equips operators with the tools needed to view cyber terrain, reason about cyber activity and fight with cyber capabilities.

## GUARDING THE PERIMETER

As the Army prepares to operate in a contested, multidomain arena that combines land, air, sea, space and cyber, PlanX crosses an important threshold in making cyber operational at the tactical level. For the acquisition community, it also serves as a new approach to attaining emerging cyber capabilities that are needed quickly.

In developing PlanX, DARPA worked closely with the U.S. Army Cyber Protection Brigade, Army Cyber Command (ARCYBER), the assistant secretary of the Army for acquisition, logistics and technology and multiple program executive offices to ensure that the capability met operational needs for the Army's cyber force. But unlike the existing tools in the Cyber Protection Brigade arsenal, which are used mainly for specific functions such as surveying and securing, PlanX lays an integrated foundation for executing, collaborating, planning and managing a wide range of operational cyber activities. It also integrates cyber into the fighting mindset by making it easier for Soldiers to visualize networks as key terrain they are charged to protect.

To provide a common foundation and operational platform, PlanX integrates new and existing cyber tools and enables collaboration across multiple teams operating simultaneously. Tools are selected automatically based on mission-specific plans—a vital time-saving capability in the cyber realm, where vulnerabilities can be exploited within seconds. The tools then are deployed to monitor, survey and map target networks to detect disruptions and irregularities, and determine whether those anomalies are malicious.

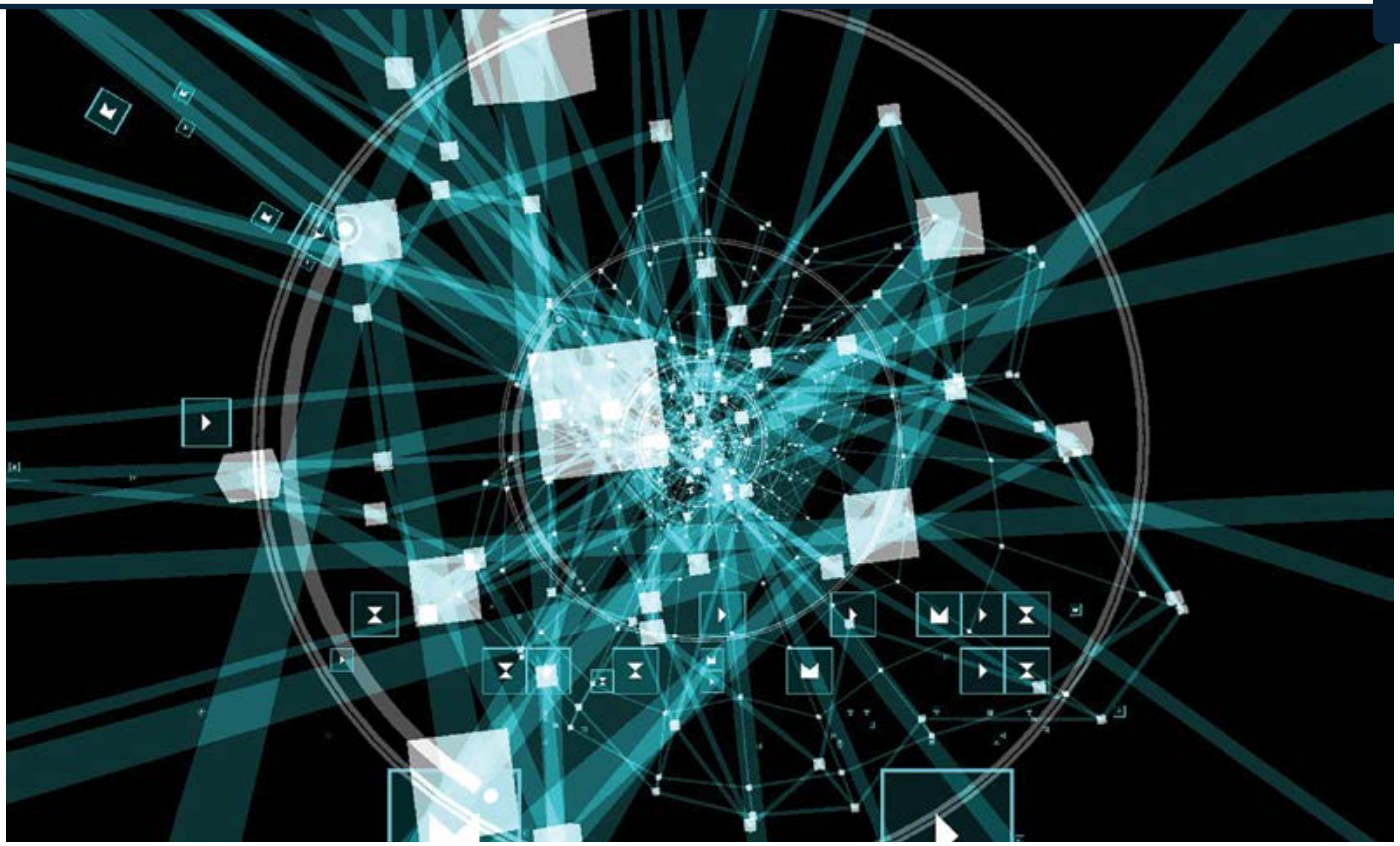
Think of it as defending an Army unit out in the field. Just as a stray dog could break a perimeter with no malicious intent, network disruptions can also be just that: a glitch. With PlanX, the cyber force will have a common operating picture of information—portrayed through standardized icons, intuitive graphics and symbols—to illustrate network irregularities and relationships, allowing Soldiers to determine the nature of the threat and act accordingly. Perhaps even more powerful, PlanX promotes a shared understanding of cyberspace by "baselining" the networks so cyber protection teams can quickly visualize and identify anomalies. Baselining cyber terrain, or determining which critical assets to defend, is no different from establishing the engagement area for any defensive operation.

This visualization component is also a key driver in ensuring that the capability is embraced by not only the most skilled, experienced cyber Soldiers, but by other operators as well. To make PlanX as intuitive as possible, DARPA developers sought to abstract and automate burdensome or complex tasks and functions. It also conducted training and war-gaming to enable rehearsals in virtual ranges while measuring performance and evaluating actions, so that commanders, operators and analysts can collaborate and make informed risk decisions. Focus areas within the ranges include mission rehearsal, operator training and malware analysis, which are used to test the simulations and understand the results.

## NOT JUST ANOTHER PRETTY FACE

While PlanX is turning heads because of its capability alone, it also is being closely studied by acquisition officials, including those in the Army Rapid Capabilities Office, who believe it could serve as a model for quickly prototyping and transitioning emerging technologies. Stood up in August 2016, the Rapid Capabilities Office is focused on rapid prototyping and initial equipping of capabilities, targeting the areas of cyber, electronic warfare, survivability and positioning, navigation and timing, as well as other high-priority projects designed to enable Army operations in contested environments. The office is watching how parts of the technology could possibly be delivered as a prototype or initial build, which could mature over time through incremental improvements delivered in partnership with the Army's acquisition and science and technology communities.

Rare among military acquisition projects, PlanX fully embraced innovative development methods straight out of Silicon Valley. Take, for example, the surge weeks, "user jury" type events that spur a constant and rapid cycle of improvement. The process follows a six-week rotation, kicked off when DARPA takes the latest software build of PlanX to the Cyber Protection Brigade so commanders and operators can use and experiment with it. Their feedback informs future development sprints of PlanX by identifying and prioritizing feature requirements, which



**BRINGING CYBER INTO FOCUS**

DARPA's PlanX is working to help military cyber operators visualize the cyber battlespace and perform missions there based on an established cyber framework and a common operating picture. PlanX engineers are developing platforms that DOD will use to plan for, conduct and assess cyber warfare in a manner similar to kinetic warfare. (Image courtesy of DARPA)

are then incorporated into the development schedule and demonstrated during the next surge week. The first three surge weeks produced almost 300 feature requests and identified bugs that brought refinements to PlanX components, including the COP, battle tracking methods, force management and threat overlays.

This quick and continuous interaction between DARPA, serving as the developers, and the Cyber Protection Brigade, serving as the operators, is known in the computer gaming community as DevOps, a mashup of the terms "software development" and "information technology operations." In the gaming world, if the operators or customers aren't happy or if the product is not intuitive to operate, the game is not getting played and the online reviews are largely negative. This constant feedback pushes game developers—and other cutting-edge companies such as Facebook—to change code daily. Sometimes, the user is unaware of those changes. Other times, the changes are announced as an upgrade. Either way, DevOps represents constant and rapid change based on steady interaction with operators.

DARPA is spreading this mindset in the Army development community by conducting regular PlanX App Boot Camps, where software engineers demonstrate the ease of building and integrating tools within the PlanX system. Also, recognizing that PlanX is an operational tool that will need to work in a system-of-systems environment, DARPA participated in Cyber Guard and Cyber Flag, annual exercises aimed at dealing with cyber threats, and Hackathon, a weeklong exercise held in Arlington, Virginia, to learn how to detect unfriendly network intrusions, for additional feedback on PlanX. Not stopping there, DARPA also brought in third-party red teams to hack the software, giving a fresh set of eyes the opportunity to find new vulnerabilities.

## SET FOR RELEASE

With a planned transition in September to the Program Executive Office for Enterprise Information Systems' (PEO EIS) Project Manager for Installation Information Infrastructure Communications and Capabilities (PM I3C2), PlanX will soon graduate from prototype to program. It will be part of the Army's Defensive Cyber Operations Mission Planning solution,

which provides an application-based, scalable, secure warfighting capability to support cyberspace operations, mission command and planning at the global, regional and local levels.

The transition represents a significant milestone for the Army. PlanX was built to test a "DARPA hard"—or extremely difficult to achieve—hypothesis: to determine if a system could abstract and interact with cyberspace in such a way that users could apply the military science of maneuver-centric warfare to cyber operations. Now, with only a few months remaining before the program transitions to the acquisition arena, the Army is set to gain a system that could serve as its baseline mission command system for cyberspace operations.

Technology maturity will be key to the success of the PlanX transition, and PM I3C2 has been engaged in the program since its beginning. An initial technology readiness level assessment was conducted with Carnegie Mellon University in the first quarter of FY17, and PM I3C2 will continue to assess the technology throughout the next several months with key stakeholders by leveraging developmental and operational assessments to ensure that the technology is ready for transition to production and deployment.

Another critical aspect of the transition is requirements planning and documentation. Recognizing that the development of information systems is quite different from that of a major weapon system, the Army is using the proven Information Technology (IT) Box approach for its defensive cyber operations capability requirements. This construct provides the flexibility needed to meet the challenges of cyber. The IT Box breaks down the information system initial capabilities document into deliverable increments, based on requirements definition packages, and uses periodic capability drop documents to make changes to a baseline product. This approach allows the Army to adjust and upgrade PlanX and related capabilities more quickly to keep pace with evolving technologies and threats.


**SURGING FORWARD**

Army Cyber Protection Team members use PlanX at a recent surge week, one of the development methods used to create and improve the system. First used by software and system developers in Silicon Valley, surge weeks are designed to gather user feedback about system functionality. That feedback is used to identify and prioritize new requirements, which then are incorporated into the development schedule and demonstrated during the next surge week. (U.S. Army photo)

## CONCLUSION

With global threats changing rapidly, the Army recognizes the need for increased readiness in cyberspace, including across DOD's Cyber Mission Force. PlanX supports several of Army Cyber Command's operational priorities for designing, building, delivering and integrating capabilities for the future fight. PlanX will likely inform future offensive cyber operations capabilities as well.

At the same time, PlanX shows how Army acquisition can balance initial capability to satisfy requirements while also laying the groundwork to adopt emerging technologies quickly. Industry already does this, and the Army's broader cyber community is watching and listening. With DARPA's agility setting the stage for further improvements at PEO EIS, tomorrow's Soldiers could have a cyber COP and common foundation that is just as familiar as physical terrain—and corresponding capabilities to defend, fight and win on this newest field of battle.

**SAME MISSION, DIFFERENT BATTLEFIELD**

Soldiers with the 780th Military Intelligence Brigade conduct cyberspace operations during a training rotation at the National Training Center at Fort Irwin, California, in January 2016. The Fort Meade, Maryland-based 780th was one of several cyber organizations participating in the rotation as part of a pilot program designed to help the Army develop how it will build and employ cyber in its tactical formations. (U.S. Army photo)


**IDENTIFY, DEFEND AND PROTECT**

By incorporating information like this screenshot, which shows a view of the battlespace and the status of executed courses of action, PlanX allows warfighters to plan and conduct cyber missions based on the defense of key cyber components such as mail and file servers, routers and gateways, and provides visibility into the status of those components. (Image courtesy of DARPA)

*For more information, go to* ***http://www.eis.army.mil/****;* ***http://www.darpa.mil/****;* ***http://www.arcyber.army.mil/Pages/ArcyberHome.aspx****; and* ***http://rapidcapabilitiesoffice.army.mil/****.*

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**BLUE TEAM SEARCHES FOR RED**

A High Mobility Multipurpose Wheeled Vehicle outfitted with a radar system scans for possible enemy aircraft during a training exercise as part of NIE 16.2 near Fort Bliss, Texas, in May 2016. NIE 16.2 took a new approach to testing and evaluating new cyber capabilities: Instead of keeping the teams that play Army users and opposing forces separate until the event was over, NIE 16.2 allowed them to talk and evaluate during the event, giving stakeholders a better understanding of new systems' strengths and weaknesses sooner. (U.S. Army photo by Sgt. Jarred Woods, 16th Mobile Public Affairs Detachment)

# PARTNERING at the *SPEED* of CYBER

Stakeholders broke out of traditional roles while testing and evaluating cybersecurity at NIE 16.2, learning that when red and blue teams talk earlier and more often, cyber systems get stronger.

*by Lt. Col. Jeff Strauss and Mr. Robert Wedgeworth*

The ever-increasing complexity and interconnectivity of Army tactical networks and mission command systems, along with the requirement for mission assurance in the contested domain of cyberspace, present a unique challenge to operational test and evaluation (T&E). The challenges in cyber T&E stem from several factors, first among them the sheer number of devices and the amount of data they exchange. These, when coupled with the growing size, evolution and complexity of software and the ever-present human factor risks, can make it seem nearly impossible to assess the true cybersecurity posture of our networks.

These challenges call for new and innovative ways to partner for success in cyber T&E—in fact, a fundamental change in our traditional approaches. One such successful partnership was evident recently in the teaming of multiple organizations at Network Integration Evaluation (NIE) 16.2. During this event in May 2016, the stakeholders charged with developing, testing, fielding and ultimately operating and defending tactical networks and mission command systems took a fresh look at cybersecurity T&E paradigms, including the exchange of information.

These stakeholders included program managers (PMs) from the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA(ALT)), along with testers from the U.S. Army Test and Evaluation Command (ATEC), the U.S. Army Research Laboratory (ARL), the U.S. Army Training and Doctrine Command (TRADOC) G-2, and the Threat Systems Management Office (TSMO). Army cyber defenders at the brigade, division and regional cyber center levels completed the team.

Cybersecurity T&E requirements are grounded in DOD Instruction 5000.2, "Operation of the Defense Acquisition System," and other supporting regulations and directives. The primary purpose of cybersecurity T&E is to determine the operational impact of real-world cyber effects on the unit's mission. The overall evaluation of a system's cyber posture is a result of testing across the spectrum of developmental and operational environments, which typically follow the test-fix-test model. The operational test (OT) environment is the most complex and involves linking the system under test to the Soldier operators and defenders in an operational environment, including a representative cyber threat force.

## CYBER TESTING STEP BY STEP

The first step to cyber testing during an OT event is a cooperative vulnerability and penetration assessment (CVPA). Cybersecurity professionals evaluate the system to uncover all potential vulnerabilities and threat vectors. The system technical experts, typically program office or field service representatives, and network defenders cooperate fully and work directly with ARL testers to perform a comprehensive assessment. The CVPA typically occurs weeks or months before the actual OT. The results of the CVPA are shared with defenders and owners of the system under test. Then cooperation begins to attempt to correct any cyber deficiencies before the next phase of testing.

The second cybersecurity test event is the adversarial assessment. This assesses the ability of a unit equipped with a system to support its missions while withstanding validated and representative cyber threat activity. Additionally, testers are chartered to evaluate the ability to protect the system, detect threat activity, react to threat activity, and restore mission capability degraded or lost due to threat activity. In NIE 16.2, cyber operators from the TSMO assumed this adversarial role, attempting to gain access, exploit vulnerabilities and create mission effects on the systems under test.

## BLUE VS. RED

In a traditional OT environment, participants maintain a rigid separation of the test audience, known as the blue team, and the opposing threat forces, or the red team, to preserve the operational realism of the test event. In the cyber domain, this "firewalling" of the red and blue elements historically has led to disappointing and frustrating cyber assessments.

There are several challenges with this traditional model. The primary challenge is a lack of timely detailed feedback on the systems and the efforts to defend them; feedback typically is not available until well after all testing is completed. Without any dialogue among stakeholders, these OT events fail to achieve their full potential in uncovering system vulnerabilities and developing improvement strategies for detection and mitigation. While traditional tests typically achieve the goal of demonstrating the operational risk of cyber vulnerabilities, they fall short of the goal to actually improve prevention, detection and mitigation procedures.

Historically, OT cyber testing has revealed a consistent list of problems: default passwords, misconfigured hardware, poor user behavior and unpatched vulnerabilities. While this is important, much more can and should be learned from these rare opportunities to exercise cyber defense in a realistic environment. When cybersecurity OT finds only seemingly simple issues that surface routinely, it leads to frustration for decision-makers at every level.

The result of firewalling key players during cyber OT often results in the system's PMs discovering the "bad news" far too late in the system life cycle, when making meaningful changes is more costly and time-consuming. The lack of real-time feedback was also a problem for principal decision-makers throughout the acquisition and T&E communities who desired more comprehensive exploration of cyberattack vectors and methods.

## A DIFFERENT APPROACH

During NIE 16.2, Brig. Gen. Kenneth L. Kamper, then commanding general of ATEC's Operational Test Command, envisioned a different approach to cyber OT centered on teaming. "We have some very specific goals when it comes to cyber operation testing and protocols that need to be followed for good reasons, but we also ought to be using every opportunity to learn and get better every day," Kamper said after the event.

Striking that balance was the goal of several partner agencies charged with conducting cyber OT at NIE 16.2. The central concept involved much more frequent and results-minded interaction between the red and blue elements. The assumption was that if the network

**ONE DEVICE OF MANY**

A Soldier assigned to 1st Battalion, 1st Infantry Regiment, 2nd Brigade Combat Team sets an unmanned observer drone during NIE 16.2. The huge number of devices and systems in the network—and the volume of their interactions with one another and their human users—make it difficult for Army cyber defenders to get a true picture of the Army's cybersecurity posture. This challenge has prompted closer and more far-reaching partnerships among stakeholders in the acquisition, T&E, research, training and doctrine and threat assessment communities to develop more effective assessments. (U.S. Army photo by Sgt. Henrique Luiz de Holleben, 55th Combat Camera)

defenders (blue team) were provided more information about how the cyber threat (red team) was behaving, they would be in a much better position to prevent, detect, react to and ultimately defeat the cyber threat and restore systems. The result would be a more comprehensive assessment of the cybersecurity posture of systems under test during the condensed testing window of the 14-day evaluation.

The teams met before the event and at the midpoint to discuss what each was seeing on the network. These formative discussions, while somewhat guarded to maintain a spirit of fair competition, were productive in ensuring that the teams were not overly focused on one aspect of the network and systems. At the end of the event, a much more robust and open technical exchange was conducted. This exchange, labeled the "Tech-on-Tech," was analogous to the after-action reviews that are a staple of the combined arms training centers. Here, both red and blue teams discussed what their plans and actions were during each phase of the test event. The discussion allowed an immediate, in-depth analysis of the action-to-counteraction maneuvering on the network, and resulted in lessons learned for the defenders as well as those responsible for system engineering and design.

## TECH-ON-TECH

A special feature of this exchange was the presentation of a codified assessment of defenders' actions against the threat. This evaluation rubric outlined behaviors and criteria along a continuum of observed indicators from the viewpoint of the adversary. The red team essentially told the blue team how hard the blue team made each phase of the threat presentation based on discrete observations of the network security. The feedback from the event was uniformly positive. One observer from the

blue team stated that he learned more during this event than from all previous NIEs combined. This positive response has prompted decision-makers to further explore and codify this concept for future NIEs and similar cyber test events.

While senior leaders in the test and PM communities push for more opportunities to partner closely in cyber T&E, they are also paying special attention to ensure the integrity and validity of operational realism. In planning future exchanges during OT, caution is warranted in data exchanges among developers, defenders and testers. It is critical that teams not mask system issues, and thus make system performance appear better in a test than it would actually be in a true operational situation, by exchanging too much information. Invalid testing could allow the fielding of substandard equipment, threaten our national security and ultimately cause loss of service members' lives.

**ENABLING BETTER MISSION COMMAND**

A Soldier inspects a mobile WIN-T network node during NIE 16.2. WIN-T provides the tactical communications network backbone to enable mission command, network communications and situational awareness across the brigade. The real-time interactions between red and blue teams at NIE 16.2 offered WIN-T's developers the opportunity to note and fix weaknesses in this critical backbone sooner. (Photo by Amy Walker, PEO C3T Public Affairs)

The stakeholders at NIE 16.2 did an excellent job of balancing this need to maintain threat integrity for the system under test with the desire to make systems better through collaboration. While these partnering events were not as robust as exchanges held during training events or Army Warfighting Assessments, they re-established the notion of "one team" and helped break down the "us vs. them" atmosphere that can inhibit positive exchanges and improvement in cybersecurity.

Ensuring that systems are ready for Soldiers to rely on them on the battlefield remains the focus of operational testing, and these exchanges helped to meet that end. The Tech-on-Tech discussion, observed by PMs and developers, provided great insight into the test and how systems fared against a representative cyber threat. The content was much more technical than at previous events, covering specific software and hardware vulnerabilities and exploitations. During the final exchange, subject matter experts from both teams participated in focused discussions with system developers on how to thoroughly improve the system under test.

## CONCLUSION

The initial feedback on these discussions has been very positive. Col. Greg Coile, project manager for the Warfighter Information Network – Tactical (WIN-T), praised the continued partnering initiative. "The insights we gained in near-real time of potential vulnerabilities in the network and applications enabled us to make rapid improvements to continue to harden the network," he said after the event.

A post-test presentation of NIE 16.2 cyber findings, hosted by the Program Executive Office for Command, Control and Communications – Tactical (PEO C3T) after a more comprehensive analysis of the event results, discussed various source code and software features that could be modified to enhance security. This review looked at network diagrams and screenshots of trouble areas, among other analysis, and reinforced the spirit of partnership as developers, PM system engineers, various software testers, red and blue teams, and PM and PEO leadership worked together to better understand the cybersecurity posture and performance of the tested systems.

After the event, Nancy Kreidler, the information assurance program manager for

**FEEDBACK STRAIGHT FROM THE FIELD**

During NIE 16.2, Soldiers in the desert delivered feedback on the systems under test through the 2nd Brigade Combat Team, 1st Armored Division's Main Tactical Operations Center. Culminating this steady feedback was an open, rigorous, highly detailed Tech-on-Tech review at the end of the NIE in which the red and blue teams discussed their plans and actions to attack and defend a cyber system during each phase of the test event. (Photo by Vanessa Flores, ASA(ALT) System of Systems Engineering and Integration Directorate)

PEO C3T, summed it up this way: "The follow-on technical exchange between the red team and our larger team of security engineers from the program offices was invaluable. It allowed our folks to look at vulnerabilities in a new light and get after some of these challenges in our labs."

The unassailable truth about cybersecurity is that the discipline is evolving at a rate that challenges our current processes all along the spectrum of doctrine, organization, training, materiel, leadership and education, personnel, facilities and policy. If we are to have any chance to surmount this rapidly changing problem, we must be willing to challenge our own culturally entrenched ways of thinking about the problems and refuse to become moored to any idea that limits our overall ability to respond to change and accomplish valid and reliable testing. Partnership among all stakeholders is the key to tackling these difficult problems in a dynamic discipline.

*For more information on how programs can succeed through increased partnering between the test and acquisition communities, or to request test team support, go to* ***https://www.atec.army.mil/rfts.html****.*

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**SMARTER, SAFER RESUPPLY**

Joint Sustainment Command – Afghanistan Soldiers conduct a convoy in southern Afghanistan to relocate equipment between Tarin Kowt and Kandahar. CERDEC is exploring artificial intelligence technologies that could perform logistics analysis to determine when, where and how to conduct maneuvers like this to resupply critical mission assets. (Photo by Capt. Steven P. Haggerty, 1225th Combat Sustainment Support Battalion, Army National Guard Element, Joint Force Headquarters Michigan)

# Mission Command on Semi-Automatic

Autonomous control of routine, time-consuming tasks could free up commanders to concentrate on more difficult decisions.

*by Mr. James Hennig, Dr. Peter Schwartz and Ms. Kathryn Bailey*

When the fight commences, the commander shifts the military decision-making process into high gear.

While the commander's years of experience often dictate the pace of this process, even the most battle-hardened leaders must operate within the confines of the human brain's cognitive capabilities. What if technology could automate routine, time-consuming tasks to shave minutes, or even hours, off decision-making? DOD thinks it can and is evaluating overarching concepts that would incorporate autonomous systems and artificial intelligence (AI) into its future combat warfare missions.

AI is a component of the Pentagon's third offset strategy, designed to obtain strategic advantage by outmaneuvering adversaries through advanced technologies. The first offset strategy began with the development of a nuclear arsenal during the early Cold War years of the 1950s. The U.S. implemented the second offset strategy in the 1970s and 1980s, when it introduced stealth systems, precision-guided weapon technologies and GPS. The third offset strategy, according to Deputy Secretary of Defense Bob Work, will "lead to a new era of human-machine collaboration and combat teaming."

In a mission command construct, which integrates the warfighting functions of movement and maneuver, fire support, sustainment or logistics, reconnaissance, surveillance and intelligence, AI systems must "learn" to communicate the commander's intent. But only by establishing parameters within which the technology can operate will it gain the commander's trust. The goal is to allow AI to process certain tasks and functions that are data-heavy or generally repeatable and then rapidly suggest courses of action (COAs) to the commander, who ultimately will make the final decision.

## LEVELS OF AUTONOMY

As the Army's applied research and advanced technology development organization for mission command capabilities, the U.S. Army Communications-Electronics Research, Development and Engineering Center (CERDEC) understands both the art and science of mission command and believes that AI will have considerable implications for mission command capabilities. CERDEC is monitoring Army strategy closely, along with AI advances in industry and academia, as it evaluates options to produce mission command systems that communicate the commander's intent and provide military users automated assistance with planning, monitoring and decision-making.

**MAPPING THE USE OF AI**

Steve Mazza, an engineer with the Command, Power and Integration Directorate, explains the automated planning framework concept, which would use artificial intelligence to partially automate the military decision-making process for commanders and staff, including COA development for maneuvers. (U.S. Army photo by Lindsey Rash, CERDEC)

*AI could provide Soldiers better navigational information based on its understanding of how other squads crossed terrains under specific environmental conditions or times, to suggest an alternate route that would be faster and safer.*

Systems achieve different levels of autonomy based on the amount of human-to-machine interaction required to operate them. Autonomous technologies are further categorized as either "autonomy at rest," which are software agents or the brains behind a system, or "autonomy in motion," which represent actual platforms, such as driverless vehicles and robots.

## COMMAND BY DIRECTIVE

At the lowest level of autonomy, "command by directive," systems require a one-to-one human controller. Each autonomous machine is controlled by joystick using high-bandwidth/low-latency communications within a reliable communications range. In mission command systems, command by directive applies to autonomy at rest, because the user must tell software agents exactly what to do through every step of the process to achieve the objective. Most software and robotic systems operate in this manner; for example, the explosive ordnance disposal robot is joystick-controlled.

## COMMAND BY PLAN

"Command by plan" provides autonomy at a middle level, where scientists specifically instruct the software on when, where and how to carry out tasks that alleviate the burdensome direct joystick control. For example, CERDEC's mission command experts explored autonomous route-planning technologies for intelligence, surveillance and reconnaissance missions. The operators identified an objective and instructed unmanned aerial and unmanned ground vehicles to maneuver to certain waypoints on a map. The software was able to determine how best to reach those waypoints—for example, to avoid certain obstacles. The CERDEC technology developed under this program was a first step at moving from command by directive to the higher-level command by plan.

In another example of midlevel autonomy, CERDEC is gathering user feedback to develop an automated planning framework prototype that would allow computer scientists to use AI technologies to assist in mission planning, monitoring and prediction. This framework would allow commanders and staff to run through the military decision-making process, which includes COA development and analysis for maneuvers to identify who will go where, when and how; logistics to convey how much fuel, ammunition or water will be needed, and when to refuel. Eventually the system would support all other warfighting functions, such as fires and intelligence.

To support the logistics portion of this plan, CERDEC has developed the Energy Aware Mission Planning Tool (E-AMP), which would select supply routes, understand what vehicles are traveling along those routes, assess weather and other environmental factors and calculate how much fuel is needed to support a COA, allowing a logistics officer to design a concept of support. In the long run, AI can extend the capabilities of this software automation by performing reasoning and optimization to provide useful recommendations, such as how and where to conduct resupply and which assets to use.

## COMMAND BY INTENT

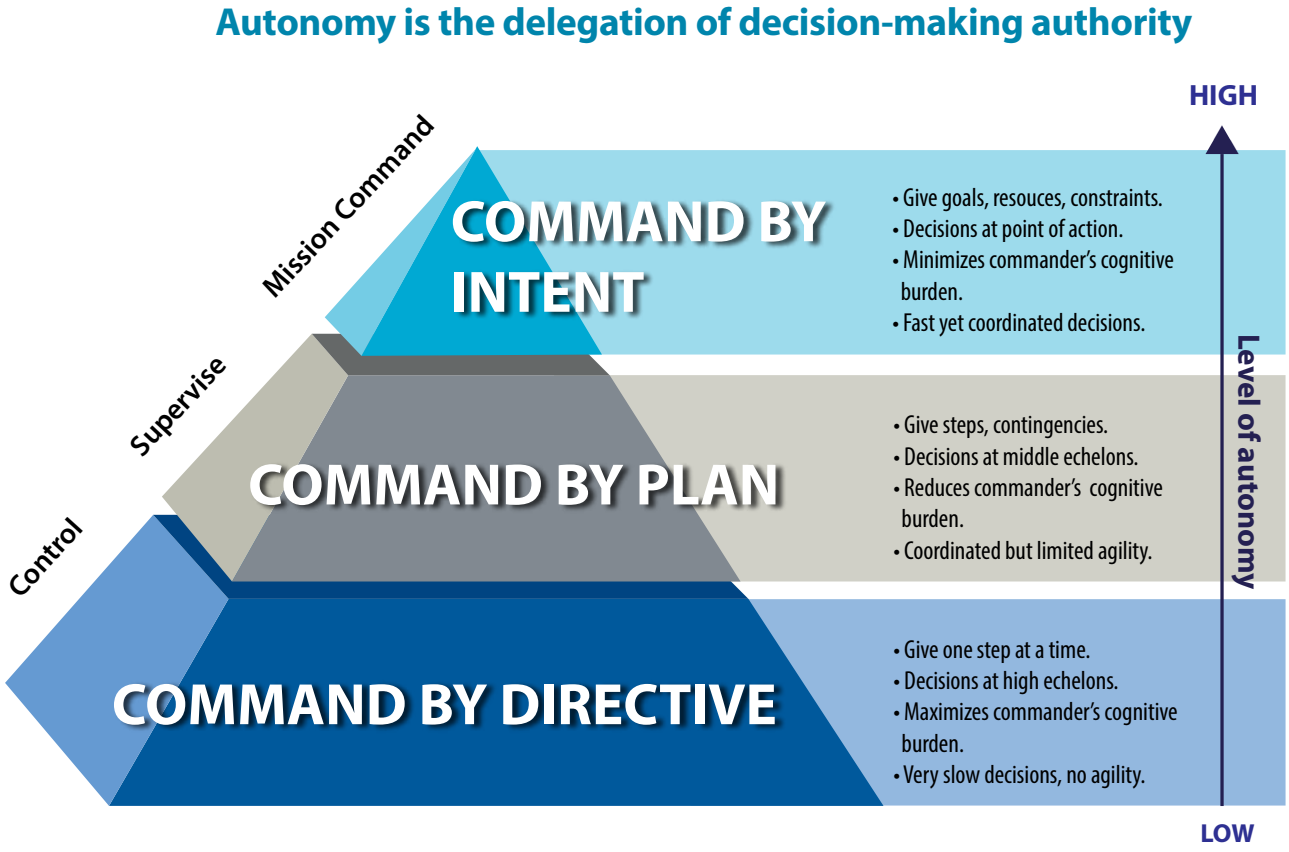
In each of the above scenarios, developers still program specific tasks into the system. At the highest level of autonomy, "command by intent," programmers do not tell the computer what to do; they instruct the computer on how to figure out what to do. In this scenario, the system is provided only with the objective, such as to patrol and secure an area. It does not require further instructions on how to reach map waypoints or any other tasks required to pronounce an area secure.

It is imperative to understand that CERDEC's efforts will use AI to augment human capabilities—not replace them. Humans and machines work best in combination when they complement each other using what some have called the centaur model, which pairs machine precision and reliability with human robustness and flexibility. In that model, commanders evaluate input collected with AI but make the final decision about what COA to take. CERDEC is teaming with industry, other government research and development entities and academia, and conducting internal working groups to understand this human-to-technology paradigm to organically grow its AI expertise.

For example, CERDEC, in conjunction with Carnegie Mellon University, participated in an Army technology objective that concluded in 2012 and focused its AI efforts on enhancing three mission command principles: build cohesive teams, create shared understanding and reinforce the commander's intent.

**READY FOR A CLOSE-UP**

CERDEC engineers Eric Bickford, left, and Dr. Gary Katulka demonstrate a laboratory prototype of a vision-aided navigation system for dismounted Soldiers. PNT capabilities aid GPS when its signal becomes degraded or denied by environmental conditions or an adversary. Machine learning could insert intelligence into PNT systems so that Soldiers know which sensors are most reliable under any given circumstance. (U.S. Army photo by Kathryn Bailey, CERDEC)




**SCALING THE PYRAMID**

The use of artificial intelligence isn't an all-or-nothing proposition: Systems achieve different levels of autonomy based on the amount of human-to-machine interaction required to operate them. CERDEC is evaluating AI technologies that will capture the commander's intent to provide the highest level of autonomy for mission command systems. (Image courtesy of CERDEC)

Commanders and staff naturally increase their use of automation when communicating instructions, coordinating resources and gathering information for analysis. To assist the commander with analyzing staff behavior and effectiveness, which could be two levels down, researchers conducted forensics on staff digital conversations—such as text and chat—to identify key actors, locations, resources, patterns of interest, hidden connections and spheres of influence from within the organization. This information helps to identify how well the staff is, or is not, synchronized, to aid the commander in propagating his intent throughout the organization.

## MACHINE LEARNING

One AI technology, machine learning, will significantly aid mission command by allowing computers to provide better answers as they are exposed to more data. Machine learning draws from big data across all of the internet—every Facebook and Twitter post, every image, coupled with high-performance computing—and allows the computer to process billions of lines of code to find new correlations between data sets and thereby complete complicated tasks in nanoseconds.

CERDEC is exploring options to apply machine learning to intelligence systems, which would speed up the process for finding correlations between data sets, such as learning new patterns and recognizing images. Machine-aiding tasks and asset collection would maximize the value of reconnaissance and surveillance information while minimizing the risk to the mission and friendly forces.

*CERDEC's efforts will use AI to augment human capabilities—not replace them. Humans and machines work best in combination when they complement each other.*

To aid the Army's cyber defense objectives, CERDEC is evaluating how AI and machine learning could improve anomaly detection and possibly incorporate a response inspired by the human immune system, which would allow a system not only to recognize when a malicious virus is attacking it, but learn to repair itself.

Another area that is primed for AI support is position, navigation and timing (PNT). CERDEC is currently supporting the Army's priority to develop assured PNT technologies, which provide Soldiers and autonomous systems the capability to conduct operations in GPS-denied or -disrupted conditions. PNT solutions comprise an assortment of sensors such as inertials, which use accelerometers and gyroscopes to measure position orientation and velocity, and cameras to shoot and compare pictures frame by frame to determine movement. These combined sensors aid GPS, but some may be more reliable in certain situations.

Machine learning would insert intelligence into the system to autonomously determine which sensors are the most trustworthy. For example, AI could provide Soldiers better navigational information based on its understanding of how other squads crossed terrains under specific environmental conditions or times, to suggest an alternate route that would be faster and safer. Soldiers who may be relying on a camera for position information may not realize that the sun is interfering with the camera, so AI would ignore that sensor (the camera) to ensure that the most accurate sensors provide the required information.

To ensure alignment with Army strategy, CERDEC plans to support the U.S. Army Tank Automotive Research, Development and Engineering Center, the Army's autonomy lead, as it incorporates manned-unmanned teaming into its initiatives. CERDEC also plans to support the U.S. Army Maneuver Center of Excellence, the Mission Command Center of Excellence and sister science and technology organizations to develop technologies and approaches that incorporate all aspects of autonomous systems into mission command systems and doctrine.

## CONCLUSION

CERDEC, as the Army's mission command research and development arm, is working to grow its AI and machine learning expertise and rapidly integrate advances from industry and academia into effective mission command systems. By introducing these technologies into the mission command tool set, systems will achieve the highest level of autonomy to allow decisions at the point of action—which, in turn, will minimize the commander's cognitive burden to enable fast yet coordinated decisions. Communicating the commander's intent to autonomous entities, both at rest and in motion, letting computing systems act on our behalf and trusting automation to provide recommendations and assistance where appropriate will act as force multipliers and ultimately provide the U.S. and its allies with overmatch capability.

*For more information, go to* ***http://www.cerdec.army.mil/contact/****.*

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**CALLING IT IN**

An AH-64 Apache attack helicopter lands as Soldiers radio reports during an opposing forces "attack" in July 2016 as part of Arctic Anvil 2016, an exercise in Donnelly Training Area near Fort Greely, Alaska. The exercise gave FAST advisers the opportunity to see what issues Soldiers experience with equipment and technology. (Photo by Justin Connaher, 673rd Air Base Wing)

# SCIENCE on the SPOT

RDECOM science advisers assigned to commands in the field are poised to respond to capability gaps quickly—often with a prototype produced with 3-D printing.

*by Ms. Argie Sarantinos-Perrin*

If Gloria shows any signs of distress, Soldiers know to steer clear. That's because Gloria, a pig who came to "life" through the magic of additive manufacturing, or 3-D printing, makes loud noises and oozes if there are chemical, biological or nuclear threats nearby. Without Gloria, Soldiers could step into a potentially hazardous situation without even realizing it.

Gloria is one of the numerous projects that the Field Assistance in Science and Technology (FAST) advisers have developed, along with Edgewood Chemical Biological Center (ECBC), to keep Soldiers safe. FAST advisers, part of the U.S. Army Research, Development and Engineering Command (RDECOM), are positioned with major units around the world and serve as liaisons between the commands and RDECOM. The FAST program gives commanders access to thousands of subject matter experts within RDECOM. As a major subordinate command of the U.S. Army Materiel Command, which researches, designs and develops every item that a Soldier wears, drives, flies, communicates with or operates on the battlefield, RDECOM provides commanders with innovative solutions for operational issues, enabling them to focus on their missions.

**PROTECTION PLUS**

A chemical Soldier from 1st Stryker Brigade Combat Team "Arctic Wolves" participates in the Arctic Anvil exercise that was held in Alaska in July 2016. FAST advisers are using cutting-edge technology demonstrated at exercises like Arctic Anvil to close capability gaps and keep Soldiers safe. (Photo by Rodney Jackson, 196th Infantry Brigade, Joint Pacific Multinational Readiness Capability)

"What RDECOM provides is not just material technology that goes in the hands of the warfighter, but a dynamic and responsive presence to the emerging threats warfighters face," said Maj. Angela Smoot, RDECOM FAST adviser to U.S. Army Europe. Smoot, who has been a FAST adviser for two years, enjoys seeing Soldiers "light up" when she introduces a new technology to them, and she uses their feedback to advance technology development.

## EXPERTISE AROUND THE WORLD

There are currently 28 FAST advisers deployed in major commands around the world, including U.S. Army Europe, U.S. Forces Korea (USFK), U.S. Army Pacific, U.S. Africa Command and U.S. Army Garrison Japan. The advisers are mostly scientists and engineers who have experience in one or more fields, including mechanics, electronics, computer science, physics, chemistry, optics and aerospace design. The assignments are two to three years long.

One of the challenges that Smoot faces is ensuring that equipment and technology are interoperable between countries. That is no small feat since most European countries share multiple borders, and their close proximity may cause spectrum and frequency issues between countries.

For instance, bringing new technology, such as a radio that operates on the same frequency as commercial equipment, into a country can cause a conflict, especially if the new equipment uses high power. The conflict may result, for example, in shutting down cellular coverage or emergency services. To avoid this situation, the host nation provides the frequency and power that the equipment must operate with to eliminate conflict. Additionally, NATO allies must provide input before a new technology is brought to the European theater.

"I worked directly with the staffs at USFK, 8th Army and 2nd Infantry Division, interacting at gunneries and exercises to keep a thumb on the pulse of emerging requirement gaps," said Lt. Col. Marc Meeker, formerly the FAST adviser to USFK and now director of the U.S. Army International Technology Center Atlantic – Germany.

Once FAST advisers identify requirements or capability gaps within their commands, they query program management offices, RDECOM's research, development and engineering centers (RDECs) and industry partners to expedite potential solutions. The solution is often a prototype that is developed in a prototype integration facility at one of the RDECs.

When Soldiers in Germany couldn't see the brownish-green, donkey-shaped pillow that alerted them to a chemical, biological or nuclear threat, the FAST team worked with ECBC to develop Gloria the pig. While the 4-by-4-foot "donkey" blends into the ground terrain, Gloria's bright color and ability to make loud noises and ooze if there are threats nearby make her a good training tool for Soldiers. Since Gloria can be manufactured quickly via 3-D printing, the wait is shorter than if a similar product had to be shipped from stateside, and the cost to ship is eliminated.

"Getting prototypes into the hands of Soldiers mitigates the gaps that are often the result of long lead times," said Meeker. "If a program manager says he'll have a production model in 2022 but I can get a prototype now, the gap has just been lessened. It is even better when there is no financial burden on the command because prototypes or low-rate initial production models are already paid for with research dollars."

FAST advisers also work with outside agencies, including the U.S. Army Test and Evaluation Command, U.S. Army Training and Doctrine Command and various program management offices, to field technology. Working with Meeker when he was the FAST adviser in Korea, the project manager for Maneuver Ammunition Systems within the Program Executive Office for Ammunition fielded a safer training munition for Soldiers. The new M1020 120 mm training munition, fielded to the 2nd Infantry Division, has a nose that breaks on impact, decreasing fragment size and rapidly dissipating kinetic energy, resulting in less damage at ranges and fewer fragments in the training area. Developed by RDECOM's Armaments Research, Development and Engineering Center (ARDEC), the M1020 is fired from the main gun on the M1 Abrams battle tank.

## SIDE BY SIDE WITH SOLDIERS

FAST advisers work closely with Soldiers in the field. By supporting Army exercises and training events, FAST advisers see firsthand what issues Soldiers experience with equipment and technology.

Andy Margules, FAST adviser to U.S. Army Alaska, was a part of the Arctic Anvil exercise in July 2016. The exercise, supported by more than 8,000 personnel from the Army, National Guard, Air Force, foreign partners, civilians and contractors, was the largest held in the interior of Alaska in 15 years. It was also the first time that the Joint Pacific Multinational Readiness Capability, a mobile package of personnel and equipment designed to support training exercises across the Pacific theater, was used outside of Hawaii.

"Maintaining a strong relationship with the Air Force, Navy and Coast Guard personnel in Alaska is key, and informing them of potential technologies and opportunities to experiment and demonstrate technology is paramount," said Margules. Margules is currently supporting a project that moved from the beginning stage, where the need for a quicker, safer system was identified, to the testing stage. The Prime Mover Ammunition Carrier (PMAC), designed by 1st Lt. Thomas Prose of the 1st Stryker Brigade Combat Team, was prototyped by ARDEC and is being evaluated at the National Training Center, Fort Irwin, California.

Prose designed PMAC with speed, utility and safety in mind. Built with M232 propellant canisters, PMAC can hold both M107 and M795 series projectiles. Using steel components and bolted directly to the vehicle (unlike with the prior system), PMAC holds the projectiles in place even if the vehicle rolls over. In addition, PMAC is located at the driver's end of the vehicle, ensuring easy access to get the gun firing quickly.

In February 2015, Margules worked with engineers from RDECOM's Tank Automotive Research, Development and Engineering Center (TARDEC) to test a ground robotic system in Alaska's diverse, mountainous terrain, extreme cold weather and high altitude. Feedback from those tests not only informed the capability development document, but also will be used for future unmanned ground robotic projects.

In addition to their technical knowledge, FAST advisers are often relied on to

**SONG OF THE SOW**

Gloria, manufactured with 3-D printing, is used as a training tool for Soldiers to detect chemical, biological or nuclear threats. (Photo by Staff Sgt. Eddie Siguenza, U.S. Army National Guard)

**WALKABOUT**
A Japanese delegation from the Ground Systems Research Center visited the TARDEC Prototype Integration Facility in Warren, Michigan, in March 2016. FAST advisers, who are liaisons between RDECOM and commanders, use prototypes to solve operational challenges that Soldiers experience. (Photo by Kimberly Bratic, TARDEC Public Affairs)

bridge communication gaps. For instance, Jinwoo Park, a FAST adviser in Korea, is fluent in Korean and English, so he can communicate with Korean and U.S. Soldiers who work together on international projects. Park, an electrical engineer, also understands the technical language associated with satellite communications, so he provides the link between engineers and Soldiers.

"I am part of an interoperability team that is addressing communication challenges between the U.S. and Korean Soldiers," said Park. "However, it's not just a language barrier. We have had problems communicating on a technical level for more than 50 years."

## GROWING THE PROGRAM

The number of FAST advisers, who are military officers in the Acquisition Corps and senior Army civilians, fluctuates according to need. If a new command is stood up or priorities change, then FAST advisers are added or moved to other areas. Lt. Col. Kevin Finch was recently assigned as the first FAST adviser to U.S. Army Cyber Command (ARCYBER). Located at Fort Belvoir, Virginia, ARCYBER will direct and conduct cyberspace operations to ensure freedom of action in the cyberspace and information environment and deny access to adversaries.

Other FAST advisers are assigned to support more than one command. Maj. Jimmy Harris wears two hats as FAST adviser to both the U.S. Army Special Operations Command and U.S. Army Forces Command (FORSCOM) until a full-time FAST adviser is assigned to FORSCOM.

To prepare new FAST advisers for their role, RDECOM puts them through an intensive three-week orientation and reachback training program, "which exposes them to the total enterprise of RDECOM and its full spectrum of capabilities that support Soldiers," said Jim Gibson, director of FAST at RDECOM.

While training prepares FAST advisers for their role, they also need to be well-rounded and adaptable. "There's a lot that has to happen before we get technology into the warfighter's hands," said Smoot. "I strive for quality, not quantity."

## CONCLUSION

The FAST program began in 1985 and initially covered South Korea and Germany. In 2003, the program expanded to the Iraq and Afghanistan theaters. "The number of FAST advisers has remained around 28 for several years, but the program is evolving, and we constantly evaluate our footprint to optimize our support to current Army priorities," said Gibson.

As the program continues to evolve, FAST advisers will continue to reach back to RDECOM's scientists and engineers to solve commanders' operational problems. With innovative projects such as Gloria the pig, FAST advisers are helping to develop cutting-edge technology to close capability gaps and keep Soldiers safe.

*For more information, visit* ***http://www.rdecom.army.mil/FAST/****.*

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*MS. ARGIE SARANTINOS-PERRIN, a public affairs specialist with Huntington Ingalls Industries – Technical Solutions Division, provides contract support to RDECOM. She holds an M.S. in professional writing and a B.A. in mass communications from Towson University. She has 11 years of public affairs experience supporting DOD.*

# MULTIDOMAIN MEDICINE

The battlefield of the future could be exponentially more complex than any the Army has known. That's why TATRC is exploring novel ways to treat and evacuate casualties.

*by Mr. Nathan Fisher*

In a conference room of the U.S. Army Medical Research and Materiel Command (USAMRMC) headquarters at Fort Detrick, Maryland, leaders and staffers listened intently in January as Gen. David G. Perkins, commanding general of the U.S. Army Training and Doctrine Command, outlined the future of the Army—the multidomain battlefield.

The operational concept for the multidomain battlefield is built upon the premise that the joint force will not be able to assume uninterrupted superiority in any domain (land, sea, air, space and cyberspace) during future operations. The Army and Marine Corps are developing concepts and strategies for future ground combat operations in the 2025-40 time frame that require highly capable and dispersed units to create and exploit temporary windows of advantage.

"Force health protection and health services support to the warfighter will be challenging in future widespread combat operations and in dispersed 'self-sufficient force icons' characteristic of the type of multiple-domain battle discussed by Gen. Perkins, and considering the limitations of supplies and equipment, complex acute and critical care, and minimal medical personnel," said Gary R. Gilbert, program manager of the USAMRMC Telemedicine and Advanced Technology Research Center's (TATRC) Medical Intelligent Systems.

The joint force is likely to leverage manned-unmanned teaming (MUM-T) capabilities to penetrate high-risk areas and provide support in contested environments to increase reach, capacity and protection. In the future, commanders will employ unmanned systems as force multipliers in environments where mobility and resources are limited or nonexistent. Future multipurpose unmanned system platforms could assist in medical operations in such environments.

"The growing planned use of unmanned systems and robotics on the future battlefield affords both great opportunities for medical force multipliers as well as significant operational medicine and medical research challenges," Gilbert said. Medical support from unmanned systems could provide emergency medical resupply and deliver blood products and aid in delivering telehealth or teleconsultation to support prolonged field care when evacuation is not possible. Unmanned systems also could offer expedited casualty evacuation when immediate evacuation is not possible with manned assets.

TATRC is working to prepare the Army for this uncertain future. Its Operational Telemedicine Laboratory, headed by Gilbert, is a robust group of research scientists and technologists from the fields of artificial intelligence, engineering, computer science, telecommunications and robotics, as well as experienced research managers and field operators in combat health services support and force health protection.

The laboratory's goal is to leverage enabling technologies in diverse scientific domains such as artificial intelligence, robotics, mechanical engineering, linguistics, cognitive psychology, computer science, telecommunications, biomonitors, sensors, medical diagnosis and treatment, to enable force health protection mission command and virtual health support for the multidomain battle at the point of injury, during prehospital evacuation and at medical treatment facilities in remote locations and in hazardous or denied areas.

**VIRTUAL DOCTORS**

The Autonomous Critical Care System shown here is being developed by the Office of Naval Research to autonomously maintain a patient during transport through patient monitoring and closed-loop control systems. (U.S. Army TATRC photo by J. Adam Wyatt)

## UNMANNED SYSTEM TESTS

Future operations in megacities and dense urban areas provide an example of an environment that presents significant challenges to freedom of movement and protection. Adversaries in megacities will be able to blend in with a dense population of noncombatants and will exploit vertical, surface-level and subterranean spaces to conceal threats. Securing and sustaining safe routes for troop transport, medical evacuation and logistics support will be extremely difficult in this highly complex threat environment.

The future operational environment, which could be anything from a megacity to an austere location, is likely to cause severe restrictions on the mobility of vehicles used for medical missions, including both air and ground platforms used for medical evacuation (medevac), casualty evacuation (casevac) and medical logistics missions resulting from area denial challenges. Casevac differs from medevac in that neither the casevac vehicle nor its operators are necessarily dedicated medical assets. In situations where medical resources are already spread thin, the mobility of medical resources becomes of paramount importance.


**CASEVAC BY AIR**

The DP-14, a small tandem VTOL UAS in development by Dragonfly Pictures Inc., is an example of an emerging UAS platform that could provide emergency medical supply and expedited casevac in future environments in which manned assets are not available. (U.S. Army photo by J. Adam Wyatt, TATRC)

"Unmanned and autonomous platforms have the potential to completely rewrite the medical doctrine for how we conduct emergency resupply of unmanned and autonomous platforms, including whole blood products delivered directly to the point of need, as well as monitored casevac missions when dedicated medical evacuation assets are unavailable or are otherwise denied entry because of weather, terrain or enemy activity," said Col. Daniel R. Kral, TATRC commander.

To develop medical platforms for the warfighter, TATRC leverages and exploits emerging robotic and unmanned systems from other government laboratories as well as academic and industry partners. Employing existing systems enables TATRC to save money and resources while developing solutions for service members more quickly.

## INTEGRATING TELEMEDICINE AND UNMANNED SYSTEMS

The Army and the other services are currently developing unmanned aerial system (UAS) capabilities for logistics operations. These capabilities probably will be extended to casevac missions in future operational environments where conventional medical assets are denied access or are otherwise unavailable. To realize the potential benefits of an unmanned casevac and medical resupply mission capability, a human-computer interface (HCI) and command-and-control (C2) infrastructure needed to be developed for the combat medic to effectively interface with unmanned vehicle platforms. TATRC has used two Small Business Innovation Research (SBIR) contracts to develop two prototype HCI and C2 applications that would enable combat medics to use existing Nett Warrior-type end user devices to interact with emerging UAS logistics platforms assigned to medical resupply and casevac missions.

The overall goal of this project was to develop an application on a handheld device that would provide the capability to a medic, with little or no training in a vertical takeoff and landing operation, to interact with a UAS to complete unmanned casevac and resupply missions. The application provides the medic in the field situational awareness of the aircraft's mission status and the ability to provide high-level commands to the UAS, such as permission to land after arriving at the specified landing zone and permission to take off after the supplies have been unloaded or the casualty has been secured. Because of the high mental demands placed on the medic in the field, the human-computer interface needs to be both intuitive and efficient, and require only supervisory-level control from the field medic.

TATRC and Neya Systems LLC conducted a successful field demonstration in August 2016 of a casualty evacuation mission using the Lockheed Martin Corp. K-MAX UAS employing the Vertical Takeoff and Landing (VTOL) Evacuation and Resupply Tactical Interface (VERTI). During the demonstration, the VERTI application was used to plan and execute a casevac mission using an unmanned ground vehicle (UGV) and the K-MAX UAS platform. The UGV assisted in casualty extraction to the UAS evacuation point, where the simulated casualty was secured on the K-MAX UAS and evacuated to a medical treatment facility.

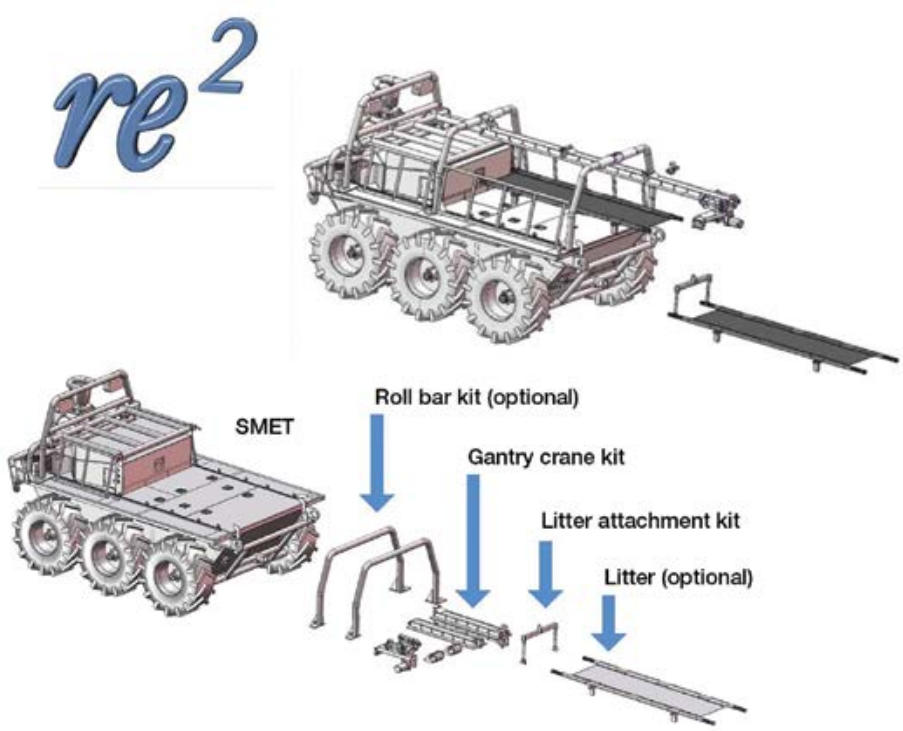
During casualty transport on both the UGV and UAS, the VERTI application enabled tactical information flow from an operational telemedicine patient monitor to a medical care provider at the receiving medical treatment facility. Telemedicine data was integrated with the existing tactical radio network used for command and control of the unmanned systems through the VERTI application.

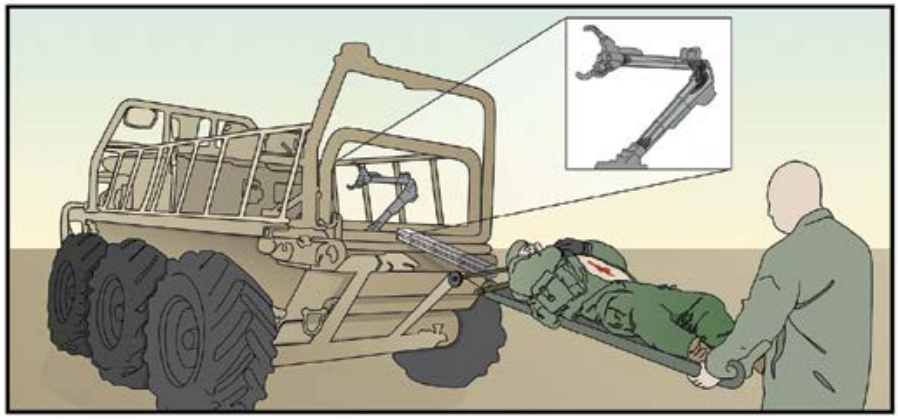
This capability allows seamless medical data exchange for medical operations using unmanned systems from the point of injury through arrival at the medical training facility, including transmission of an electronic Tactical Combat Casualty Care Card DD Form 1380 and live streaming of vital signs while en route.

## BY LAND

Another SBIR program that Gilbert and his team are sponsoring is a robotic technology to assist combat medics in the field when using emerging UGV platforms for casualty transport. Future UGV platforms, like the Army Squad Mission Equipment Transport (SMET) UGV, are designed to support multiple mission payloads and to fill a secondary role for providing casevac. The goal of the SMET program is to develop a UGV that can follow an infantry squad and help carry its equipment and supplies during dismounted operations, enabling the squad to sustain itself over longer intervals of time and distance.

An additional mission of SMET is to transport a casualty from at or near the point of injury back to a safe location for further assessment and treatment. TATRC initiated two SBIR projects aimed at demonstrating an innovative and novel medical module payload for future military UGVs that would provide casevac capability for the SMET and enable patients to be loaded and secured




**OUT OF HARM'S WAY**

RE2 Robotics of Pittsburgh, top, and Vecna Technologies Inc. of Cambridge, Massachusetts, are developing electromechanical systems that use robotic technologies to enable a single medic to load a casualty on a litter onto a SMET unmanned ground vehicle as quickly as possible near the point of injury, for eventual transport back to a casualty collection or medical evacuation point. The two small businesses are working under Phase II SBIR contracts. (Graphics by RE2 Robotics, top, and Vecna Technologies)

*"The growing planned use of unmanned systems and robotics on the future battlefield affords both great opportunities for medical force multipliers as well as significant operational medicine and medical research challenges."*

for movement by just one first-responder Soldier instead of the usual two. This would help save lives while minimizing diversion of warfighters from their primary duties.

The SMET UGV casevac module prototyping effort is in Phase II of development. Two different companies are prototyping SMET casevac systems, and while the basic SMET vehicle is intended to be the same, each of these companies is following a different approach to prototyping the casevac module and loading patients onto the vehicle.

## BY AIR

The TATRC team is developing a UAS research platform that is much smaller than traditionally piloted vertical takeoff and landing aircraft. It has the potential to provide some unique capability for medical logistics compared with larger aircraft. Because of the increased mobility of the smaller aircraft, for example, it requires a much smaller landing zone, which increases the number of available landing zones in difficult terrain.

TATRC is currently testing this UAS research platform to address operational gaps in future medical mission areas and to mature the capability of using UAS for emergency medical resupply and casevac. This UAS is intended to be used as a platform to aid in the development and test of innovative methods of providing en route care and limiting patient exposure to harmful environmental conditions during unmanned system casevac. The research project aims to develop technologies and procedures to ensure that unmanned systems can be safely and effectively employed to provide medical logistics support or expedited casevac in future operational environments in which manned assets are not available or are denied access.

"We are partnering with the U.S. Army Aeromedical Research Laboratory and Dragonfly Pictures Inc. to test this system," said Gilbert. (Dragonfly is a U.S. industry leader in small rotary wing unmanned aerial vehicles.) "With funding from the Defense Health Agency Joint Program Committee for Combat Casualty Care, we are currently initiating a research project to provide a cost-effective UAS research platform for the operational testing and evaluation of emerging en route care and medical resupply technologies."

## CONCLUSION

The medical application of unmanned systems and robotics in future environments has the potential to evolve health support throughout the range of military operations, and this includes peacetime humanitarian support missions.

In the not-too-distant future, according to Gilbert, unmanned aerial systems are likely to be used heavily in combat operations in dense urban environments because of the increased freedom of movement that they afford to a wide range of mission types. These unmanned systems will be multipurpose in nature. They could be called upon in support of critical medical missions if certain medical-specific considerations are addressed as these future unmanned systems platforms are being developed. Support from unmanned systems could become increasingly important in other situations in which mobility is restricted, such as during a natural disaster or other mass casualty event.

"We heard everything that Perkins said, and we are already conducting research in how to use these unmanned systems to support medical missions on the multidomain battlefield," Gilbert said. "While the formulation of the doctrine, tactics, techniques and procedures that would provide these types of capabilities to medics to use in combat are still in their infancy, our research is focused directly on identifying and providing the enabling technologies that will be needed, and that is the primary mission of TATRC."

*For more information about TATRC, go to* ***http://www.tatrc.org/www/default.html****.*

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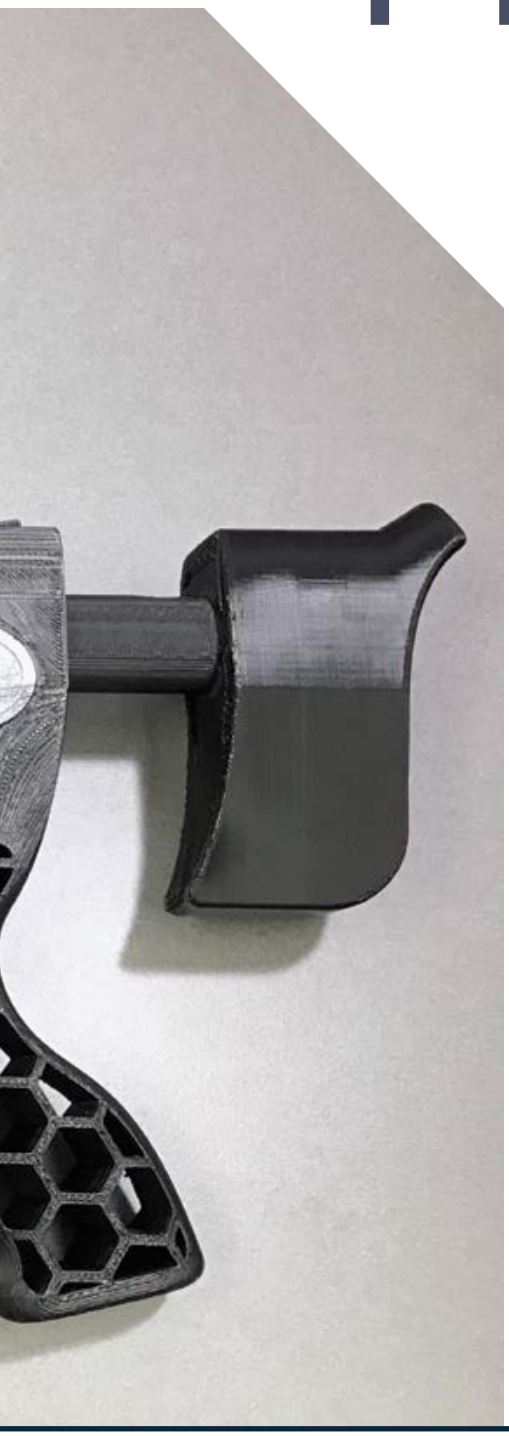
*MR. NATHAN FISHER has been a project manager, mechanical engineer and roboticist with TATRC since 2014. Before that, he spent eight years as a mechanical engineer supporting the design and manufacturing of various vehicle systems, including military combat vehicles and commercial aircraft systems. His current professional focus is the adaptation of emerging robotic technologies to provide future capabilities for combat medics in far-forward operational environments. He holds an M.S. in mechanical engineering from Johns Hopkins University and a B.S. in mechanical engineering from the University of Maryland.*

**MEET RAMBO**

The additive-manufactured RAMBO system includes an NSRDEC-designed stand-alone kit with printed adjustable buttstock, mounts, grips and other modifications—modifications made possible by the quick turnaround afforded by 3-D printing. (U.S. Army photo by Sunny Burns, ARDEC)

# RAMBO'S PREMIERE



A first for ARDEC: Researchers fire 3-D printed ammo out of a 3-D printed grenade launcher.

*by Mr. Seung kook "Sunny" Burns and Mr. James Zunino*

Researchers at the U.S. Army Armament Research, Development and Engineering Center (ARDEC) successfully fired the first grenade created with a 3-D printer from a grenade launcher that was produced the same way. This demonstration shows that additive manufacturing (commonly known as 3-D printing) has a potential future in weapon prototype development, which could allow engineers to provide munitions to Soldiers more quickly.

The printed grenade launcher, named RAMBO (Rapid Additively Manufactured Ballistics Ordnance), was the culmination of six months of collaborative effort by the U.S. Army Research, Development and Engineering Command (RDECOM), the U.S. Army Manufacturing Technology (ManTech) Program and America Makes, the national accelerator for additive manufacturing and 3-D printing.

RAMBO is a tangible testament to the utility and maturation of additive manufacturing. It epitomizes a new era of rapidly developed, testable prototypes that will accelerate the rate at which researchers' advances are incorporated into fieldable weapons that further enable warfighters. Additive manufacturing (AM) is an enabling technology that builds successive layers of materials to create a three-dimensional object. Every component in

the M203A1 grenade launcher, except springs and fasteners, was produced using AM techniques and processes. The barrel and receiver were fabricated in aluminum using a direct metal laser sintering process. This process uses high-powered precision lasers to heat the particles of powder below their melting point, essentially welding the fine metal powder layer by layer until a finished object is formed. Other components, like the trigger and firing pin, were printed in 4340 alloy steel, which matches the material of the traditional production parts.

## WHITHER RAMBO?

The purpose of this project was to demonstrate the utility of AM for the design and production of armament systems. A 40 mm grenade launcher (M203A1) and munitions (M781) were selected as candidate systems. The technology demonstrator did not aim to illustrate whether the grenade launcher and munition could be made cheaper, lighter or better than traditional mass-production methods. Instead, researchers sought to determine whether AM technologies were mature enough to build an entire weapon system and the materials' properties robust enough to create a properly functioning armament.

To be able to additively manufacture a one-off, working testable prototype of something as complex as an armament system would radically accelerate the speed and efficiency with which modifications and fixes are delivered to the warfighter. AM doesn't require expensive and time-intensive tooling. Researchers would be able to manufacture multiple variations of a design during a single printing build in a matter of hours or days. This would expedite researchers' advances and system improvements: Instead of waiting months for a prototype, researchers would be able to print a multitude of different prototypes that could be tested in a matter of days.

## AS SIMPLE AS PRINT AND DONE?

Depending on a part's complexity, there can be numerous steps involved before it is ready for use. For instance, in the case of RAMBO, the printed aluminum receiver and barrel required some machining and tumbling. After printing, the components were cut from the build plate, and then support material was removed from the receiver.

*Rapidly created prototypes and kits that included custom handgrips based on warfighter requests and specifications — customization made possible because of the design freedoms and rapid turnaround afforded by AM.*

**LESS BUCKS, MORE BANG**

More than 90 percent of the components in the prototype grenade launcher, top, were printed with AM, in just 35 hours and on a single build plate. ARDEC researchers developed the AM effort to identify better methods for producing the fielded grenade launcher, shown at the bottom of the photo. (U.S. Army photo by Sunny Burns, ARDEC)

**SHOTS FIRED**

These M781 components were produced during a six-month collaborative effort that involved RDECOM, ManTech and America Makes, the national accelerator for additive manufacturing and 3-D printing. Modeling and simulation were used throughout the project to verify that the printed materials had sufficient structural integrity to function properly. (U.S. Army photo by Sunny Burns, ARDEC)

The barrel was printed vertically with the rifling. After it was removed from the build plate, two tangs were broken off and the barrel was tumbled in an abrasive rock bath to polish the surface. The receiver required more post-process machining to meet the tighter dimensional requirements. Once post-processing was complete, the barrel and receiver underwent Type III hard-coat anodizing, a coating process that's also used for conventionally manufactured components of the M203A1. Anodizing creates an extremely hard, abrasion-resistant outer layer on the exposed surface of the aluminum.

The barrel and receiver took about 70 hours to print and required around five hours of post-process machining. The cost for powdered metals varies but is in the realm of $100 a pound. This may sound like a lot of time and expensive material, but given that the machine prints unmanned and there is no scrap material, the time and cost savings that can be gained through AM are staggering. The tooling and setup needed to make such intricate parts through conventional methods would take months and tens of thousands of dollars, and would require a machinist who has the esoteric machining expertise to manufacture things like the rifling on the barrel.

## PRINTING 40 MM AMMO

Beyond AM fabrication of the weapon system, ManTech also requested that a munition be printed. Two RDECOM research and development centers, the U.S. Army Edgewood Chemical and Biological Center (ECBC) and the U.S. Army Research Laboratory (ARL), participated in this phase of the project to demonstrate RDECOM's cross-organizational capabilities and teaming. An integrated product team selected the M781 40 mm training round because it is simple and does not involve any energetics—explosives, propellants and pyrotechnics are still awaiting approval for use in 3-D printing.

The M781 consists of four main parts: the windshield, the projectile body, the cartridge case and a .38-caliber cartridge case. The windshield and cartridge case are traditionally made by injection molding glass-filled nylon. Using multiple AM systems at multiple locations helped emphasize manufacturing readiness and the Army's capability to design, fabricate, integrate and test components while meeting tolerances, requirements and design rules. ARL and ECBC used selective laser sintering and other AM processes to print glass-filled nylon cartridge cases and windshields for the rounds.

**TECHNOLOGY TAKES OFF**
The AM-produced M781 leaves the muzzle after successful firing in October 2016. Further maturation of the AM process will mean that prototypes can be tested and built in days instead of months, and designs that lighten, simplify and optimize armaments will now be feasible. (U.S. Army photo by Louis Schnibbe, ARDEC)

The .38-caliber cartridge case was the only component of the M781 that was not printed. Instead, it was purchased and pressed into the additively manufactured cartridge case. Research and development is underway at ARDEC to print energetics and propellants.

## THE PROJECTILE BODY

In current production, the M781 projectile body is made of zinc: It's easy to mass-produce through die-casting, it's a dense material and it's relatively soft. The hardness of the projectile body is critical, because the rifling of the barrel has to cut into the softer obturating ring of the projectile body. The rifling imparts spin on the round as it travels down the barrel, which improves the round's aerodynamic stability and accuracy once it exits the barrel. Currently, 3-D printing of zinc is not feasible within the Army. Part of the beauty of AM is that changes can be made quickly and there is no need for retooling, so four alternative approaches were taken to overcome this capability gap:

**The first approach** was to print the projectile body in aluminum as an alternative material. The problem with that approach is that aluminum is less dense than zinc; therefore, when fired, the projectile achieves higher speeds than system design specifications call for. Interestingly, even though the barrel and projectile body were printed from the same aluminum material, because the printed barrel was hard-coat anodized, it allowed for proper rifling engagement with the softer untreated printed aluminum projectile body.

**The second approach** was to print the projectile body in steel, which better meets the weight requirements, and then mold a urethane obturating ring onto it. The obturating ring is required to ensure proper engagement and rifling in the aluminum barrel. We couldn't keep the obturating ring as steel, like we did with the first approach, because steel is a lot harder than aluminum, and even with the hard-coat anodization it would have destroyed the grenade launcher's barrel. So for this approach, the projectile body's design was modified to take advantage of design for AM.

The original projectile body designs did not consider AM fabrication and processing. For this AM technology demonstrator, the design was modified to take advantage of AM design rules to reduce the amount of post-machining required. This approach also used 3-D printing to fabricate a "negative" mold and then create a silicone positive mold to produce an obturating ring onto the printed munition bodies.

**The third approach** also used a groove and obturating ring, but instead of overmolding, the plastic was printed directly onto the steel projectile body using a printer with a rotary axis.

**The fourth approach** used a wax printer to 3-D print projectile bodies. Using the lost-wax casting process, plaster was poured around the wax bodies and allowed to set. Once set, the hardened plaster mold was heated and the wax melted away. Molten zinc was then poured into the plaster mold to cast the zinc projectile bodies.

## RAMBO DEBUTS

ARDEC researchers used modeling and simulation throughout the project to verify whether the printed materials would have sufficient structural integrity to function properly. Live-fire testing was used to further validate the designs and fabrication. The printed grenade launcher and printed training rounds were live-fire tested for the first time on Oct. 12, 2016, at the Armament Technology Facility at Picatinny Arsenal, New Jersey.

Testing included live firing at indoor ranges and outdoor test facilities. The system was remotely fired for safety reasons, and the tests were filmed on high-speed video. The testing included 15 test shots with no signs of degradation. All the printed rounds were successfully fired, and the printed launcher performed as expected. There was no wear from the barrel, all the systems held together and the rounds met muzzle velocities within 5 percent of a production M781 fired from a production-grade grenade launcher. The variation in velocities were a result of the cartridge case cracking, and the issue was quickly rectified with a slight design change and additional 3-D printing. This demonstrates a major advantage using AM: The design was modified and quickly fabricated without the need for new tooling and manufacturing modifications that conventional production would require. More in-depth analysis of material properties and certification is underway. The RAMBO system and associated components and rounds are undergoing further testing to evaluate reliability, survivability, failure rates and mechanisms.

## THE WARFIGHTER WEIGHS IN

Before the live-fire testing, the U.S. Army Natick Soldier Research, Development and Engineering Center (NSRDEC) gathered warfighter input from the 2nd Battalion, 504th Parachute Infantry Regiment of the 82nd Airborne Division. The regiment was consulted on features and capabilities it would like to have available on the M203A1 grenade launcher. Using that feedback, NSRDEC created the stand-alone kit for RAMBO. The M203 grenade launcher is typically mounted under other Soldier weapons. NSRDEC researchers took advantage of AM and rapidly created prototypes and kits that

*RAMBO epitomizes a new era of rapidly developed, testable prototypes that will accelerate the rate at which researchers' advances are incorporated into fieldable weapons that further enable warfighters.*

**IDENTIFYING NEW SOLUTIONS**

Wax molds are ready for placement in plaster molds, one of four methods used to print the M781 ammunition. Zinc, used in the projectile body of the round, cannot be 3-D printed, but since AM affords quick changes and eliminates the need for retooling, alternatives could easily be explored to identify a new component that could be used. (U.S. Army photo by Sunny Burns, ARDEC)

**NUTS AND BOLTS**

There are 50 components in the M203 grenade launcher, and all of the parts except for springs and fasteners were produced with 3-D printing. This was a promising first for ARDEC. (U.S. Army photo by Sunny Burns, ARDEC)

included custom handgrips based on warfighter requests and specifications—customization made possible because of the design freedoms and rapid turnaround afforded by AM.

## 3-D COMMUNITY OF PRACTICE CHIPS IN

The concept and funding for this project initially came from ManTech and ARDEC. ARDEC managed and executed the project with collaboration from other RDECOM AM community of practice and associated member organizations. Some of that collaboration was ad hoc and need-based—the need to find certain printing capabilities that ARDEC lacked, for example—and other collaborative efforts represented a concerted effort to leverage the experience and expertise of the community of practice.

Key organizations included ARDEC, Army ManTech, ARL, ECBC, NSRDEC, America Makes, DOD laboratories and several small businesses. ARL worked with ECBC for development of printed glass-filled nylon cartridge cases, and with NSRDEC for designs and fabrication of the printed standalone kits with Soldier-requested variations.

The Army Special Services Division at Fort Meade, Maryland, expeditiously printed aluminum barrels and receivers to complement ARDEC's capabilities for additive manufacturing of metals. America Makes developed and printed finely tuned AM barrels and receivers. The project also included services from several small businesses and AM service houses. The cross-organization teaming between government and industry illustrated the current state of the art for AM and the robustness and manufacturing readiness of AM as an enabling technology for current and future U.S. production.

## CONCLUSION

The 40 mm AM-produced grenade launcher and components were a highlighted project at the 2016 Defense Manufacturing Conference. Although there are still many challenges to be addressed before Armywide adoption of AM, demonstrations like this one show the technology's advances. Successfully firing an AM-produced weapon system validates AM maturation and applicability in armament production.

By using AM, researchers and developers will be able to build and test their prototypes in a matter of days rather than months. Designs and parts previously unachievable can now be realized. Complex designs that lighten, simplify and optimize armaments are now feasible and manufacturable. These advances will improve products and facilitate faster and more efficient transition from the labs to the field, further enabling our warfighters.

*For more information, contact the authors at* ***seungkook.k.burns.civ@mail.mil*** *or* ***james.l.zunino.civ@mail.mil****.*

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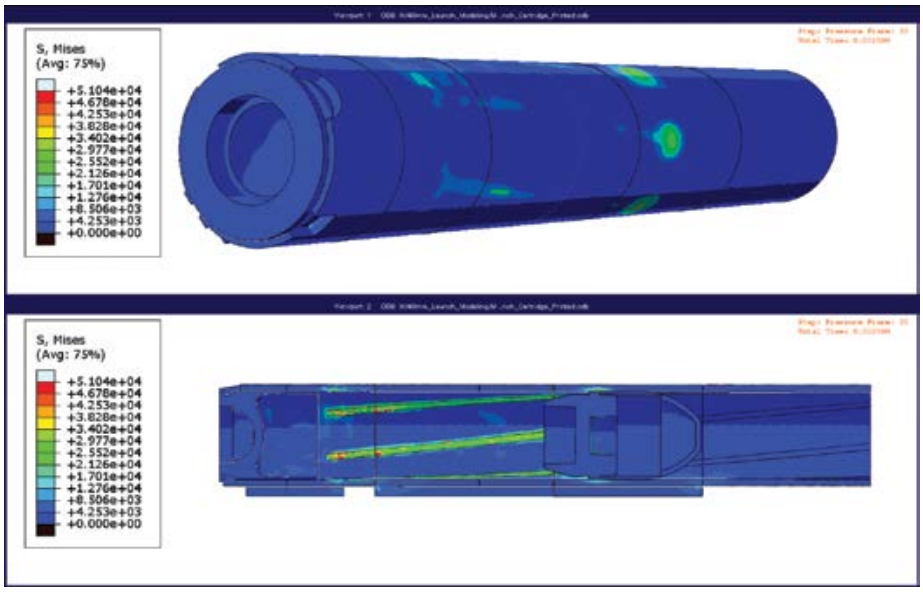
*MR. SEUNG KOOK "SUNNY" BURNS is a prototyping engineer for ARDEC at Picatinny Arsenal. He holds a master of engineering degree in mechanical engineering and a bachelor of engineering degree from the Stevens Institute of Technology. He is the ARDEC project officer for the Additive Manufacturing of 40 mm Grenade, Launcher and Components.*

*MR. JAMES ZUNINO is a materials engineer for ARDEC at Picatinny Arsenal. He is a leading subject matter expert for AM and co-chair of the Army AM Community of Practice. He holds an MBA and a B.S. in chemical engineering from the New Jersey Institute of Technology.*




**LOCK, STOCK AND BARREL**

Modeling and simulation verified whether the printed materials, including the barrel shown here, would have sufficient structural integrity to function properly. Live-fire testing conducted in October 2016 confirmed the models' results. (U.S. Army photo by Raymond Chaplin, ARDEC)

**AFTERMATH**

AM-printed rounds like this one were fired from the 3-D printed launcher at indoor ranges and outdoor facilities. Fifteen test shots did not produce any signs of degradation, and the rounds' muzzle velocities were within 5 percent of the velocities achieved by standard launchers. (U.S. Army photo by Sunny Burns, ARDEC)


## MS. TARA CLARK

**COMMAND/ORGANIZATION:**
U.S. Army Engineering and Support Center, Huntsville, Alabama

**TITLE:**
Ballistic missile defense project manager

**YEARS OF SERVICE IN WORKFORCE:** 14

**DAWIA CERTIFICATIONS:**
Level III in facilities engineering

**EDUCATION:**
MBA, The Citadel; B.S. in mechanical engineering, Geneva College; professional engineer – Pennsylvania and certified Project Management Professional

**AWARDS:**
Huntsville Center Project Manager of the Year; Achievement Medal for Civilian Service; Europe District Hero of the Battle; Certificate of Achievement, NATO Special Operations Headquarters Project Delivery Team; Certificate of Achievement, Interagency and International Services Project Delivery Team; Certificate of Achievement, Phased Adaptive Approach Romanian Planning Charrette

# A career marked by big transitions

In her 14 years of working for the federal government, Tara Clark's career has taken her from one service to another, across Europe and back to Alabama. Along the way, she's learned about the challenges of working overseas, the benefits of professional certification and the importance of learning from one's mistakes.

She started her career with the Naval Facilities Engineering Command (NAVFAC) in 2002, and developed a solid footing in both engineering and acquisition. "NAVFAC pushed hard to make sure I achieved each facilities engineering certification level as it became available," said Clark. While with NAVFAC she also obtained her professional engineer certification and earned an MBA. "I think it was critical that I had a good foundation in my mechanical discipline before jumping over to the program and project management side," she said.

In early 2009, she was offered two positions outside the continental United States, one with NAVFAC Europe Africa Southwest Asia in Naples, Italy, and one with the U.S. Army Corps of Engineers' (USACE) Europe District in Wiesbaden, Germany. The Europe District offer was as the mechanical engineer for the Missile Defense Agency (MDA) European Interceptor Site, "an exciting and groundbreaking project," Clark noted. After careful consideration, she took the Europe District job, spending five years there as a mechanical engineer on Army, Air Force, humanitarian aid and other foreign projects.

"One of my most interesting mechanical projects was preparing the planning and design RFP [request for proposal] for telemedicine centers in Albania," she said. "Linking rural facilities to the main hospital in Tirana [Albania's capital] as well as stateside facilities gave rural doctors a chance to consult with specialists to solve challenging cases."

## CONTRACTING

In early 2011, she transitioned to a project manager (PM) post in the Missile Defense Branch. "At that time, we were just beginning work on the presidentially mandated European Phased Adaptive Approach [EPAA], designed to deal with the threat posed by Iranian short- and intermediate-range ballistic missiles to U.S. assets, personnel and allies in Europe," she said.

Clark was the PM for the Phase I implementation of the EPAA program, a radar component of the land-based Aegis Ashore Ballistic Missile Defense (BMD) System, which was successfully brought online in December 2011. The Aegis Ashore BMD System is the first operational land-based version of the Aegis Combat System, which combines phased-array radars, fire control directors, computers and missiles.

She considers the position an important one in her career development: "It was a unique opportunity that allowed me to work at an extreme pace on a very unusual project with a presidential mandate." She worked on a handful of different projects for the program until 2014, when she accepted a job offer at the Huntsville Center.

**EXCEEDING EXPECTATIONS**

Clark receives the Huntsville Center Project Manager of the Year Award from Col. Robert J. Ruch, then commander at the center, at an award ceremony in June 2016. (Photo by Rusty Torbett, Visual Information Specialist, U.S. Army Corps of Engineers)

Now, as a ballistic missile defense PM, she manages MDA-authorized projects from cradle to grave and leads product delivery teams in developing solutions to provide the MDA with facilities and infrastructure that meet its needs. "The systems are constantly being improved to better protect the U.S. homeland, its territories and allies," she said. "The projects I work on are vital to the protection of our nation, and in my little way I am making a difference." At Huntsville Center, with prior agreement by the host USACE district, she has been overseeing small MDA construction and repair projects at Vandenberg Air Force Base, California; Clear Air Force Station, Alaska; and other locations.

"As a PM, I'm a facilitator, translator and link," said Clark. "A PM needs to be able to listen and translate unusual customer needs into something that can be accomplished through your program office." A positive attitude helps with the challenges that the position presents, she said. "I try to look for the positive, and challenges are just opportunities to exceed expectations," she said. "Since Huntsville Center can only take projects that have been turned down by the geographical district, we always are given projects that give us opportunities to exceed expectations."

Looking back on her career, Clark noted that she has had some exceptional supervisors and mentors. "An early PM supervisor at NAVFAC Mid-Atlantic had so much faith in my ability that he tasked me with repairing the fractured relationship between Marine Corps Air Station Cherry Point [North Carolina] and my branch. I was so successful that I was named the PM lead for this base," she said. "When I was in Europe, my supervisor pretty much let me handle the work and trusted that I would brief him as needed. And Huntsville Center gave me the opportunity to temporarily act as manager over the BMD program when the program manager had to take off for emergency medical leave."

Those experiences have taught her wisdom she offers as advice for others: "Learn your strengths and maximize these areas. Understand and forgive your weaknesses. Take training when it is offered, and participate in the classes. And if you make a mistake, learn from it and move on."

***—MS. SUSAN L. FOLLETT***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govDELIVERY

# KEEPING CONTRACTS FROM CRASHING

When reality strikes in contract administration for Army helicopters, DCMA Sikorsky Aircraft – Stratford fills in the gaps with real-time information and critical multifunctional expertise.

*by Maj. Rob Massey and Staff Sgt. Daniel Martin*

In every contracting course and every contracting office, you hear a familiar refrain: "The perfect contract is just a modification away." Yet even after incorporating that modification, circumstances and events inevitably will require input and intervention from the organization charged to administer the contract.

Enter the Defense Contract Management Agency (DCMA), an organization responsible for providing contract management support to some of the most complicated contracts across DOD. A case study is the Army's contract for the UH/HH-60 Black Hawk utility helicopter. Within DCMA, the contract management office (CMO) at DCMA Sikorsky Aircraft – Stratford ensures that the Army receives a high-quality product that conforms to the contract. Located in Stratford, Connecticut, DCMA Sikorsky Aircraft essentially is the last line of defense between the warfighter and an inferior helicopter.

Complicated aviation contracts, like the one for the Black Hawk—with the current model entering its 15th year of production—often require expertise that is rare in the acquisition community. DCMA Sikorsky Aircraft is able to manage the nuances of aviation-centric contracts by employing some of the best-trained and most experienced military test pilots and aviation ground support personnel available in DOD.

*There's no such thing as autopilot when it comes to complex contract administration, including the post-award phase.*

**TESTING, TESTING**

Chief Warrant Officer 4 Vance Corey, a government flight acceptance pilot and government flight representative with DCMA Sikorsky Aircraft – Stratford, completes a government flight acceptance test on a UH-60M Black Hawk helicopter in Stratford, Connecticut. DCMA Sikorsky Aircraft's experienced military test pilots help the contract management office perform its key function as the last line of defense between Soldiers and a helicopter that doesn't perform as needed. (Photo courtesy of Maj. Rob Massey, DCMA Sikorsky Aircraft – Stratford)

One of DCMA's 46 contract management offices, the Stratford organization has existed in various capacities since the 1960s to provide support for defense contracts awarded to Sikorsky, the manufacturer of a half-dozen rotary wing platforms including the Black Hawk. Originally Sikorsky Aircraft, the company has been an element of Lockheed Martin Corp. since November 2015. DCMA Sikorsky Aircraft provides contract oversight and flight operations support to multiple contracts that together combine to produce over 2,500 flying hours annually—more than any other office within DCMA.

## MANY PLAYERS, ONE TEAM

Multiply the complexities of contracting by the complexities of a military helicopter, and you get an idea of the diversity of skills that DCMA Sikorsky Aircraft requires to operate successfully.

Within DCMA, government ground representatives (GGRs) are responsible for developing and implementing surveillance plans to support the contract. These comprehensive plans allow GGRs, along with quality assurance personnel, to balance resources with contract risk to ensure that the government routinely inspects the most important tasks performed by the contractor. These experts bring an aviation background to the contract administration process, ensuring a high-quality, conforming helicopter and allowing them to manage the contractor's flight operations, which is critical to ensuring a safe work environment for both government and contractor personnel. The GGR's role in contract administration is important to reducing risk to mission, troops and funds.

The functions delegated to DCMA Sikorsky Aircraft under Part 42 of the Federal Acquisition Regulation enable the Army and the contractor to continue production in those instances that the contract could not or did not foresee. On the Army's most recent Black Hawk production contract, DCMA Sikorsky Aircraft supports critical post-award contracting functions. Some of the more important are ensuring contractual compliance with quality and safety requirements; engineering surveillance; reviewing requests for deviation; and maintaining surveillance of flight operations at the contractor's facilities.

To adequately support these and many other efforts, DCMA Sikorsky Aircraft leverages the collective experience of quality assurance personnel, technical engineers, industrial specialists and program integrators. The fruits of these specialists' efforts are evident almost daily in large and small ways.

**A MULTIFUNCTIONAL TEAM**

The DCMA M-model Black Hawk team gathers in October 2016 in front of the 1,000th aircraft delivered to the Army: from left, Chief Warrant Officer 5 Mike Bobkoskie, chief of flight operations; Maj. Rob Massey, the program integrator for the M-model Black Hawk; Kathy Agosto, administrative contracting officer; and Chief Warrant Officer 4 Mike Tobin, government flight acceptance pilot and deputy program integrator. DCMA supports some of the most complicated contracts across DOD, including those requiring multifunctional expertise like the Black Hawk, knowing that moving from a piece of paper to a fully functional aircraft is a challenge with high stakes. (Photo courtesy of Maj. Rob Massey, DCMA Sikorsky Aircraft – Stratford)

Across every tactical operating center and command post in the Army, you will hear the words, "Who else needs to know?" A smooth flow of communication is one of the primary responsibilities of program integrators at DCMA Sikorsky Aircraft – Stratford. Program integrators lead integrated project teams that bring all stakeholders and functional areas together to address contract challenges in a timely manner.

Program integrators have direct access to the contractor's facility, including work as government acceptance pilots. Furthermore, the relationship between DCMA Sikorsky Aircraft and its supported contractor translates to close cooperation that not only helps build the team but also brings potential discrepancies in the production and test flight processes to light quickly, preventing problems from developing and quality from slipping. The program integrators thus can provide rapid feedback to the Army customer.

Last year, during a routine weekly integrated product team meeting, the prime contractor alerted DCMA that it was no longer able to access required Army publications to support the contract effort because of changes in the Army's forms and publication distribution process. This issue affected the contractor's employees worldwide, including pilots and maintainers, who needed access to technical publications, forms and records. The program support team at DCMA Sikorsky Aircraft stepped in immediately to resolve the issue, working with all parties involved to establish procedures that would enable the contractor to request updated publications and forms in an organized and efficient manner through appointed government sponsors.

## CONNECTIONS ARE KEY

In addition to the support DCMA provides to each individual contract delegated to it, the organization also can leverage a vast network of CMOs to support contract administration with skilled oversight. By tapping into this network of CMOs, DCMA can work across major contract efforts to solve problems.

DCMA units work closely with the procuring contracting officer of the organization that delegated the contract's administration. In the case of the Black Hawk contract, that organization is the U.S. Army Contracting Command – Redstone Arsenal. However, several other contracts awarded by DOD organizations also influence and sometimes complicate production of the Black Hawk. This is where relationships among CMOs can be especially useful—in fact, critical— to managing contract risk.

Recently, for example, Sikorsky had to return an aircraft engine to the subcontractor for additional servicing and testing before installation. Upon completion, the engine was to be rushed back to Sikorsky's production facility. When errors in the shipping paperwork delayed the return shipment, program integrators from DCMA Sikorsky Aircraft intervened and worked with a sister office that oversees the subcontractor to fix the errors, ensuring timely delivery and preventing any production delays.

There's no such thing as autopilot when it comes to complex contract administration, including the post-award phase. Post-award contracting requires daily


**BATTING A THOUSAND**

Marine Col. Jack Perrin, left, commander of DCMA Sikorsky Aircraft – Stratford, Army Col. Billy Jackson, PEO Aviation's project manager for utility helicopters, and Daniel C. Schultz, president of Sikorsky, display a plaque presented to the acquisition team to mark the delivery of the 1,000th Black Hawk M-model in October 2016. Close cooperation, including co-location, between DCMA military and civilian staff and the contractor results in quick response times and efficient delivery. (Photo courtesy of Stuart Walls, Woodstock Studio)

and sometimes aggressive efforts on the part of the CMO. Nonconformances in the production process, even those that may seem insignificant at the time, can manifest themselves as major costs and safety consequences later.

As an example, recently Sikorsky discovered that a grounding cable connected to the helicopters' windshield wipers had been installed incorrectly. While the discrepancy posed no flight safety risk, DCMA and the contractor agreed to rework the discrepancy to prevent the potential early deterioration of the component. This decision ultimately will help the Army save on replacement costs.

While contract administration represents its own phase in the contracting process, DCMA is also equipped to support other contract phases, with CMOs providing the contracting officer with valuable feedback on a contractor's performance based on observations gathered by walking the production line and interacting daily with the contractor's functional leadership. Furthermore, having navigated the challenges of a contract action firsthand, the CMO is well-equipped to provide input to a follow-on contract and prevent repeat performance issues.

**By tapping into this network of CMOs, DCMA can work across major contract efforts to solve problems.**

## CONCLUSION

When Gen. Mark A. Milley assumed duties as the Army's 39th chief of staff in August 2015, readiness was at the top of his priority list. Ensuring equipment readiness is no small undertaking, and for the Black Hawk, it extends well beyond the program managers in the Utility Helicopters Project Office of the Program Executive Office (PEO) for Aviation.

Contract administration is anything but routine. The support that DCMA Sikorsky Aircraft – Stratford provides allows the project office to fulfill its charter: to provide warfighters with the best equipment to meet their operational needs while actively managing all life cycle aspects of the program.

*For more information, contact the DCMA chief of public affairs at* ***mark.woodbury@dcma.mil*** *or go to* ***www.dcma.mil****.*

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*MAJ. ROB MASSEY is the program integrator with DCMA Sikorsky Aircraft for the Army's UH-60M Black Hawk Program. He holds an MBA from the University of Rochester's Simon Business School and a B.S. in pre-law from the United States Military Academy at West Point. He is Level II certified in contracting and a member of the Army Acquisition Corps.*

*STAFF SGT. DANIEL MARTIN is the government ground representative for the Army Program Team. He has 14 years of experience in aviation maintenance and operations. He holds certifications in aircraft weight and balance, quality assurance, occupational safety and health, and hazardous materials transportation.*

# RECOGNIZING *OUTSTANDING* ACHIEVEMENT

## Army announces its Excellence in Contracting Awards for 2016

The Office of the Deputy Assistant Secretary of the Army for Procurement has announced the winners of the 2016 Secretary of the Army Awards for Excellence in Contracting, honoring Army contracting organizations and individuals who've exemplified excellence in productivity, process improvement and quality enhancement.

The U.S. Army Contracting Command (ACC) – Rock Island, Illinois, netted three awards: an individual honor for outstanding contract specialist, and group awards for contingency contracting and for systems, research and development (R&D) and logistics support (sustainment) contracting.

More than 60 nominations were received for the FY16 awards—13 honors in three categories. Mary P. Hernandez, ACC–Warren, Michigan, was named Contracting Professional of the Year, and Sgt. 1st Class Matthew Girard was named Contracting Noncommissioned Officer of the Year. At the time, he was with the 918th Contracting Battalion, Mission and Installation Contracting Command – Fort Carson, Colorado.

*For more information on the awards, go to* ***http://asc.army.mil/web/contracting-awards/****. The full list of honorees follows.*

***—MS. SUSAN L. FOLLETT***

**Barbara C. Heald Deployed Civilian Award**
**Natanielle L. Little**, U.S. Army Corps of Engineers (USACE), Transatlantic Afghanistan District, Bagram, Afghanistan

**Outstanding Contract Specialist/ Procurement Analyst**
**Michael DeBisschop**, ACC–Rock Island

**Exceptional Support of the AbilityOne Program**
**Guy Hunneyman** and **Evangelina C. Tillyros**, ACC–New Jersey

**Contracting Professional of the Year**
**Mary P. Hernandez**, ACC–Warren

**Contracting Noncommissioned Officer of the Year**
**Sgt. 1st Class Matthew Girard**, 918th Contracting Battalion, Mission and Installation Contracting Command – Fort Carson

### *OUTSTANDING CONTRACTING OFFICER AWARDS*

**Installation Level/Directorate of Contracting**
**Laquita L. Mox**, ACC–Redstone, Alabama

**Systems, R&D, Logistics Support (Sustainment) Contracting**
**Ercilia Del Orbe**, ACC–Aberdeen Proving Ground, Maryland

**Specialized Services and Construction Contracting**
**Oksana A. Joye**, USACE, Engineering and Support Center, Huntsville, Alabama

**Contingency Contracting**
**Maj. Timothy G. Godwin**, 900th Contracting Battalion

### *OUTSTANDING UNIT/TEAM AWARDS*

**Installation Level Contracting Office/ Directorate of Contracting**
**Contracting Support Plans and Operations Division**, 414th Contracting Support Brigade

**Systems, R&D, Logistics Support (Sustainment) Contracting**
**Information Technology Division**, Branch D, ACC–Rock Island

**Specialized Services and Construction Contracting**
**Mosul Dam Team**, USACE, Principal Assistant Responsible for Contracting – Winchester, Virginia

**Contingency Contracting**
**Field Support Directorate**, ACC–Rock Island


## MS. JACKI A. GARNER

**COMMAND/ORGANIZATION:**
G-6 Communications, U.S. Army Europe

**TITLE:**
Chief, Information Technology Theater Business Office

**YEARS OF SERVICE IN WORKFORCE:** 14

**YEARS OF MILITARY SERVICE:** 2 years, 10 months

**DAWIA CERTIFICATIONS:**
Level III in information technology

**EDUCATION:**
M.S. in computer information systems, University of Phoenix; B.S. in computer science, University of Central Texas; associate degree in business programming, Central Texas College

**AWARDS:**
Defense Acquisition Workforce Individual Achievement Award in Information Technology; Commander's Award for Civilian Service

# Streamlining IT purchases for USAREUR

U.S. Army Europe (USAREUR) has Jacki Garner to thank for a theater information technology (IT) acquisition process and an IT investment governance and management program that have been instrumental in saving her command nearly $6 million in procurements.

As chief of the Information Technology Theater Buying Office (IT-TBO), Garner manages USAREUR's procurement of the IT supplies and services needed to support and sustain its mission. She's been with IT-TBO since USAREUR G-6 created it in 2008 to focus on controlling IT costs.

"The intent is to manage enterprise requirements holistically to ensure standardization and sustainability for the command," Garner said. "USAREUR's portfolio management framework aims to eliminate redundant and unnecessary IT spending and gain better pricing through consolidated procurements."

Garner led her staff in redesigning the USAREUR IT portfolio dashboard so that it could provide functional program managers with the necessary tools and data to help them manage their programs effectively. She developed a theater IT acquisition process to enable the early identification of requirements, giving her staff time to structure IT procurements using the acquisition strategy necessary to ensure the most economical purchase. She directed that IT requirements be itemized and disclosed during preparation of USAREUR's annual budget, which resulted in IT requirements being "procurement ready" for command approval, and identified opportunities to consolidate requirements for better pricing, thus reducing the total cost of IT.

Garner also developed a framework for tracking and disclosing current-year IT investment costs with associated future-year defense program data, in accordance with Army regulations that require accountability for all Army service component command IT costs in the Army

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BBP 3.0

Portfolio Management System (APMS). This provided planning data for the DA chief information officer (CIO)/G-6 to better inform the program objective memorandum. Garner's actions captured more than $160 million of USAREUR FY16 IT costs in APMS and ensured that they were properly aligned to the common user infrastructure, data center, system or application records. She also created an IT acquisition working group, which included representatives from the 409th Contracting Support Brigade and USAREUR major subordinate commands.

"The intent is to manage the overall cost of IT through prestaged enterprise contracts that provide the warfighter with a streamlined procurement process and ensure that he or she gets the right tool at the right time and at the right price," Garner said. "Aggregating requirements at the command level gives us better buying power, enforces standardization and enables long-term sustainability. It also simplifies the procurement process, enhances the quality of the procurements and alleviates 90 percent of the workload to build a quality acquisition packet to buy the necessary IT supplies or services."

Standing up a new organization can be daunting under the best of circumstances, but Garner welcomed the challenge. "Establishing the new business processes and framework to manage IT cost collectively from the enterprise level was appealing because it was leading-edge and really had not been done before within the Army," she said. "Carving new ground within USAREUR was exciting, as we had leadership support and drive to establish the mechanism behind IT cost management, and we've been able to yield significant savings across the theater."

She and her team encountered a handful of hurdles, including establishing new and effective business processes from the enterprise perspective, ensuring that customers were aware of these new processes and securing the necessary participation from a policy and leadership perspective.

"We used an iterative process to establish the portfolio management framework and its centralized review and governance of IT spending, incorporating feedback from our customers and making adjustments as we went along," Garner said. They developed an information campaign and conducted unit-level site visits to educate users on the new policy and business processes. To ensure participation, the IT-TBO established a policy that requires the review of all IT procurements in excess of $25,000 through the USAREUR Requirements Validation System.

Garner's work for the IT-TBO earned her the 2016 Defense Acquisition Workforce Individual Achievement Award. "The award is reflective of the quality of my team and the leadership support I have received to date," she said. "It really was a team effort, and I could not have accomplished what I did without the support and the technical expertise of my management and my team."

She was quick to note that mentors have played an important role in her career development. Chief among them is John J. Gannon, USAREUR's deputy G-6. "He has always stressed the importance of professional development and involvement in professional forums and communities as a critical aspect of that development," Garner said. "IT skill sets are perishable, and technology changes every two years. Therefore, it is imperative to embrace continuous learning as a key tenet to ensure that IT professionals remain relevant and capable to perform effectively within the IT career field. This is true of critical acquisition skills as well."

Taking advantage of the courses offered through Defense Acquisition University has also been important. "Using what we've learned from those courses—applying it to real-world situations to effectively manage cost and proactively accomplish the mission—allows my office to function as a force enabler for USAREUR's mission," said Garner. "The broader your background, the more in-depth your experience will be, and that depth of experience is critical to performing strategic IT cost management and acquisition support services for the enterprise at the Army command level."

She's also glad to be part of "a community that facilitates collaboration to translate new initiatives like Better Buying Power into an actual acquisition strategy that allows us to provide resources to the warfighter while still buying for more for less." For example, she said, USAREUR developed a life cycle replacement functional program for office automation equipment throughout the USAREUR workforce. By consolidating requirements at the enterprise or command level, USAREUR has reduced its cost to purchase automation equipment by more than 35 percent each fiscal year.

Garner served in the Army in the mid-1980s and used the funds she received from the Veterans Educational Assistance Program to go to college. "Serving in the military gave me an appreciation and respect for our Soldiers and what they do in support of our great nation," she said. "Every day, it's about the bottom line: Are we effectively resourcing our troops for the mission at hand?"

***—MS. SUSAN L. FOLLETT***

# *Need a* LFT?

PEO Ammunition and ARDEC have a patent-pending and cost-effective way to LFT the 155 mm high-explosive round for increased anti-materiel performance.

*by Mr. Paul Manz*

In an attempt to partially mitigate the capability gap resulting from DOD's policy on cluster munitions—which mandates a significant reduction in the amount of potential unexploded ordnance left on the battlefield by 2019—a trio of technical professionals at Picatinny Arsenal, New Jersey, faced the challenge of eking out increased performance from existing 155 mm high-explosive unitary munitions without breaking the bank. The policy-driven loss of most U.S. cluster munitions impacts all dual-purpose improved conventional munitions (DPICMs) used by the Army and Marine Corps.

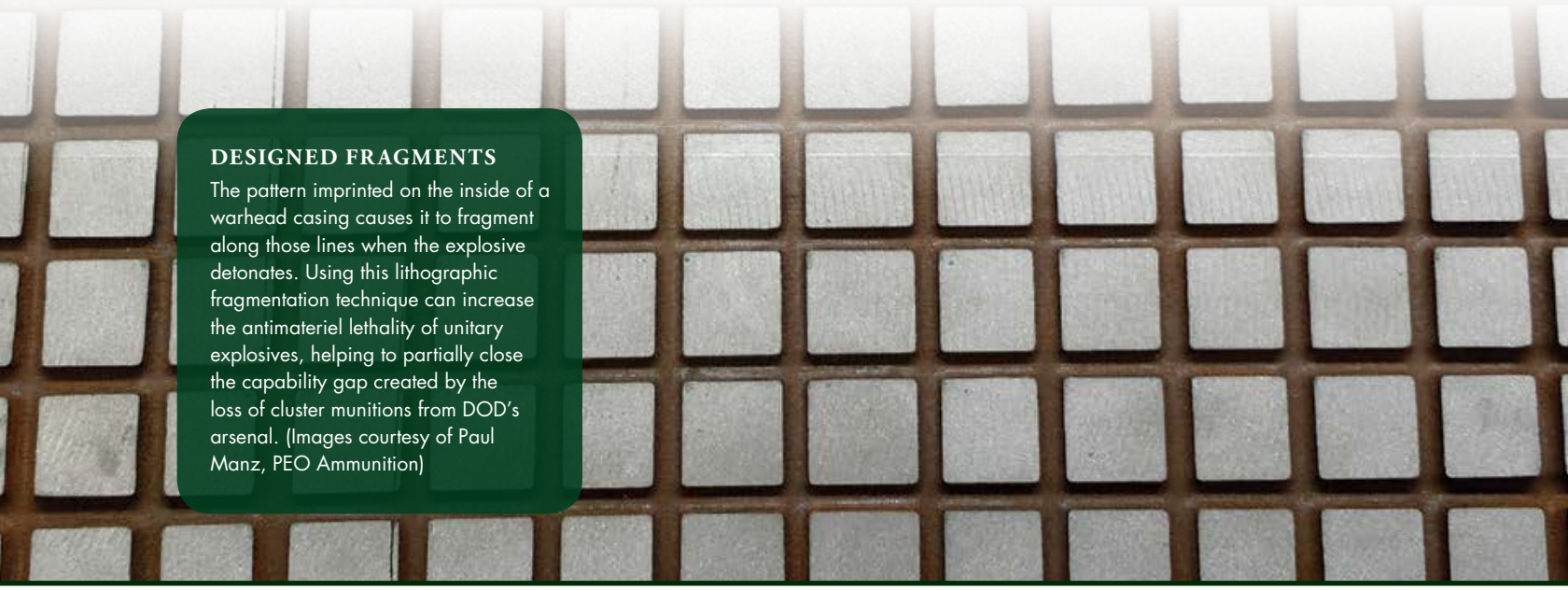
LFT, or lithographic fragmentation technology, is a new, patent-pending processing technique developed by the government to cost-effectively pattern and generate preformed fragments for optimized target effects. LFT, pronounced "lift," can force unitary high-explosive (HE) munitions to produce larger specific fragment sizes and shapes when increased anti-materiel performance is required versus the multitude of smaller-sized anti-personnel fragments produced by most current fragmentation warhead products.

Without DPICMs, some target sets may require development of new and relatively expensive advanced sensor-fuzed munitions (SFMs). SFMs are expensive for a reason: They are basically intelligent munitions that use multiple sensors and onboard processing to autonomously engage and defeat targets independent of terrain and weather conditions. Many of the remaining target sets can be reasonably engaged through a combination of precision guidance, programmable height-of-burst fuzing or enhanced lethality capabilities. LFT is focused on addressing the latter capability and leverages current 155 mm cannon HE unitary solutions (i.e., using a single explosive, as opposed to a cluster of smaller ones), including well-known materials, explosive fragmentation principles, established manufacturing methods and industrial base sunk-cost investments.

## THE USES OF FRAGMENTATION

Fragmentation warheads allow for the engagement of multiple targets with a single warhead. Large caliber gun-launched munitions, such as 155 mm cannon HE unitary projectiles, typically use fragmentation as their primary target-defeat mechanism. Although blast wave effects also contribute to lethality, it is generally a secondary mechanism of defeat.

The fragments produced by these munitions are very specific to the type and quantity of explosive, steel wall material and the thickness of the steel wall of the projectile. Each munition will generally produce a natural distribution of many small and some larger fragments based on test data. This natural distribution allows these munitions to defeat a wider range of targets but is not optimized for specific target sets. Target defeat is a function of the number of each specific-size fragments produced, fragment velocity, fragment shape and total number of fragments.



**DESIGNED FRAGMENTS**
The pattern imprinted on the inside of a warhead casing causes it to fragment along those lines when the explosive detonates. Using this lithographic fragmentation technique can increase the antimateriel lethality of unitary explosives, helping to partially close the capability gap created by the loss of cluster munitions from DOD's arsenal. (Images courtesy of Paul Manz, PEO Ammunition)

## MUNITION SAFETY

The current DOD cluster munitions policy was established on June 19, 2008, during the administration of President George W. Bush, to minimize the potential unintended harm to civilians and civilian infrastructure to the extent possible when employing U.S. cluster munitions.

At the same time, it recognizes that cluster munitions can be the most effective and efficient weapons for engaging massed formation of enemy forces, individual targets dispersed over a defined area, targets whose precise location are not known, and time-sensitive or moving targets. The policy defines cluster munitions as munitions composed of a nonreusable canister or delivery body containing multiple, conventional explosive submunitions but excludes nuclear, chemical or biological weapons; obscurants, pyrotechnics, nonlethal systems (e.g., leaflets); nonexplosive kinetic submunitions (e.g., flechettes or rods); electronic effects; and landmines.

The policy applies to systems delivered by aircraft, cruise missiles, artillery, mortars, missiles, tanks, rocket launchers or naval guns that deploy payloads of explosive submunitions that detonate via target acquisition, impact or altitude, or that self-destruct (or a combination of both). The policy states that after Dec. 31, 2018, DOD can no longer use cluster munitions that, after arming, result in more than 1 percent unexploded ordnance across the range of intended operational environments.

### THE PATH TO LFT

Affordable enhanced lethality is a recurring imperative across DOD's large, diverse conventional munitions portfolio, which is managed by the Program Executive Office (PEO) for Ammunition. The U.S. Army Armament Research, Development and Engineering Center (ARDEC), co-located with PEO Ammunition at Picatinny Arsenal, investigated several potential innovative approaches to enhance cannon HE unitary lethality.

One approach looked at using flexible, perforated metal sheets as liners in an attempt to reliably create patterned fragments out of the metal shell casing. While cost-effective, this method was not easily compatible with current manufacturing methods and many munition warhead designs such as one-piece artillery shell bodies.

In these one-piece 155 mm artillery shells, the only opening is a small hole at the top that is about one-third the diameter of the main portion of the shell casing. This opening is used to pour in explosive fill; it then serves as a threaded well for attaching a fuze. Unfortunately, the aforementioned metal liner cannot be rolled up, inserted through this hole, and then unrolled to conform to the tapered end of the shell casing without creating potentially significant gaps and spaces between the sheet and the internal metal surface. When hot, liquefied explosive fill is subsequently poured into the shell, the potential becomes very high for voids and cracks to form in the explosive fill as it cools around these gaps. That creates a probability of premature detonation in a gun tube because of the abrupt, high-speed movement of the explosive fill into these voids and cracks during high-g (high acceleration) gun-launch setback.

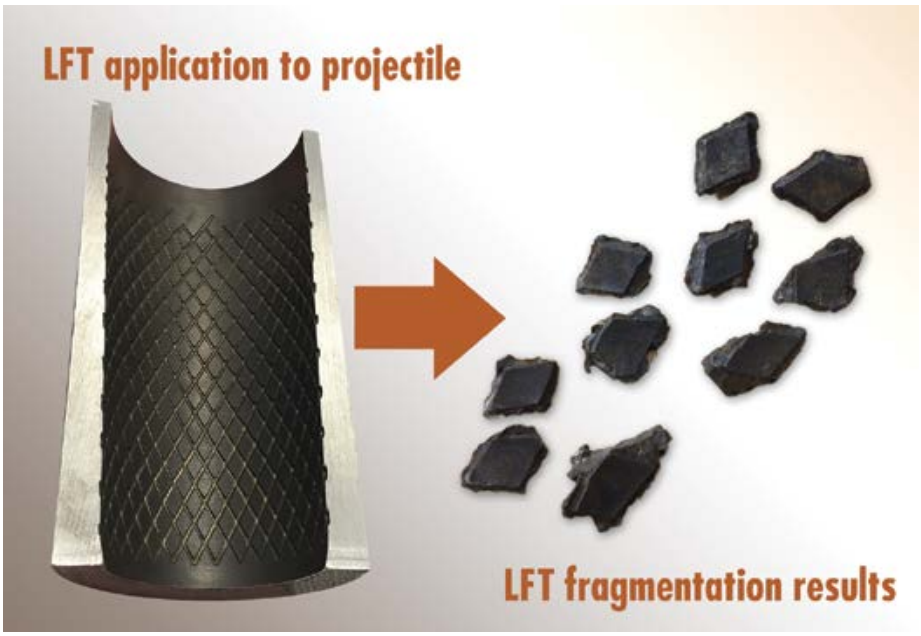
As an alternative to metal liners, ARDEC has long understood that warhead cases can be scored with a fragmentation pattern by mechanical means, a process that unfortunately would be more costly and time-consuming for artillery shells.

### MUNITIONS GET A LFT

Enter LFT, which combines the positive aspects of these known approaches for creating preformed fragments with high-volume, low-cost, repeatable lithographic techniques. One such technique is commonly used across the semiconductor industry to enable manufacturing of affordable products for the commercial consumer marketplace. Since they conceived the idea of LFT, the three U.S. government inventors from PEO Ammunition and ARDEC have prototyped, tested and demonstrated the application


**BUILDING IN SAFETY**

Used for current munitions such as this 155 mm HE artillery shell, LFT can enhance safety without raising costs prohibitively, by addressing the risk of premature detonation that exists with naturally fragmenting metal liners.




**HOW LFT BREAKS DOWN**

Because LFT causes munitions to fragment in a predefined pattern, it improves those munitions' effectiveness against a specific target set. Whereas a munition without LFT might break into a natural distribution of some large fragments and some small, using LFT in a munition can force the creation of larger fragments in higher quantities than would occur naturally.

of LFT for increased anti-materiel performance.

The method can be employed on currently produced, otherwise naturally fragmenting, metal shell bodies from the government-owned, contractor-operated Scranton Army Ammunition Plant in Pennsylvania. The performance results to date, along with the predicted low manufacturing costs, have been impressive enough that Army leadership has recently directed the use of LFT on a new, extended-range artillery projectile being developed by ARDEC and PEO Ammunition for accelerated Army production.

This extended-range round will have a small payload (i.e., less HE fill) than its existing shorter-range naturally fragmenting counterpart in the U.S. munitions stockpile. LFT will help make up the difference in anti-materiel lethality to cost-effectively get the same or better performance at longer ranges.

## LFTING THE JOINT WARFIGHTER AND INDUSTRY

As DOD's official single manager for conventional munitions, PEO Ammunition considers the requirements for products it provides to the Air Force, Navy, Marines, special operations forces and Coast Guard in addition to those it provides to the Army. Many of these military customers also use larger unitary HE munitions that rely upon fragmentation for lethality, and these stakeholders are also facing the policy-driven loss of most of their cluster munitions after Dec. 31, 2018. Communicating through its on-site Air Force, Navy and Marine Corps liaisons at Picatinny Arsenal, PEO Ammunition and ARDEC are considering these other customer applications through proactive collaboration with the appropriate service stakeholders upfront. The aim is to maximize joint warfighter "goodness" down the line as LFT is being matured and further optimized for initial use in cannon artillery munitions.

## CONCLUSION

As a U.S. government patent-pending technology, LFT conceivably could be modestly licensed to U.S. industry to try to win back previously lost NATO or allied munition customers by providing improved products at equal or lower cost than offerings from international industry competitors. That, in turn, could also enable U.S. taxpayers to recoup some of LFT's development investment.

LFT is just one example of the many good ideas that Joint Center Picatinny Arsenal delivers, a result of its institutional culture, which continuously considers all aspects of materiel development and acquisition throughout the product life cycle to ensure maximum benefit to the joint warfighter, U.S. taxpayers and industry partners.

*For more information, go to Picatinny Arsenal's website at* ***www.pica.army.mil****.*

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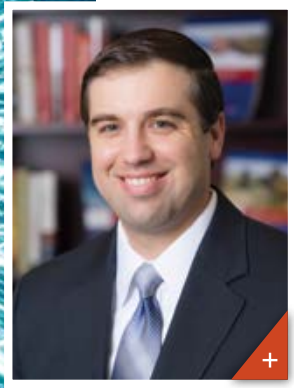
**I CAN SEE THE FUTURE**
According to Scharre, "The most compelling opportunity to create long-term advantage … is the process of innovation, of translating technological opportunity into new operational concepts." But keeping pace with technology's potential requires institutions to be more adaptable and flexible. (Image by carloscastilla/iStock)

# ROBOTICS REVOLUTIONARY

Former Army Ranger Paul Scharre, drawing on his experience in uniform, then in OSD and now at a private-sector think tank, fears DOD bureaucratic resistance could pump the brakes on progress in machine intelligence.



Paul Scharre

*by Ms. Margaret C. Roth*

It couldn't be a much bigger leap from Southwest Asia to downtown Washington, yet, for Paul Scharre, the two could hardly be more closely connected. What Scharre experienced as an Army Ranger deployed to Iraq and Afghanistan—his first look at how robots could mitigate the huge toll that improvised explosive devices (IEDs) were taking on Soldiers—led him directly to what he's doing now as a civilian: senior fellow and director of the Future of Warfare Initiative at the Center for a New American Security.

In just 10 years, Scharre (rhymes with "sorry" but with "sh" instead of "s") has seen warfare from three distinct vantage points: the battlefield, as a graduate of the Army's Airborne, Ranger and Sniper schools and honor graduate of the 75th Ranger Regiment's Ranger Indoctrination Program; the bureaucracy (the Office of the Secretary of Defense (OSD) from 2008 to 2013); and now the more bookish community of analysts in Washington that aims to make sense of the big picture and influence our nation's defense. At OSD, he played a leading role in establishing policies on unmanned and autonomous systems and emerging weapon technologies, heading the working group that drafted DOD Directive 3000.09 on autonomy in weapon systems. Scharre also led DOD efforts to set policies on intelligence, surveillance and reconnaissance (ISR) programs and directed-energy technologies.

With an M.A. in political economy and public policy and a B.S. in physics, Scharre is wholly engrossed in how new technologies translate to warfighting doctrine and

acquisition—and he is passionately aware of how long that can take.

With the increased freedom he now has as a former DOD insider looking more broadly at the defense establishment from the outside, Scharre talked with Army AL&T magazine in February about what the Pentagon needs to do to take appropriate advantage of the rapid advances in robotics, artificial intelligence (AI) and autonomous weapon systems. As he perhaps understated it, "I'm just saying, as an observer here, these might be things that the U.S. military can do to be more effective and stay competitive."

**Army AL&T:** We were intrigued by your operational background and the amount of thought you've given to the topic of robotics and artificial intelligence. How did you get from there to here?

**Scharre:** When I was in the Army, I saw how decisions in Washington and the Pentagon really affected people downrange. When I first came to the Pentagon, we were working on a suite of different capabilities to try to make the Pentagon's sluggish bureaucracy more responsive to the warfighters in the field. Things like intelligence, surveillance and reconnaissance were huge issues at the time, and unmanned vehicles are a part of that.

But over time, robotics became a bigger and bigger issue. I think people inside DOD began to realize the potential of what I would describe as kind of an accidental robotics revolution that happened—the Predator [unmanned aerial vehicle (UAV)] and Gray Eagle, and then large numbers of smaller unmanned aircraft or drones, like the Wasp and Raven, thousands of those things that gave troops the ability to look over hills and around corners. I worked on the receiving end of this [demand], and there was just this tremendous appetite for more ISR, what Secretary Gates [Robert M. Gates, secretary of defense from December 2006 to July 2011] described as this "insatiable demand."

**IN IT TO WIN IT**

Then-Staff Sgt. Paul Scharre poses with Iraqi children in Diyala province, Iraq, as part of the opening of an elementary school in Baqubah in 2008. (Photo courtesy of Paul Scharre)

And what I saw—which was really disheartening but also educational for me—was the immense resistance within the bureaucracy to respond to the needs of the warfighter on this issue. Secretary Gates had to direct a stand-alone ISR task force to respond to the needs.

The needs from the COCOMs [combatant commands] were massive and just swamped the ability of the bureaucracy to understand. And rather than try to say, OK, here's a legitimate need by warfighters for emerging technology that's really valuable—and you know our current processes don't really make it possible, feasible or affordable to respond to these needs, so we need to find better ways of doing business (which there are lots of opportunities to do, because it's a new technology—instead the response of the bureaucracy was basically to reject the warfighters' needs, to just say no. And it was really only because Secretary Gates forced it on the U.S. Air Force that the Air Force grew the number of Predator or Reaper air patrols from initial small numbers, like 12, up to 50 and 60, 65 and 70 [24/7 orbits] over time.

As soon as Gates left, there was pushback within the bureaucracy. The Air Force in particular was taking its foot off the pedal and doing less. And I think it's an indictment of the bureaucracy that we've [also] seen across other areas like MRAPs [Mine Resistant Ambush Protected vehicles]. The Air Force is not unique in this.

I think the Army's failure to respond in a timely fashion on MRAPs is just unconscionable and a disgrace.

I think this is a continual problem that the bureaucracy has. The system is designed to think long term about what the future force might need in some unknown, nebulous time frame. When there are immediate needs today, people in the bureaucracy—it's not that they don't care; they don't think that it's their job to respond to those needs. And the system is so slow that it's not easy to [respond]. So I'm getting off the topic of robotics, but it's something that I'm passionate about.

I think speed is really fundamental in this type of international environment we're living in today. We have a very different military than we had almost 30 years ago at the end of the Cold War, but we're dealing with bureaucracies that are an outgrowth of institutions that we created in the Cold War. Today we have a wider set of possible challenges. We're competing against actors like terrorist groups that don't have the kinds of bureaucracies we have.

*There's no technology or set of technologies that's going to be a silver bullet.*

That's going to be a challenge in future wars as well. Whether it's a big war or small war, whether it's a war against a terrorist group or another nation-state, you've got to be constantly adapting and evolving.

And that's a really vital lesson that we need to be imparting in our institutions: that the types of threats that we face in the future will be different, and the types of adaptations will be different, and we'll need the ability to have institutions that can rapidly adapt to whatever those things are. That's really fundamental, particularly for technologies like robotics that are moving so rapidly. The progress in machine intelligence driven by deep learning and neural networks is just mind-blowing. These deep-learning neural networks are solving problems that have bedeviled AI researchers for decades, things that people just had no idea how to solve.

So we're at the beginning of an explosion in machine intelligence that's likely to unfold. It's really hard for the U.S. to stay competitive in that environment, in part because things are moving quickly and in part because a lot of the innovation of robotics is outside of traditional defense actors. It's coming from Google and IBM and Microsoft and Facebook and Apple, and they don't want to work with DOD. It's not worth the headache. I've heard from people in venture capital firms, I won't let my companies work with the U.S. military, because they're just going to bog you down into a lengthy multiyear process of futzing around with requirements. They're going to try to over-specify what they need, they're going to give you a bunch of government red tape. And at the end of the day, the profit margins aren't even going to be there.

What we're seeing is, there's this model where DOD uses tools like DARPA [the Defense Advanced Research Projects Agency] and the Office of Naval Research [ONR] to fund basic innovation in various technologies, and the concept is that they take this stuff to a commercial market and they mature these technologies, and then they spin back into the defense sector. That's a great model, [but] I'm not sure how much things are actually coming back in.

**Army AL&T:** You mean what they call transitioning?

**Scharre:** Well, there's two different kinds of concepts. One is, you have a place like DARPA develop something that's a really appealing proof of concept. And then they throw it over the transom or use some means that's supposed to cross the "valley of death" that people describe to get into a program of record. And that often fails. There isn't necessarily an institution of bureaucracy that is designed to grab hold of those things and then transition them.

**Army AL&T:** I think the new Army Rapid Capabilities Office has that intent.

**Scharre:** Yeah, the Rapid Capabilities Office seems exactly like the kind of thing the Army should be doing, and it has a lot of potential. The Army needs that kind of capability from a bureaucratic standpoint. I think it remains to be seen if they're going to have the bureaucratic clout and the funding and the autonomy to do what they need to do.

And then there's this smaller issue, that there are some technologies that aren't even right for transitioning yet. So DOD makes a fundamental investment, and it's just not mature enough to be really transitioned to a military application, and the

**IF YOU BUILD IT, THEY WILL COME**

Local residents and coalition forces inspect an MQ-9 Reaper at the Afghan Air Force's Kandahar Air Wing open house at Kandahar Airfield, in January 2011. The open house showcased Afghan and coalition aircraft inventory—which had recently grown as a result of Defense Secretary Robert Gates' order to increase Predator and Reaper patrols. (Photo by Staff Sgt. Daryl Knee, 16th Mobile Public Affairs Detachment)

company takes it to market in the commercial side and they might mature it. And you hope that over time, that [technology] comes back in.

People are trying to create ad hoc processes to do that, and we need more of those kinds of things. It's especially vital for technologies like robotics and automation, where they're moving rapidly and so much of the innovation is happening out in the commercial sector.

I will say I've seen tremendous interest in the last several years—and not just concepts about human-machine teaming in physical ways and cognitive ways, but also people really thinking hard about, OK, what does it mean to be innovative? How do we find ways of increasing experimentation and war-gaming and competition of ideas so that we're meeting at the forefront of new operational concepts in relation to adversaries?

Now the Army has the opportunity to take basically a cadre of leaders—junior and midgrade officers and NCOs who've been able to have that freedom to be innovative out in the field and have autonomy—and say, OK, we want you to take the sort of intellectual capital you had and the skill set of problem-solving and apply it to new problems: How will we fight a war against Russia? How will we project power in the Pacific? How will we respond to adversaries' challenges in cyberspace and electronic warfare and other things?

The way those wars were fought, particularly in Afghanistan, where the geography and people are so dispersed, we gave a lot of autonomy to junior leaders, and brigades and divisions were in support of people at lower levels. That's just incredibly good in terms of maturing our leaders in their critical thinking. One of the challenges the Army has going forward is, for people who grew up in that environment, how do you continue that in garrison? So you get the squad leader engaged in finding solutions. You can't do those things from the headquarters.

**Army AL&T:** That leads us to our next question, which is what do you see as the near- and long-term strengths and weaknesses of the military in these areas of robotics, AI and advanced manufacturing?

**Scharre:** There's a bit of a mythology that has arisen within DOD, and the Army in particular, about how DOD will remain competitive in an era of robotics and automation and human-machine teaming. The story is basically, well, we have better people and that's what's going to make a difference. And that's true to a point. The thing to be keeping in mind is that that means there's more room for others [potential adversaries] to catch up.

Are our people better trained? Do we recruit a better slice of the population? Are they better-educated? Yes. All those things are true. That also means that it's harder for us to get a 10 percent improvement in people—versus in another country where the ground ahead of them, in terms of improving their people and their training, might be easier. So I think that [that] alone isn't something you can take to the bank.

In a world of rapidly advancing technology that is widely available to all, how do you create enduring military advantage? And one of the quick conclusions that people have come to is, there's no technology or set of technologies that's going to be a silver bullet, which I think is absolutely true. But sitting back and resting on our laurels and saying our people are better—that's not going to work, either.

The most compelling opportunity to create long-term advantage—what history shows us where advantage really comes from in periods of rapid technological change like this—is the process

of innovation, of translating technological opportunity into new operational concepts to solve concrete operational problems. There is, particularly within the Army, a sub-current of pushback against the technology-driven sort of themes of the third offset. DOD as a whole is a very sort of technophile kind of organization, very interested in new technology. In the Army, we all look at this and are a bit skeptical: "When I was marching up and down the mountains of Afghanistan, what were all these stealth planes doing for me? And what were all these whiz-bang technology things doing to really change warfare at the ground level, down there in the mud?"

It's been very difficult to translate technology advantage down to the squad level, down to the infantry Soldier. Part of that is because you're limited in the amount of stuff you can give a foot-mounted Soldier. People are loaded down with insane amounts of weight they've been lugging around Iraq and Afghanistan.

There are ways in which that might begin to change. Could we use robotic teammates or, maybe not far off, exoskeletons to try to carry more weight or to off-load weight to robotic teammates? Possibly. I'll point out that there are opportunities that the Army might not totally be invested in. The Army's doing nothing on exoskeletons. That's probably a weakness, because there are really transformative potentials here. It's not going to be ready tomorrow, but right now the Army's taking a wait-and-see approach to see what SOCOM [U.S. Special Operations Command] is doing [with the Tactical Assault Light Operator Suit program]. While what SOCOM is doing is great, it's probably not adequately funded to do technological development. They're doing some things, but the Army would have more resources, and they have potentially different needs and different requirements.

Similarly, the Army is doing more with robotic kinds of teammates to carry load and increase situational awareness and lethality. But in general, the enduring advantage is going to come not from any of those technologies in the long term, but from the ability for people and organizations to come up with new ways of using these technologies.

**Army AL&T:** Can you give us an example?

**Scharre:** The Israelis are building unmanned vehicles to be used to evacuate their troops. The Marine Corps is developing unmanned cargo aircraft that can potentially be used to do casualty evacuation, which is great. But the Army medical community, whose job it is to do this, had said in writing on three occasions that they think that should be prohibited. And it's not because they're trying to do something that's harmful to Soldiers. But they have a certain paradigm for what medical evacuation is.

There are a number of individuals in the Army medical community who would like to see that opportunity open up. [See "Multidomain Medicine," Page 61.] There might be situations where an unmanned system is the only way to evacuate a wounded Soldier. If that is the case, then we need to have that option available.

If we're worried about safety, what is the right standard? How should we think about that kind of thing? That's the right approach instead of just a blanket rejection of technology.

**Army AL&T:** Do you think that DOD is flexible enough to look at the potential for technological breakthroughs in robotics and AI and whatnot and weigh them individually in terms of cost, in terms of risk versus benefit?

**Scharre:** We better be. If these technologies give important advantages on the

battlefield, then we better find out a way to be flexible enough. In general, our requirements system is not super flexible and fast. We're capable of being innovative and smart, but robotics is going to challenge some communities in ways that are going to be uncomfortable.

So we're going to have to be able to take a hard look at ourselves and say, am I objecting to this use of robotics and automation based on concerns that really, objectively make sense? Do the costs and benefits here add up? Or am I being biased based on my perception of how we ought to do this job? Because robotics will enable us to change how we fight, and that is the most difficult thing for innovation.

Instead of saying, no, we can't do it that way, start by saying, why not? Why not fight in a completely different way? What if, in the future, the front line is going to be unmanned, it's going to have robotic systems, and tanks are in a supporting role, a command-and-control role? The primary method of destroying the enemy would be sending out robotic forces and long-range scouts to find the enemy and then call in the long-range fires.

There are pockets of people that are starting to think those kinds of things. It's amazing. But there's not enough of that. The Army's interested in building a new light tank. It's valuable. But is that the most valuable thing in the long run? I'm not sure that it is.

**Army AL&T:** So how do you think we stack up in terms of the other major powers and the lesser, more flexible, somewhat less sophisticated powers, such as insurgents?

*We have better people and that's what's going to make a difference. And that's true to a point. The thing to be keeping in mind is that that means there's more room for others to catch up.*

**WATSON, CAN YOU HEAR ME?**

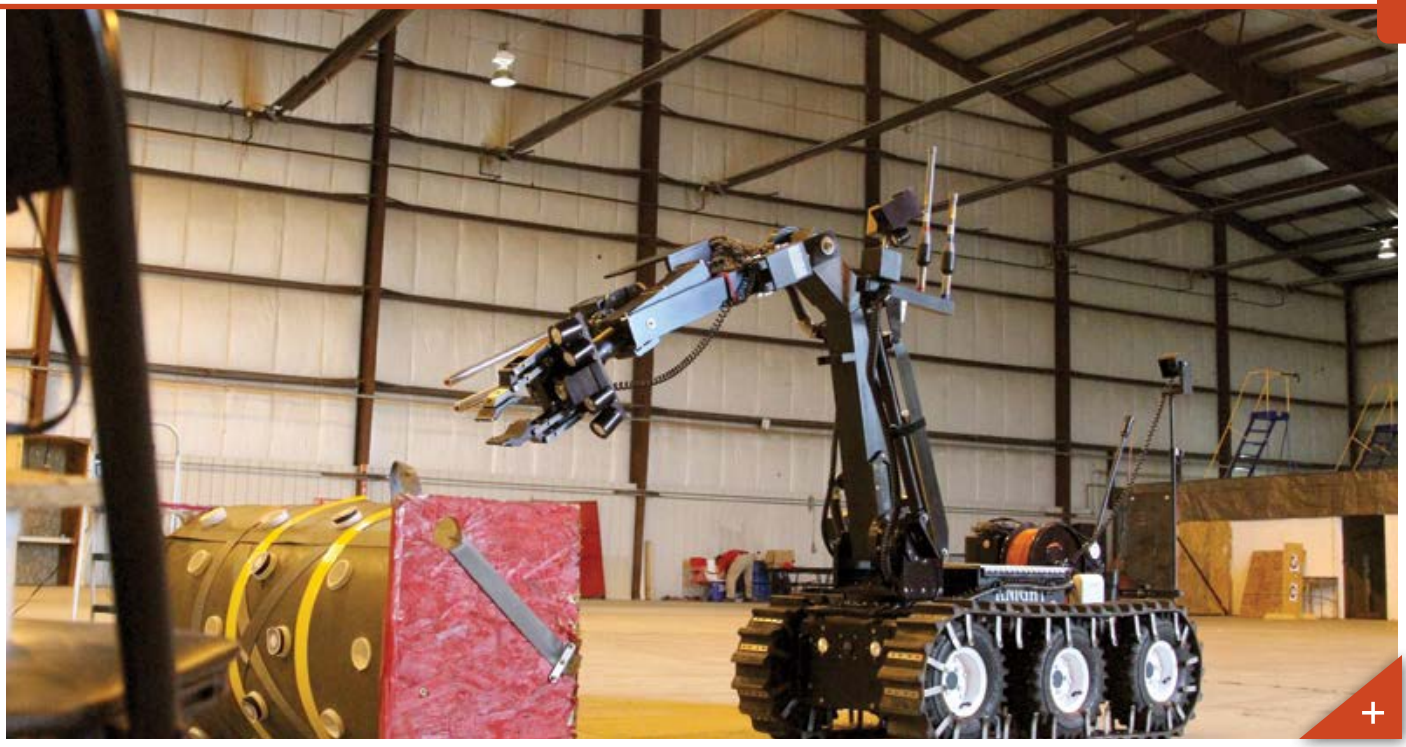
IBM's Watson for Cyber Security uses cognitive capabilities to improve cybersecurity investigations. Scharre notes that many of the developments in AI come from the private sector, which is often reluctant to work with the government. However, he also notes that many AI tools are open source and therefore publicly available. (Photo by John Mottern/Feature Photo Service for IBM)

**Scharre:** Russia's invested heavily in ground robotics. They're doing quite a bit. They're weaponizing them. They've got a whole fleet of different ground robotic vehicles of various sizes, almost all of which are armed. Russia's just going gangbusters on ground robotics. I'm not sure, from an underlying technological standpoint, that they're more capable than the U.S. They can build good things, and they have a very capable military. But I don't know that they're building anything that we couldn't do.

But they are doing things that the Army is not doing. And it's not because of policy reasons or it's prohibited in some way; it's just because the Army has decided not to go there and not to push the bounds of experimentation and constant development. I think there's more we could do in robotics.

**Army AL&T:** How about AI?

**Scharre:** A lot of the really interesting AI stuff is coming from U.S. companies like Google and Microsoft and IBM and Facebook. But it's not happening in the defense sector. All of the



**LET ME GET THAT FOR YOU**

A remotely piloted explosive ordnance disposal (EOD) robot hefts a 150-pound package during the May 2016 Raven's Challenge exercise held at the New York State Preparedness Training Center in Oriskany, New York. The author's experience with a similar EOD robot crystallized his thinking that the Army could do more to use robots, as well as AI and other intelligent machines, to do some of the dangerous and difficult work that falls to Soldiers. (U.S. Army National Guard photo by Sgt. J.P. Lawrence)

really powerful AI tools are open source. They're all publicly available. You can go to TensorFlow, an open source AI tool that Google created to download information on neural networks. So basically anybody has access to this.

We don't really have any advantages there. We're going to have to really race hard to stay just competitive. A lot of the best AI companies are U.S. companies, but they're not building these things for military applications, they don't want to build them for military applications.

**Army AL&T:** Do you think the Pentagon even understands the potential of this revolution in AI?

**Scharre:** I think people are beginning to start to ask, what is this AI thing all about? Yes, we need to wake up to that. People in the tech industry have talked about it being as big as the invention of electricity. That's kind of a big deal, right? Sometimes I think the wrong way for people to look at this is if everyone has it, then why is that something we should stake our advantage on? We should find something else.

That's not the point. The point is, if it's as big as electricity, then we don't want to miss out on it. That's big. We've got to compete in that space. People are starting to wake up to the idea that an AI revolution is beginning and it will probably have really transformative effects for military, and we need to start to figure out really quickly what those are.

**Army AL&T:** Do you see anybody in the lead on that?

**Scharre:** The Israelis do really great stuff in robotics and automation in general. I think they're ahead of us in terms of robotics—not in terms of AI necessarily, but in terms of robotics. In terms of AI, very few militaries have really begun to think about how to implement that from a military standpoint.

In our military, the Navy's doing some incredible things in terms of experimentation. The Air Force is really starting to do some interesting stuff on low-cost swarming aerial drones, which will potentially have really interesting applications for the Army as well. If a C-130 could dump a swarm of a couple hundred drones over a city to do surveillance and detection of the enemy

while we're in the middle of an assault into a city, that could be really dramatic. Imagine the Thunder Run into Baghdad [the April 2003 U.S. armored strike] with a swarm of a thousand drones overhead.

In general, the Army is probably underinvested in ground robotics. The Army is doing things like SMET, the Squad Mission Equipment Transport program. That's good. But there's room to do more there. Similarly with exoskeletons, which people sort of refer to as wearable robotics.

**Army AL&T:** To put it in concrete terms, where do think we ought to be in, say, five years, in terms of specific aspects of readiness and technology?

**Scharre:** In robotics, there's a lot of quick, easy wins that the Army could do right. I'd like to see increased funding for robotics, particularly for ground robotic systems like the SMET program. I'd like to see the Army actually rescind what I think is a very harmful policy on behalf of the medical community, prohibiting casualty evacuation [casevac] with unmanned vehicles. We should be looking into that and trying to figure out the standards that we would need for safe casualty evacuation—and then, if we're building cargo, air or ground vehicles, trying to bake into the requirements whether they could be used for casevac. Others have suggested this approach. It's really a no-brainer.

**ONE PLANE, ONE MOUSE, ONE KEYBOARD, ONE PERSON**

An RQ-4 Global Hawk descends after completing a sortie in support of Operation Inherent Resolve in February at an undisclosed location in Southwest Asia. The Global Hawk is not piloted but directed remotely by an operator using a keyboard and a mouse. However, that ratio—one pilot to one aircraft—could limit the potential uses of unmanned technologies, given limitations on the availability of personnel. (U.S. Air Force photo by Senior Airman Tyler Woodward)

**Army AL&T:** What do you see as the pros and cons of fully autonomous weapon systems?

**Scharre:** There are situations where the pressures of time may unfortunately take the human out of the loop. We have four auto modes on the Patriot [air and missile defense system], for example, because there may be situations where a person is too slow and the system needs to respond [automatically]. That's risky, it's dangerous, right? But there are situations where maybe that's necessary.

We're now talking about full autonomy, about a weapon system that's operating on its own, finding targets, destroying them on its own, and there's no human involved. So you've got a robotic vehicle roaming on the battlefield, and it's doing this according to its programming, but there's no human to check in on it. The human can't stop it even if it starts to malfunction.

From a purely military standpoint, it might be advantageous to send a robotic vehicle into a communications-denied

*When I was marching up and down the mountains of Afghanistan, what were all these stealth planes doing for me?*

environment to do this. It's probably not a good idea because the risk is really high. We're talking about a very lethal system that is operating in an environment that you can't see. It's not obviously illegal under the laws of war, but it's also not illegal to make a hand grenade with a half-second fuze—it's just stupid, because it's going to blow up in your face.

**Army AL&T:** You've written about robots and swarming in mass numbers, and I wonder what you think about the potential for it.

**Scharre:** There are a couple of different issues here. One is that when we say swarming, we really mean cooperative autonomy. So it doesn't sound as exciting—swarming sounds super exciting. But basically it's the ability to task a group of autonomous agents to go out and conduct a mission or a task and to do so collectively, working together as a group. So today we have all these unmanned or uninhabited or remotely piloted systems, or whatever you want to call them. But they're basically remote control.

Some of the more advanced ones are pretty automated, like a Global Hawk. The pilot's not flying a Global Hawk with a stick and rudder, the pilot is directing the Global Hawk where to go with a keyboard and a mouse, and the airplane flies itself. But the paradigm is still one pilot to one aircraft. And we're always going to be limited in how we can really take hold of the robotics revolution under that paradigm. Because we're always going to be limited in personnel.

In the U.S. military, people are costly. And if we can begin to break that paradigm with a one-to-many approach, where one person can task a group or a team or a swarm of autonomous vehicles that go on a connected mission together, that's really where you begin to see the payoff in terms of cost [and] operational effectiveness. I can trim my personnel or I can reallocate personnel to other things.

The Army and Marine Corps are looking at uninhabited ground vehicles for logistics and resupply for convoys. And you'll probably have the same amount of logistics and resupply, but now maybe I can trim the number of people I need and then I reallocate those people somewhere else in the force where I have shortages. That's really what automation is about. It's about limiting certain kinds of tasks.

So the essence of swarming is maybe I can put more low-cost distributed sensors on the battlefield. If I don't have to put a person in a vehicle, can I make the vehicle smaller, cheaper? Can I make it more expendable? Maybe less survivable? That's a really appealing paradigm for DOD. We've been fighting this multidecade trend in rising platform costs for ships, aircraft, ground vehicles, you name it—any major platform.

We're facing that and lean budget times. The costs keep going up. There are just limits to what we can do when we have this sort of vicious cycle of fewer platforms, so the ones we have need to be more capable, more multimission. They're more valuable, they have to be more survivable, which means there have to be fewer of them. So that's a tough challenge. Look at, say, Army ground combat, where you can put on large numbers of low-cost sensors and they could be static, unattended ground sensors that are air-dropped or launched from artillery and then lie in wait. They hibernate and they listen to the enemy or various types of signatures about enemy movement or dissension, various types of modes of intelligence, and record it back.

**NIGHT PATROL**

Then–Lt. Col. Geoffrey Barnes, commander of Detachment 1, 46th Expeditionary Reconnaissance Attack Squadron, performs a preflight inspection of an MQ-1B Predator in September 2008. The ISR capabilities of the Predator, a medium-altitude, long-endurance, remotely piloted aircraft, and other UAVs sparked at that time what the author calls "an accidental robotics revolution." (Photo by Senior Airman Christopher Griffin, U.S. Air Forces Central Command Public Affairs)

**A TECHNOLOGY DEMANDING ATTENTION**

Exoskeletons—also known as wearable robotics—hold considerable potential for improving Soldier performance in future engagements in remote, austere terrain or contested megacities. The author sees the technology's "transformative potentials" but speculates that the Army's wait-and-see approach might not be ideal for the near-term challenges it faces. (Image courtesy of zabelin/iStock)

Or it could be mobile sensors that are airborne or on the ground, drones or ground robotics. But they're cheap and they're expendable. That's a whole new way to think about mass and warfare that the U.S. military really just hasn't thought about in decades. I mean, our whole paradigm for the last 70 years—during the Cold War and since then—has been quality over quantity, right?

That's not the only way to fight. We're probably not going to make an Abrams [M1 tank] expendable. But could we make cheap robot scouts for the Abrams that help identify the enemy and are made expendable? Maybe we could.

**Army AL&T:** Is there any service or any private industry or country that you think is technologically ahead in this area of optionally manned devices or vehicles?

**Scharre:** A lot of companies do neat things on applique kits, whether it's for airplanes or helicopters or ground vehicles, where you can take the sensors and the brains and you can slap them onto almost anything. Now you can build out the autonomy, and then you can retrofit it to whatever in potentially existing platforms.

We've got thousands of Humvees and M113s [armored personnel carriers] in the U.S. Army's inventory that aren't going to be survivable enough to put people in in a future conflict, but they would be survivable enough for a robot. And if we could make low-cost applique kits to put on those, you could fuel at low cost a robot army of scouts. They don't have to be particularly intelligent; in fact, ideally you have robust communications with them and they're sending back streams of data. You can put

weapons on them, and you could call for fire with them and do other things.

**Army AL&T:** In the latest "Star Trek" movie, the Enterprise's nemesis had a swarming capability launching an array of networked, apparently smart projectiles that ripped to shreds anything in their path. Could you see one fighter jet team with a swarm of much less costly unmanned jets or optionally manned jets being more effective in aerial combat than manned jets?

**Scharre:** It's possible. We just don't know. Swarming is very appealing because there are a couple of different paradigms. One could be that they're very capable, high-speed, very lethal, survivable assets, but you network them and they're communicating. They're working together to time their attack to overwhelm the defensive position at the same time.

One of the key concepts here is that just having a bunch of stuff is not a swarm. That's just a deluge of things. Swarming is about cooperative behavior. It's about elements that are able to work together to a common purpose. We're not quite there yet in terms of our munitions. I think one of the real advantages going forward is to take existing munitions—it might be the same missile with just a block upgrade, adding in-flight networking with human controllers so you can give in-flight targeting updates, but also adding in-flight targeting among the munitions themselves so they can communicate on targets. There are many different ways to communicate.

Look at nature. When you look at wolves, they have complex intrapack communication, but not when they're on the attack. When they're on the attack, there's a signal to attack by the pack leader and then they attack. And then a lot of what they're doing is based on implicit communication. Wolves are watching others behave.

And then you have even simpler agents like ants and bees and termites that use even simpler forms of communication. Termites and ants communicate by leaving signals. And then another agent comes along and sees a clue, a tag in the environment that someone left and then reacts. So you can imagine, for example, you're doing sea mining operations this way, where robots go around and they just tag things, and then others respond to those tags and cues.

**Army AL&T:** How could you see this working in urban areas, for instance?

**Scharre:** Let's say you want to go into a house. Right now people storm into the house, right? Maybe you throw a flash-bang in, and then we run in and hope that nobody shoots you. It's super dangerous and people get killed. Well, the technology basically exists today to have a swarm of maybe five, 10, 15, 20 drones go into a house, map out the house that they've never been into before, all of the rooms without GPS, using visual-aided navigation and line art to map the environment, to sense objects using things like neural network-based object detection to look for specific individuals, look for AK-47s. Tell me where they are. And have them look together so that they map different rooms, to optimize coverage.

And then once you've mapped the environment, now you can send people in. Let's have a robot get shot, not a person.

**Army AL&T:** Any grand wish for the Army as to where it should be in five years?

**Scharre:** No, I just think there are a lot of opportunities, and I think that we want to make sure that we're capitalizing on them as best we can.

I remember very clearly a moment for me when it was clear that robotics was potentially valuable. We were in Diyala province [in eastern Iraq] in 2007-2008 during a surge, and had stopped the convoy and were waiting on the engineers to come to defuse an IED. And a number of them show up in a big MRAP. I'm waiting for the engineer to come out in a bomb suit and go defuse the bomb, and instead a full robot rolls out, and it was like a light bulb went off. I said, "Oh, yeah, send the robots to do the dangerous jobs."

And that really stuck with me. However, others have access to those opportunities as well. If the U.S. has a lead in robotics, it's a fragile one, and we don't want to fall behind.

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**A TOUGH SLOG**

A combat engineer assigned to the 10th Engineer Battalion maneuvers through a marsh as his team prepares to breach an obstacle during the Gunnery Table XII engagement in December 2016 at Fort Stewart, Georgia. The Army has not developed a new jungle boot that can withstand the challenges of operating in wet environments since the Vietnam War era. (Photo by Spc. Ryan Tatum, 1st Armored Brigade Combat Team, 3rd Infantry Division)

# THE JUNGLE BOOT

A good jungle boot is one of a Soldier's bare necessities—and the system for providing those necessities would make Mowgli's head spin. Mowgli had to deal with jungle cats; he never had to deal with an ACAT III. Unfortunately, Soldiers do.

*by Dr. Donald Schlomer, Lt. Col., USA (Ret.)*

Mowgli, the hero of Rudyard Kipling's 1894 classic "The Jungle Book," did perfectly well without boots or even shoes. U.S. Soldiers, however, have different needs. Soldiers in the U.S. Army have not had a new jungle boot since the Vietnam era, and with the request for a new jungle boot—well, therein lies a tale, but a tale far less straightforward than Kipling's famous collection of fables about the "man-cub" Mowgli, who lived in a jungle protected by a bear and a panther.

Indeed, the story of the jungle boot may be a cautionary fable about how good intentions can go systematically wrong. Mowgli had to deal with all manner of animals, including one very unpleasant cat. Shere Khan was all speed and stealth. The same cannot be said of the cat that haunts Soldiers: ACAT III, the acquisition category into which any procurement under $835 million falls. An ACAT III acquisition is clumsy and slow, utterly lacking in speed or stealth and with enough bureaucratic red tape to overwhelm even the toughest of Soldiers.

Almost anyone in the developed world can acquire a pair of boots at a brick-and-mortar retailer or from an online source within a few days. For a Soldier, such a simple acquisition might take more than two and a half years. The 25th Infantry Division, it was recently announced, will begin receiving jungle boots to use and test through a "rapid acquisition" by personnel within product manager for Soldier Clothing and Individual Equipment in the Program Executive Office for Soldier. The rapid acquisition was used to acquire a product for a specific unit to achieve a specific mission. In this case, test the boot for three months. The jungle boot they receive will not be *the* Jungle Boot. The rest of the Army and other services will have to wait. Because of this testing, they may even have to wait longer.

FIGURE 1

| Number of Days for Approval by Level of Management | |
|---|---|
| **Level** | **Days** |
| One/COE | 337 |
| Two/AROC | 124 |
| Three/JROC | 23 |
| Four/CSA | 22 |

***Note:*** *These median days are determined by U.S. Army Capabilities Integration Center (ARCIC) personnel tracking ACAT III documents through the approval process during FY16.*

**Key**

**COE** - Center of Excellence
**AROC** - Army Requirements Oversight Council
**JROC** - Joint Requirements Oversight Council
**CSA** - Chief of Staff of the Army

COUNTING THE DAYS

The 506 days required to obtain JCIDS approval represent a big chunk of the 926 days required for delivery of an ACAT III system. (SOURCE: ARCIC)

Why? The answer, simply, is the mandatory use of the Defense Acquisition System (DAS). The basic timeline within the system for delivery of an ACAT III need is 926 days. The Joint Capabilities Integrated Development System (JCIDS) approval process is approximately 506 days. (See Figure 1.) Funding, contracting and delivering the boot takes approximately 420 days. To understand why obtaining such a simple item takes so long through the DAS, we begin the journey after the Army has realized Soldiers do not have a jungle boot.

The JCIDS process started in 2003 to address the purchase of products that did not interoperate between the different branches of the military. The JCIDS manual in 2003 was 91 pages; today, after seven iterations through which Army leadership attempted to simplify the process, the manual is more than 420 pages.

JCIDS processes apply to every product the Army buys, in all acquisition categories, which are classified by the total procurement cost of the system or product. So everything from a state-of-the-art battle system with expensive hardware and millions of lines of code (ACAT I) to a simple item such as a jungle boot (ACAT III) requires the same amount of paperwork, oversight and layers of bureaucracy to approve the acquisition, defying simple logic. There are approximately 79 ACAT I programs. These are major defense acquisition programs for items costing at least $2.79 billion per year to acquire. More than 100 ACAT II programs exist, ranging in cost from $835 million to $2.79 billion per year in FY14 constant dollars. There are more than 1,000 ACAT III programs, each costing less than $835 million per year to purchase.

## STEPS TO A NEW BOOT

Army leadership assigned the development of the new jungle boot to the U.S. Army Maneuver Center of Excellence (MCOE) at Fort Benning, Georgia, during the fourth quarter of 2013. The first step for an assigned document writer at the MCOE is to generate a cost-benefit analysis (C-BA). The purpose of the C-BA is to identify the total quantity and cost of the jungle boot. The document writer completed this in the second quarter of 2014.

Following the C-BA approval, the next step is to create a capability development document (CDD) for approval by Army leadership. The CDD defines who, what, where, when, why and how the jungle boot is needed, which would likely be obvious if logic were a part of the process. The document writer at the MCOE is usually the subject matter expert (SME) on the ACAT III need (in our case, the jungle boot). In research for my doctoral study, I found that an SME might understand operational use but generally is not a good writer. Writing quality is important, because on many occasions, CDD approval is delayed because the writing does not capture the explanation necessary for Army approval. Thus, the document writer should create an integrated process team (IPT) to help in developing the CDD from the beginning. How many people does it take to write a CDD on a jungle boot? The average number of IPT members ranges from five to 15. The more people on the team, the

more opinions, which means the document may take more than a year to complete.

A CDD is typically about 45 pages. For the jungle boot, it identifies the complete specifications needed, including the color, height, material, water resistance, traction, speed of drying, protection from the environment for the Soldier, and any other requirements you would want from a boot. A CDD also addresses all the doctrine, organizational, training, material, leadership, personnel, facilities and policy (DOTMLPF-P) changes required for a new jungle boot. But why would there be any changes to DOTMLPF-P areas for a jungle boot?

Contrast the CDD to an operational needs statement (ONS), used by troops in the field to request an existing commercial off-the-shelf (COTS) product. It's five pages. An ONS also defines the who, what, when, where, why and how of a need. But it does not address DOTMLPF-P concerns or the complete life cycle of the boot, including disposal once the boot does not meet the established standards. (And that's not when the boot owner disposes of it; that's when the Army decides to go through this exercise again and develop a new boot.) Separately, the Army will develop an online maintenance handbook based on the CDD to inform the Soldier of the care and cleaning of the jungle boot. But the Army does not maintain a boot. Army supply personnel do what everyone else does: Throw them away and ask for a new pair.

In case you've lost track, we are now at more than 360 days since the initial request for a boot.

Once the CDD is in draft form, the document writer posts it to an online portal to allow units around the globe to comment, hence the name of this next stage: worldwide staffing. The Army Capabilities Integration Center (ARCIC) gatekeeper, the person responsible for moving the document through the JCIDS process, provides the document writer the initial list of units. The document writer will add to that list based on his or her experience. Once the document is posted, each unit usually has 30 days to comment. However, 30 days is an arbitrary number and could increase based on requests from the specific units. The document writer must adjudicate all the comments before the approval process can begin. The adjudication process could take a month, depending on the number and complexity of the comments. We are now at approximately 390 days.

*The JCIDS manual in 2003 was 91 pages; today, after seven iterations through which Army leadership attempted to simplify the process, the manual is more than 420 pages.*

## THE SAWTOOTH EFFECT

Mowgli avoided being eaten by Shere Khan, a tiger. Unfortunately, the JCIDS process has been overcome by a sawtooth approval process. Once the CDD is signed by the MCOE commander (a two-star general), the document goes to the ARCIC gatekeeper (a colonel) for validation and processing through multiple layers of approval. (See Figure 2, Page 104.) The Army Requirements Oversight Council (AROC) approves the CDD only after the Army Working Group (AWG), Army Requirements and Resourcing Board (AR2B) and Army Control Board (ACB) approve it.

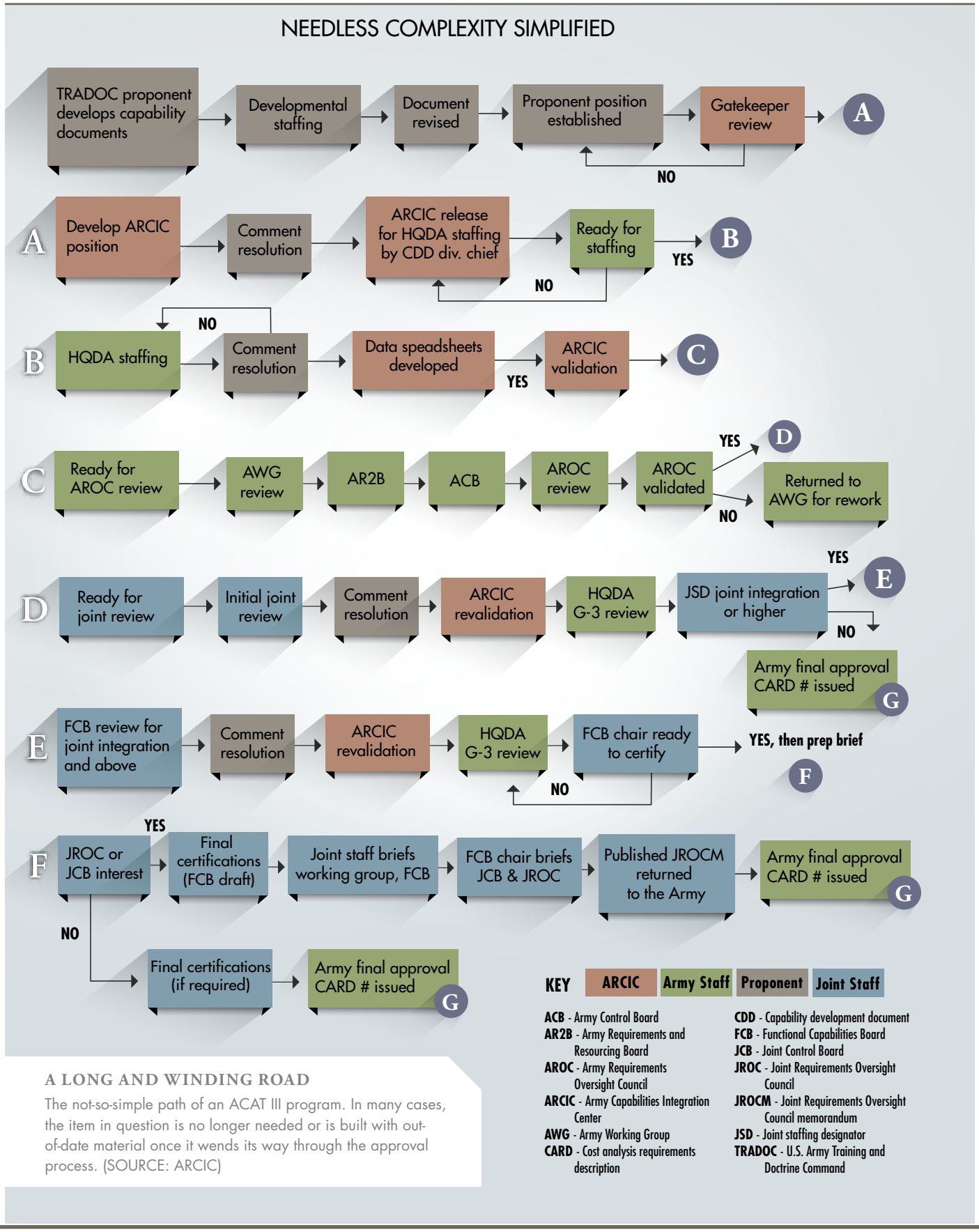
If multiple branches of the military (Air Force, Navy, Marines) will use the CDD, an additional Joint Requirements Oversight Council (JROC), with similar prior approvals, is required. Army personnel call bouncing between these different levels of approval "the sawtooth effect," because the graphic representation of the document moving between the different levels looks like a sawtooth blade.

All of these levels of approval take approximately 90 to 140 days. If any group at any level has questions, waiting for answers can delay or stop the process. If an answer to a question is critical in nature, the ARCIC gatekeeper may send the CDD back to the beginning of the approval process. Once approved at the AROC and JROC levels, the ARCIC gatekeeper sends the CDD to the chief of staff of the Army for final approval.

## HURRY UP AND WAIT

Once the approval of the boot is completed, the funding and contracting efforts begin. The average time to develop a contract for the boot through competition is 240 days. The development of a Federal Acquisition Requirements-compliant contract includes requests for information, approval to distribute the contract, distribution of the contract to all vendors for competition, receipt of proposals from all the vendors, assessment of all proposals and contract award.

FIGURE 2




**A LONG AND WINDING ROAD**

The not-so-simple path of an ACAT III program. In many cases, the item in question is no longer needed or is built with out-of-date material once it wends its way through the approval process. (SOURCE: ARCIC)

The assessment is an objective review of the proposals to determine which vendor is awarded the contract, while attempting to avoid a protest by one of the other vendors. Any vendor can protest for any reason, and a protest can delay award from 100 days to a year or more. The vendor then has 180 days or more to manufacture and deliver the boot based upon the awarded contract—which has specifications written two or more years earlier.

## SLOW PROCESS LEADS TO OUTDATED TECH

According to Moore's Law, which holds that the pace of technological innovation accelerates exponentially, technology changes every 420 to 540 days. The vendor is responsible for delivering the boot based on the contract award, regardless of the status of current technology. Based on the contract, the vendor may use material that at best is not current and in some cases is obsolete. The vendor must request permission to use material not identified in the contract or request compensation for using noncurrent material. To substitute the material or find the noncurrent material, the vendor's cost may escalate along with the increased delivery time.

Once the jungle boot arrives at an Army distribution warehouse, the warehouse ships the boot based on a Soldier's request received through the normal supply requisition system. Depending on the unit's mission priority, the boots may arrive anywhere from two to 30 days later. Now, more than two and a half years after the original request, the Soldier has jungle boots: a bare necessity to complete the mission.

## CONCLUSION

We all might agree that this is a ridiculous tale and an unreasonable timeline to supply jungle boots. Congress agreed, and because of the unusual amount of time to obtain an ACAT III need, the National Defense Authorization Act for Fiscal Year 2016 mandated that the secretary of defense develop a strategy to streamline the JCIDS approval process. The purpose of my doctoral study was to explore strategies that senior Army commanders might use to reduce the approval time of the JCIDS process for an ACAT III need document. Based on analysis of my research, I developed four recommendations:

1. Identify an objective goal for streamlining the JCIDS process. Without a goal, how do you know when the JCIDS process is streamlined? The goal should include the desired reduction in time for each level.

2. Develop a strategy to determine what person or office should approve an ACAT III need. The strategy should research the ability of the chief of staff of the Army to delegate to a person or office the responsibility to approve an ACAT III need. The strategy should include the reduction in the number of levels of approval. Army leadership should avoid the sawtooth effect for an ACAT III need, and the strategy should include a process to avoid multiple approvals within a level. Why are AWG, AR2B and ACB approvals needed before AROC approval?

3. Use worldwide staffing better. The units identified in worldwide staffing should be limited to IPT members and specific units.

4. Develop a strategy to enhance training for document writers. With enhanced document writing skills, imagine how much faster the ACAT III document would be to write, approve, fund, contract and deliver.

Because of the above-described multiple layers of approval and numerous reviews, it currently takes approximately 506 days to write and approve an ACAT III need document. Additionally, it takes another 420 days to fund, contract, manufacture and deliver the product. Thus, the total time to deliver a jungle boot to a Soldier is 926 days. Given the rapid pace of technological change, the Soldier seldom receives a product that uses current technology. This length of time for approval is an issue with all ACAT III need developments. Imagine a Soldier needing something more important than a simple bare necessity of life.

*For more information, contact the author at* ***DonSchlomer@Gmail.com****.*

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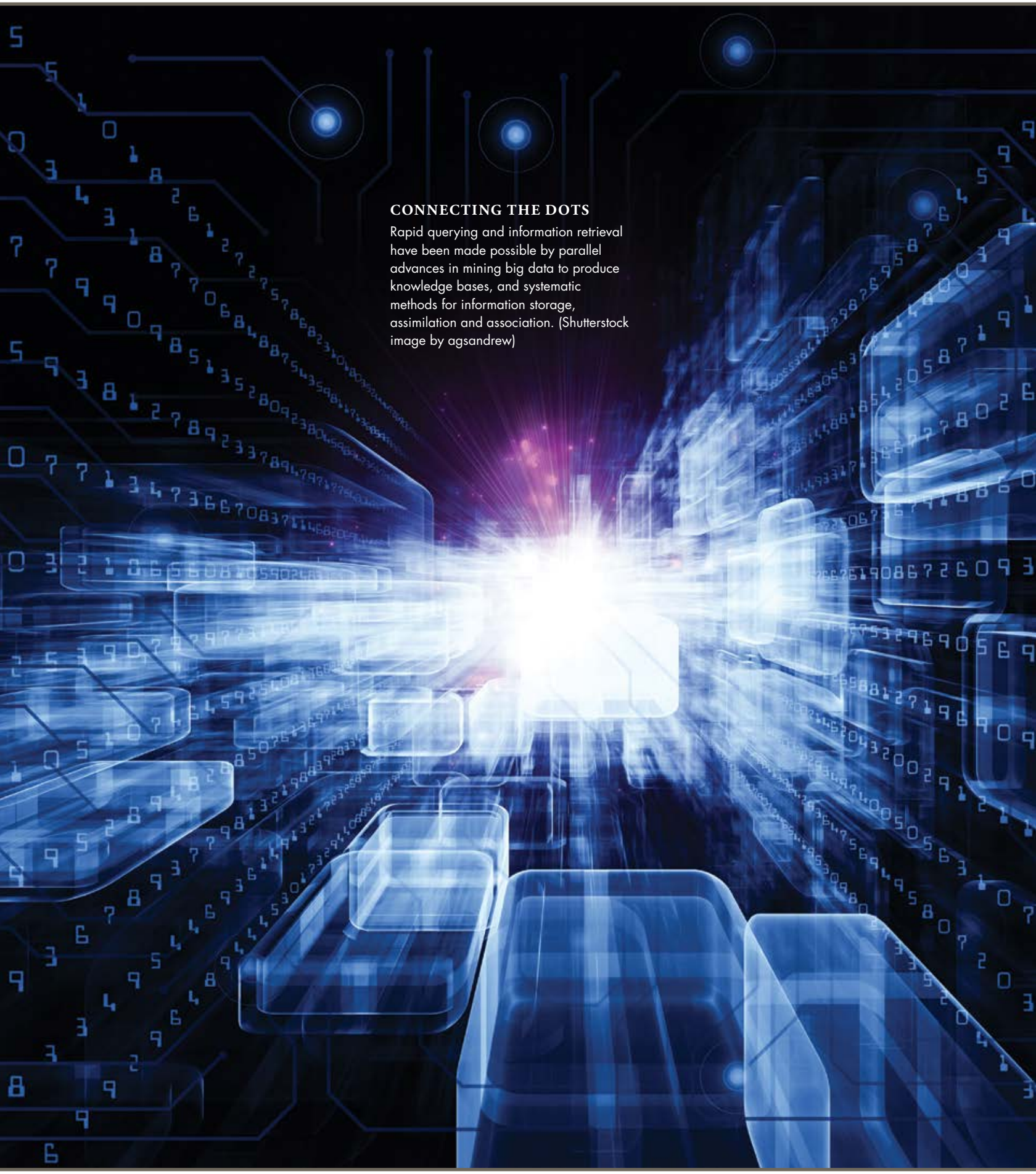


**CONNECTING THE DOTS**

Rapid querying and information retrieval have been made possible by parallel advances in mining big data to produce knowledge bases, and systematic methods for information storage, assimilation and association. (Shutterstock image by agsandrew)

# Collaborative Autonomy: A Tactical Offset Strategy

ARL's work on intelligent systems S&T is leading to a tactical offset strategy for operations in a variety of challenging settings.

Dr. Brian M. Sadler

*by Dr. Brian M. Sadler*

The desire for a third offset strategy has been a major focus of DOD science and technology (S&T) discussion for the past few years. While the Navy and Air Force primarily face issues related to large-scale, extended-range operations, the Army must address a different set of long-term challenges in complex operational scenarios. These notably include megacities and other perplexing domains such as subterranean and jungle environments. It is not difficult to envision a megacity in a developing nation facing a quicksand of natural disaster, failing infrastructure, tribal conflict and fast-spreading disease, and the subsequent call for Army operations. Other potential scenarios may prove equally challenging, complex and risky. These expeditionary Army operations likely will entail high risk and slow operations tempo (OPTEMPO), be manpower-intensive and require difficult large-scale logistic deployment.

The application of manned-unmanned machine teaming (MUM-T) and autonomous systems is a potential offset strategy. Many recent studies and workshops (including those by the Defense Science Board, the National Academies, the Defense Advanced Research Projects Agency, the Army Science Board and the U.S. Army Research Laboratory (ARL)) have reinforced the operational and technological potential of MUM-T. It is clear that if successfully developed, autonomy offers leap-ahead capability and the potential for a third offset in sea and air operations. Distributed collaborative autonomous systems, teamed with Soldiers, offer a tactical offset strategy: a means to operate in complex urban and other domains at high tempo, with significantly reduced risk and fewer Soldiers.

## APPLYING COLLABORATIVE INTELLIGENCE

At ARL, our tactical offset vision is to develop the underpinning S&T for highly distributed and collaborative intelligent systems, consisting of air and ground robotic and manned platforms, high-performance tactical computing, knowledge

**MERGING TECH ADVANCES**
Accelerating and merging advances in cognition and AI with advances in collaborative robotics and cognitive networking are critical to ARL's tactical offset vision. (Shutterstock image by chombosan)

bases and sensors, all connected to local and remote Soldiers via a self-healing network. The heterogeneous, interconnected mix of large and small platforms provides a rich potential to exploit autonomy for situational awareness, protection and networking. Examples include using autonomy for rapid intelligence, surveillance and reconnaissance ahead of and around dismounts, emplacing fixed or mobile sensor networks, providing a bubble of protection around moving Soldiers, and deploying swarms of small autonomous aerial vehicles moving at up-to-ballistic rates.

ARL's goal in developing the S&T behind intelligent systems is to enable man-machine teaming to provide tactical offset by:

- Providing large networks of heterogeneous intelligent agents that can coordinate and rapidly distribute themselves based on commander's intent.
- Extending reach and vision into large, complex environments beyond the limits of national assets.
- Collaboratively perceiving the environment and providing situational awareness against dynamic threats.
- Analyzing information to enable rapid human/intelligent system decision-making and adaptable mission profiles.
- Strategically assessing risk and directing intelligent and efficient use of force against dynamic threats.

## AXES OF COMPLEXITY

Several key factors dictate the difficulty of the Army problem and limit the operational capability of any given state-of-the-art autonomous technology suite:

- **Complexity of the operational environment.** Megacities are an extreme example of a complex environment. It is far easier to navigate an autonomous vehicle in open air or water than into buildings or tunnels.

- **Available infrastructure.** Prior knowledge of the environment, massive networking and power sources are generally available for commercial applications, but not in Army scenarios.

- **OPTEMPO.** Artificial intelligence (AI) algorithms are often so complex that they are beyond our current ability to implement them for real-time operation in small platforms that cannot rely on extensive infrastructure.

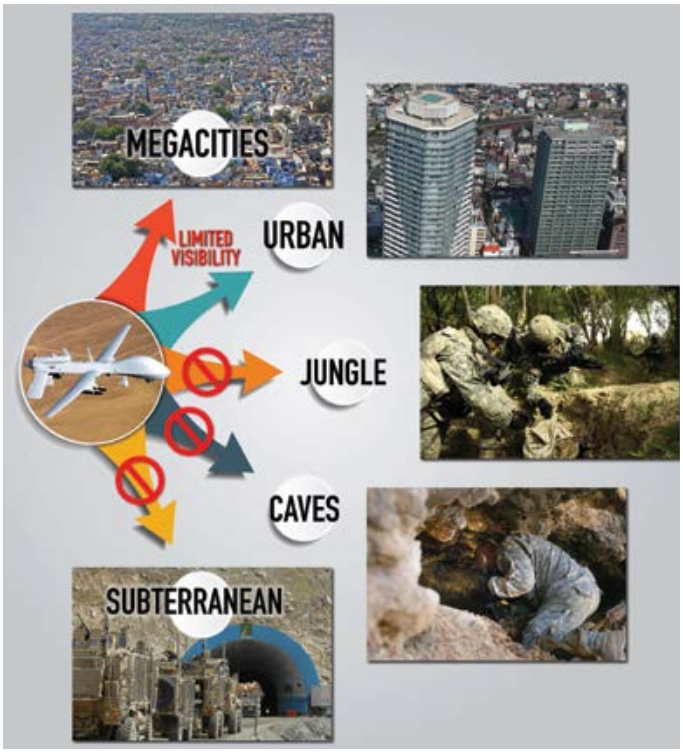
There is also the complexity of system design, which increases with the number of agents; the variety of agent types; agent complexity and adaptability; and the degree of interaction and communication needed among the agents for both machine and human interaction. Tactical application is reliant on heterogeneous architectures across Army platforms, networks, sensors and processors, which also raises questions of logistics and sustainability. However, we currently do not have a full understanding of how to design a system consisting of hardware and software modules that can be composed and assembled and that map to efficient hardware.

## AUTONOMOUS NETWORKING

The tactical offset strategy inherently relies on communications among

autonomous nodes, sensors, knowledge bases and humans. Recent ARL research has definitively shown that viewing networking as a separate add-on component leads to distinctly suboptimal results. For example, when autonomous agents collaborate to explore and map a building, the task can be much more efficiently accomplished when the agents account for radio connectivity and plan for information sharing and exchange.

The design of collaborative intelligent systems to meet the tactical offset vision must include networking as an integrated component. This will take advantage of large air and ground platforms with less restrictive power and computation requirements, and exploit cognitive radio techniques to efficiently manage spectrum usage and network capacity. The resulting system will be resilient, using autonomous nodes to heal itself, reconfiguring depending on the task and adapting to threats.




**WHAT WILL THE NEXT MISSION LOOK LIKE?**
The Army faces long-term challenges in complex operational scenarios. A system that works in an urban environment might not be adaptable to a megacity, jungles, caves or a subterranean environment. (Image courtesy of ARL Public Affairs)

## ADVANCES IN AUTONOMY AND AI

Implementing the tactical offset vision hinges on successful ongoing research and development that seeks to accelerate and merge advances in cognition and AI with advances in collaborative robotics and cognitive networking. Technology convergence continues to unite networking, processing, sensing and control onto small, mobile air and ground platforms. This follows large commercial investment and mass production trends in cellular, robotic and sensor technologies.

With a decade of Army basic research and investment in programs such as the ARL Micro Autonomous Systems and Technology Collaborative Technology Alliance, new small-scale mechanical platforms (e.g., quadrotors) are now a commercial commodity, and algorithms for autonomous control, sensing, navigation and mapping have been demonstrated.

Artificial neural networks (ANNs) have exploded into a variety of commercial applications since 2010. While the basic ANN technology dates to the 1990s, two trends have enabled their recent emergence. First, digital processing technology has continued its rapid advance as predicted by Moore's Law, such that these algorithms from the '90s can now be computed in reasonable time on laptop-quality processors. Second, it is now technically feasible to collect and use training data sets at the very large scale needed to ensure good statistical performance with brute-force learning algorithms. Through trial and error, it became apparent that the best performance could require millions of training examples. While it is time-consuming to collect such large validated data sets, digital hardware advances have made it possible to use them to train ANNs.

Embraced by large U.S. commercial enterprises such as Google and Facebook, ANNs have been successfully applied in such areas as image processing and vision, natural language processing, robotics and multi-agent systems. They have displaced decades-old technologies in image and speech processing. ANNs are now better than humans at performing some kinds of visual object and word recognition, not to mention gaming. The use of ANNs has enabled driverless cars, whose development is limited only by cost, legal regulation and reliance on fixed infrastructure such as maps, roadside electronic aids, signs, road markings and networking.

ANNs typically process one input and one output at a time, such as detecting objects in an image. An ANN variant called a recursive neural network (RNN), also dating to the 1990s, enables sequence processing, such as entire spoken sentences or

a sequence of video frames. Other ANN variants combine the above to build a system that allows a user to verbally ask a question about an image, for example, with the system responding verbally with an answer.

Parallel advances in mining big data to produce knowledge bases have produced systematic methods for the storage, assimilation and association of data, enabling rapid querying and information retrieval. Knowledge bases form the memory of intelligent systems like IBM's Watson (famous for its performance against human experts in the TV game show "Jeopardy!"), computer game-playing architectures and numerous other applications. Machine learning can be thought of in this vein, exploiting data to learn and specify models that can make predictions.

## CONCLUSION

ANN, knowledge base and machine learning technologies have advanced rapidly in this decade. Combining these with recent progress in robotics and autonomy, the Army is poised to develop the underpinning S&T for highly distributed and collaborative intelligent systems that can provide a tactical offset strategy for envisioned operations in megacities and other challenging scenarios.

*For more information, go to* ***http://www.arl.army.mil/www/default.cfm?page=2637****.*

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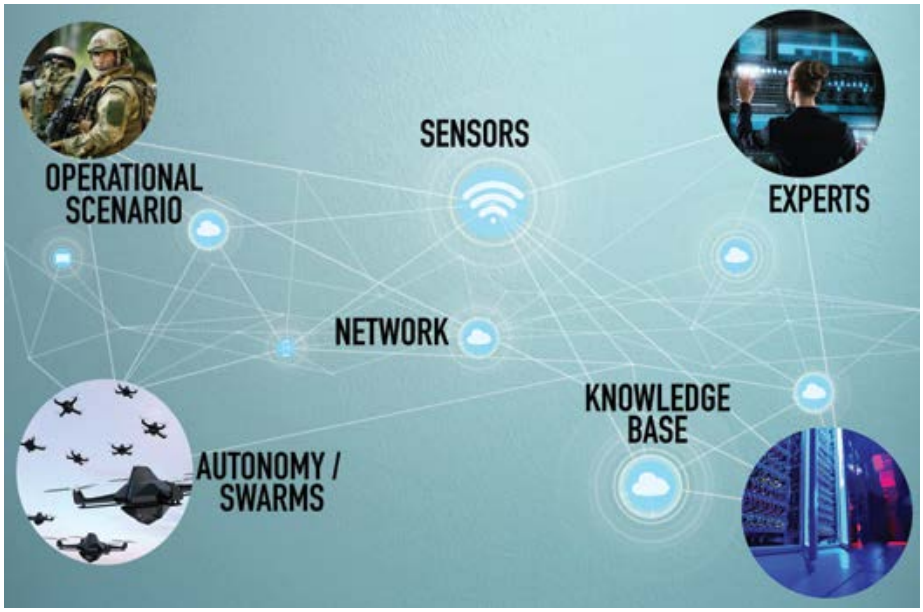



**SMARTER TOGETHER**

A tactical offset strategy—a means to operate in complex urban and other domains at high OPTEMPO, with significantly reduced risk and with fewer Soldiers—relies on communication among autonomous nodes, sensors, knowledge bases and humans. (Image courtesy of ARL Public Affairs)

**RAPID PACE OF CHANGE**

Teaming Soldiers with distributed collaborative autonomous systems is now within reach, in large part because of a combination of Army basic research and commercial developments in technologies such as robotics, AI and autonomous systems. (Image courtesy of ARL Public Affairs)

# THE MULTILINGUAL PM

An acquisition program office brings together a multitude of professional specialties, each with its own specialized language. It's the PM's job to understand, interpret, translate and unite.

*by Col. Joel D. Babbitt*

People use many languages in the course of a day. In military families, for example, it is not unusual to hear a smattering of German or Korean picked up from assignments overseas, mixed liberally with a base of English or Spanish. At work in the office of a program manager (PM), there could be a half-dozen or more specialized languages in use, each with its own vocabulary, conceptual framework and rules of usage. They are as varied and incomprehensible to the uninitiated as any other language. The only difference is that all of them are spoken using English.

If these languages are English but also not everyday English, what are they? Logistics, program management, engineering, cost estimating, contracting, budgeting, financial forecasting, requirements, cyber, upper management and user-specific tribal languages (e.g., paratroopers, armor or special ops) are some examples, and the list goes on. Like "governmentese" itself, each one of these is based in English, and each is essential to the function of a PM office.

As any linguist will attest, translating from one language to another requires first understanding and speaking both languages. And who is the designated translator for your program? It's the multilingual PM.

## BRIDGING THE LANGUAGE GAP

The Product Lead for Wideband Enterprise Satellite Systems (PL WESS) within the Program Executive Office for Enterprise Information Systems (PEO EIS) develops satellite controls, installs and maintains building-sized satellite dishes and renovates satellite facilities. However, the language of satellite communications (SATCOM) is not a common one, and the contracting, budget, logistics and other personnel who support WESS did not grow up speaking it.

Along with the "why" of the program, the PM must educate stakeholders on the "what." Until recently, misunderstandings between SATCOM engineers and the contracting folks who support us were fairly common. Contract specialists and officers often didn't understand the systems they were helping buy, and neither did their legal staff. These misunderstandings between the engineers and contracting staff resulted in delay after delay.

What changed? To help alleviate this problem, in 2015, WESS set up a three-day SATCOM 101 course in its testing facility. This course—for support personnel and organizations; contracting officers, logisticians, budget personnel, procurement lawyers and others—focused on the basics of satellite terminals, modems,

baseband systems and payload control systems, all wrapped up with live demonstrations of the products and hands-on familiarization with the equipment. This greatly reduced misunderstandings and increased cohesiveness among PL WESS stakeholders, who now speak the same language.

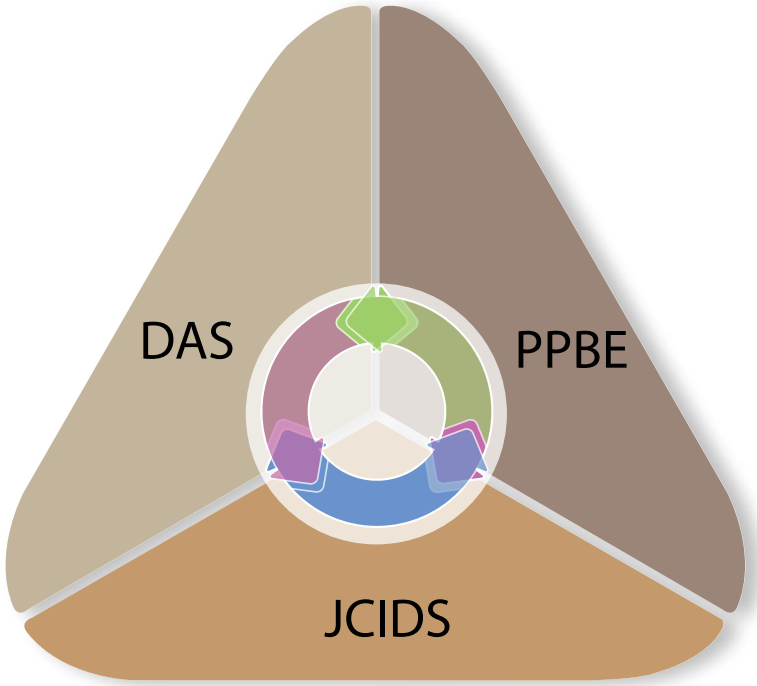
## BUILDING COMMON UNDERSTANDING

It is a mistake to assume that everyone should speak only one common language. Diversity of languages is a great benefit when solving complex problems; that's why the diversity of conceptual frameworks and skill areas exists in acquisition. When the program office for Warfighter Information Network – Tactical Increment 1 developed a modernization schema for upgrading the Army's truck-based tactical internet, the leadership assembled a team that included engineering, logistics and program management personnel. Out of that came a framework that was executable and supportable, enabling the PM to meet program deadlines.

The lesson learned from this example is that the PM's job is to connect all the different tribes of experts within the program office. If a PM fails to bring the right specialists to the table because he or she does not understand or value those specialties, or the PM is not skilled enough to translate, then the PM has failed.

It would be a mistake to develop elaborate plans with intricate interdependencies, only to have them completely upended because of a failure to include one of the experts crucial to the success of the plan, such as the engineers, who build to the plan, or logisticians, who support the plan. If you don't include the right people, then you will have to assume what their input would have been. It is much better to build plans on a solid foundation of facts, with the input of all the necessary experts, rather than on the sands of supposition.

FIGURE 1




**WHERE WORDS COLLIDE**

The Joint Capabilities Integration and Development System (JCIDS); the Planning, Programming, Budgeting and Execution (PPBE) process; and the Defense Acquisition System (DAS) together define what acquisition programs aim to accomplish, with what money and on what timeline. (Image courtesy of the author)

## THREE LANGUAGES TO LIVE BY IN ACQUISITION

Every DOD PM lives in a world created and regulated by three languages: the Joint Capabilities Integration and Development System (JCIDS), the Planning, Programming, Budgeting and Execution (PPBE) process, and the Defense Acquisition System (DAS). (See Figure 1.) These three rule the PM's world—every dollar received, every effort the PM tackles and every schedule the PM builds. Not only that, the three languages are interconnected, together forming the Army's strategy to keep acquisition programs on track.

PMs who take the time to understand how the three languages work together to build the Army gain uncommon wisdom and greater credibility. Following is a brief lexicon:

- JCIDS is the requirements system for DOD. The Army staffs JCIDS with its U.S. Army Training and Doctrine Command (TRADOC) capability managers (TCMs), informed by an understanding of the threat. At the pinnacle of the lengthy JCIDS approval process is the Army Requirements Oversight Council (AROC) or, for joint capabilities, the Joint Requirements Oversight Council (JROC). Without a valid, approved requirement, the PM has no basis to spend money. Seldom in the world outside of defense acquisition is anyone likely to hear the

words JCIDS, TRADOC, AROC or JROC. The PM, however, has to know them and their implications inside and out.

- As a PM, you can dream all you want, but until you get money, it is just a dream. The PPBE process, commonly thought of in terms of its end product, the program objective memorandum, is the process whereby the Army projects expenses and plans what it is going to buy for the next five years.

- DAS is where the requirements and money come together and become reality. This is the realm of the multilingual PM, the PM's native tongue. Terms such as ACAT (acquisition category), EVM (earned value management) and Nunn-McCurdy breach all come from here. (See "An Acquisition Lexicon," Page 114.)

## DEVELOPING FLUENCY

The first and most frequent mistake PMs make in learning these languages is working only in their DAS bubble, and not in the parts that overlap with PPBE or JCIDS. Too often PMs say, "It's the TCM's job to figure out what the users want," or, "The money folks need to figure out how to fund that." Statements like that, while technically true, show a lack of initiative.

Don't wait for other organizations to come up with the solution. Make the effort to figure out what the right solution should be—whether it be requirements, money, etc.—then meld your version of the right solution with your partner organizations' solutions. If we as acquisition professionals spend the time and effort to figure out what the right answer truly is, that will benefit our external stakeholders as well. Most of the time, if you've already figured out what the right answer is, your stakeholders will tell you to go ahead and do it.

This mentality applies to the money folks as well. A PM facing unfunded requirements should look inside the program first for the right answer. Most programs have quite a bit of carryover, which can be used for unfunded requirements. Funding requirements internally has the added benefit of driving up obligation rates, which positions the PM perfectly to spend other people's money (say, from elsewhere in the PEO or G-8 portfolio) during the end-of-fiscal-year, use-it-or-lose-it rush. It is a strange reality in DOD that he who spends all his money usually receives more.

The second mistake PMs make is to assume that an opinion from one bubble applies to another bubble. For instance, when asked what, if any, ACAT (a DAS designation) applies to a program, most PMs look at the front of their capability development document or capability production document (JCIDS products). This is akin to asking your engineer what the budget person thinks. If the PM does not have an ACAT determination memo, then the program does not have an ACAT designation—period. Similarly, a PM who builds something (based on the DAS) that does not meet the requirements (based on JCIDS) is likely to have a rude awakening when the time comes to pass the next milestone.

## CONCLUSION

Dr. Stephen R. Covey, author of "The 7 Habits of Highly Effective People," established a framework that hinges on first winning the private victory, then winning the public victory. In other words, look inside first, then go outside and conquer the world. PMs must first learn to speak the various languages of the many experts within a program office, leveraging all of their expertise, and unite the entire program staff through a common understanding to accomplish the mission.

Once PMs have mastered the many languages spoken in the acquisition trenches of a PM shop, they are poised to take on the structures and systems that frame and rule their world. So go forth, multilingual PM, fully armed, and conquer your world.

*For an overview of the acquisition "language," go to the Defense Acquisition University Guidebook at* ***https://dag.dau.mil/Pages/Default.aspx*** *and ACQuipedia at* ***https://dap.dau.mil/acquipedia/Pages/Default.aspx****. For more information on effective leadership, visit Covey's website at* ***https://www.stephencovey.com/blog/****. Contact the author at 703-806-0583 or* ***joel.d.babbitt.mil@mail.mil****.*

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## AN ACQUISITION LEXICON

- **JCIDS** – How the Army decides what it needs.
- **Requirement** – An established need defined in specific, often technical language that describes what the final product or service will do for the Soldier.
- **Unfunded requirement** – A need identified by the Army that was not funded directly in the Army's budget.
- **TCM** – The part of the Army that establishes the need for a capability and asks for a program to address it.
- **Capability** – The specific goal of the acquisition process as well as the product that results.
- **AROC** – A panel of Army senior leaders that validates and approves proposed requirements.
- **JROC** – Similar to AROC, but for joint force requirements.
- **Capability development document (CDD)** – Captures the information necessary to develop a proposed capability.
- **Capability production document (CPD)** – Captures the information necessary to support production, testing and deployment of a capability.
- **G-8** – The Army headquarters staff section responsible for finance and contracts, and the principal military adviser to the assistant secretary of the Army (financial management and comptroller). Army lead for the JROC.
- **PPBE** – How the military asks for and spends money.
- **Obligation** – A commitment by the government to fund or acquire during a defined period. Money obligated is not necessarily spent, but it cannot be used to pay other bills.
- **Obligation rate** – A metric showing to what degree a program is obligating its money within the time frame approved by congressional appropriation.
- **Carryover** – Money that is preserved from one federal fiscal year to the next.
- **Internal funding** – Funding from within a program office.
- **Bill-payer** – A program with excess funding that is realigned to pay for other programs.
- **Money guy** – Budgetary expert familiar with the ins and outs of the voluminous regulations that guide how the government spends money.
- **Use it or lose it** – Money unspent by a program at the end of a fiscal year, often interpreted as meaning that the program does not need as much money as it asked for, and an invitation to budget planners to reallocate funding to another program.
- **DAS** – How all the rules and organizations come together to make defense acquisition happen.
- **ACAT** – Every large system goes into an acquisition category, or ACAT, usually I, II or III. ACATs are defined by cost, with the most expensive systems in ACAT I; high-visibility or high-priority programs can be categorized as ACAT I or ACAT II even if they do not meet the dollar threshold.
- **Acquisition program baseline (APB)** – An agreed-upon set of schedule, performance and cost parameters that Army senior leaders use to measure the progress and success of a program. Programs may be "re-baselined" when external forces cause significant, unavoidable changes to schedule, performance or cost.
- **Nunn-McCurdy breach** – Named after former Sen. Sam Nunn and former Rep. Dave McCurdy for their part in amending Title 10, U.S.C. § 2433, "Unit Cost Reports," in the National Defense Authorization Act for Fiscal Year 1982. The provision triggers a review for possible termination of any ACAT I program that overruns certain cost metrics.
- **Earned value management (EVM)** – A set of mathematical formulas to objectively measure project performance and progress.
- **Milestone** – A key decision point in the defense acquisition life cycle at which a PM seeks approval from the appropriate oversight authority to end one phase of a project and enter the next phase.

***—COL. JOEL D. BABBITT***

TECHNICALLY SPEAKING

# YOU'RE SAYING WHAT?

Writing in plain language saves time and money while earning trust from taxpayers, Soldiers and businesses. Plus, it's the law.

*by Ms. Mary Kate Aylward*

**Writing in plain language is:**

a. **Easy:** Say what you mean to say. Type. Proofread. Run spell check. Hit "send."

b. **Hard:** Choose from among the 171,476 words (according to the Oxford English Dictionary, Second Edition) of the English language and arrange them according to seemingly arcane rules.

c. **Your duty:** Government regulations require you to explain what you spend the taxpayers' money on and why, and an explanation that the taxpayer can't understand doesn't count.

d. **The law** of the land since the passage of the Plain Writing Act of 2010.

e. **All** of the above.

f. **None** of the above; emojis are the future of human communication. ☺ 😉 ☹

*(Answer: (e), all of the above.)*

When we talk about "plain language," we are not talking about good writing, but effective writing. An English teacher might say they're the same thing, but effective writing is good for a very specific reason: It gets the point across concisely and precisely to as many of the intended audience as possible. It's writing that works for the people who use the material.

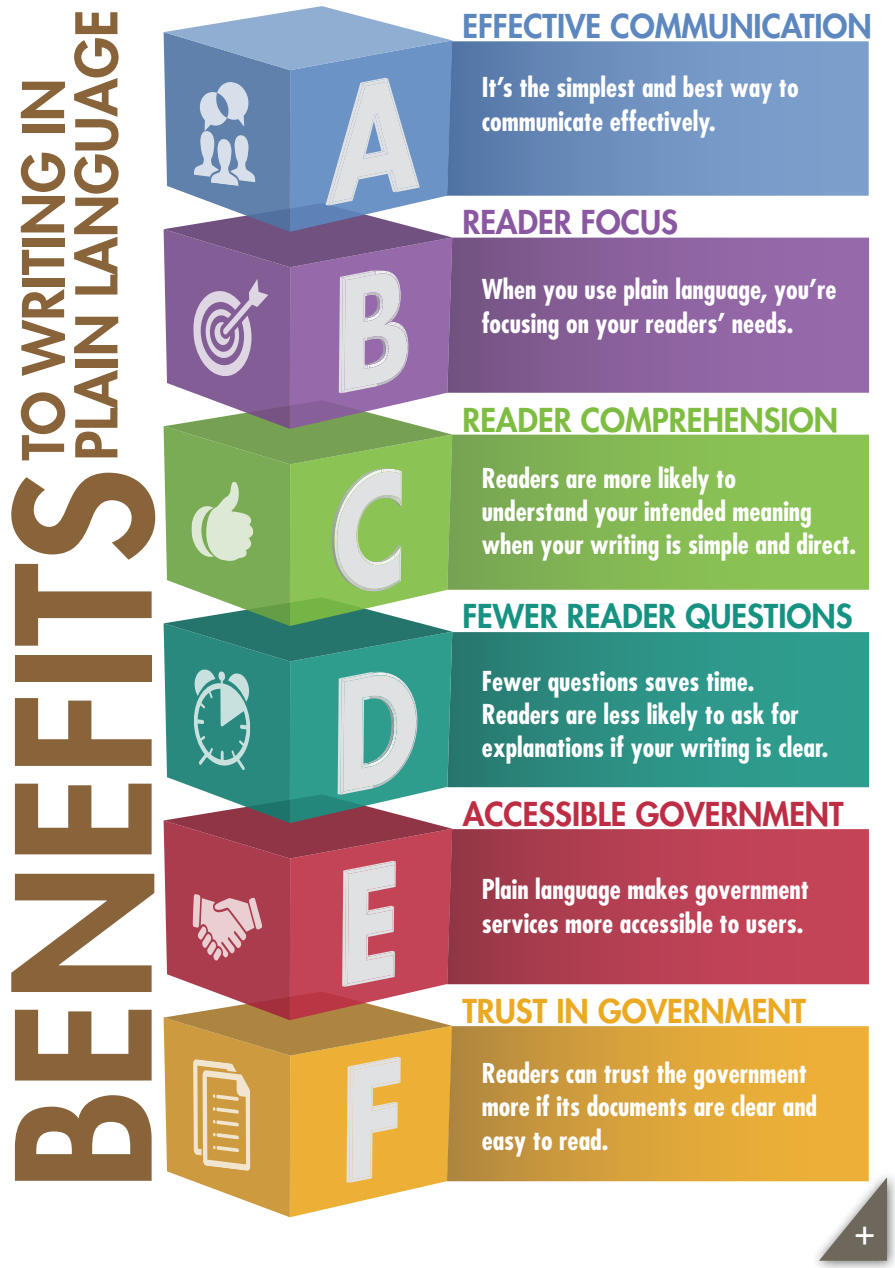
## READER-FOCUSED WRITING

When a document is in plain language, its audience can "quickly and easily find what they need, understand what they find, and act appropriately on that understanding," according to the nonprofit Center for Plain Language. (The center, founded by retired federal employees active in the government plain-language movement, advocates for government and business to communicate clearly. It issues an annual report card grading agencies' writing and sponsors the ClearMark and WonderMark awards for the year's best and worst writing, respectively.)

That's the guiding principle. But plain language is reader-focused, so beyond the center's overarching standard, who the audience is has a lot to do with writing that works. If the audience is

fellow specialists, specialized vocabulary is just fine: Chemical engineers communicate in polymers, computer scientists in cognitive networks, and so on. It's a matter of choosing words that will allow the audience to quickly and easily grasp the meaning. That's the tough part: Using plain language to communicate technical information is a technical endeavor in and of itself.

It may seem odd to think of plain writing as a technical challenge, given that we all write to one degree or another—emails, Facebook status updates, department reports. But indeed it is. As evidence, witness the powerful forces hindering good, effective writing: The mechanics of grammar and usage aren't universally taught in schools. The internet broadens access to good, simple writing, yes, but also hosts countless unpunctuated, misspelled screeds. Scroll through Facebook just a few times a week, and your brain stops registering U SEE THAT CAT VIDEO! LOL as unusual. Television's crimes against the English language are manifold: Cable news channels with 24 hours to fill let people natter on without ever making a point. Advertisers desperate to grab consumers' attention resort to depraved tactics, such as making up words ("manscaping," "framily") and delivering crucial information at warp speed and in tiny print.




**SIX IN ONE, HALF A DOZEN IN THE OTHER**
DOD's plain language initiative spells out six benefits to writing effectively. To reap these benefits requires mastering several simple guidelines, which include steering clear of acronyms and jargon. (SOURCE: DOD Plain Language website)

## (A) AND (B), EASY AND HARD

Despite these obstacles, writing plainly and clearly for a general audience can, in theory, be easy. There's the preliminary matter of understanding the subject inside and out, but once that's done and dusted, plain language relies on simple words, short sentences and straightforward organization, like a numbered list. Creativity, a large vocabulary and a grasp of the finer points of grammar aren't necessary. In fact, sometimes those can get in the way.

Then again, plain writing for government and the defense acquisition community is hard in at least two specific ways. The unclear nature of much government writing has its own inertia, creating still more unclear government writing. Ambiguously worded regulations, often spawned by ambiguously worded laws, lead to ambiguously worded policy statements and requests for proposal, as staffers attempt to comply with rules they don't or can't fully understand. Use-it-or-lose-it

budgeting and the need to keep options open also create incentives to be less than clear. Think of writing a requirements document: You want to say what you need in a capability while leaving room for companies to be creative in meeting that need.

In addition, the defense community deals with the dangerous and the deadly. Euphemism and jargon can keep at a distance the powerful consequences of the decisions we make and the products we buy. This is normal and human. But it's also something to be aware of.


**CONNECTING THE BOXES**

Writing in plain language is a discipline that pays off professionally in a multitude of ways, not the least of which is to get the job done right, or get the point across immediately and effectively. (Image courtesy of IvelinRadkov/iStock)

## PLAIN UNDERSTANDING

Whatever the subject, writing in plain language starts with understanding. What do you need to say, and to whom? How much does your audience already know about the subject?

The Plain Writing Act mandates "clear Government communication that the public can understand and use." And yet, the government—an entity for which the capital G does nothing to promote clearer understanding—still churns out plenty of ineffective writing. So, yes, it's the law, but almost no one abides by it. For one, there's no penalty. There's also no step-by-step process to follow. Does that mean effective writing is one of those amorphous "I'll know it when I see it" affairs? No. All plain language writing passes the same test—the audience for the material can quickly and easily find what they need, understand what they find, and act appropriately—and shares some of these characteristics:

**Not too much jargon.** Jargon is specialized vocabulary that tends to exclude those who are not part of a profession or group. Sometimes it is necessary or serves as a useful shorthand. Other times, it's just to make the group feel exclusive. Jargon should be avoided when it is either a wall between that group and an interested audience or when it is used to obfuscate.

**Few, if any, acronyms.** Or abbreviations, or initialisms, such as: "the Organization with a Very Long Name (OwVLN) is sourcing for an IDIQ." A glossary or key doesn't help much. If a reader has to stop in the middle of reading and move his eyes to the glossary, then back to the sentence at hand, then repeat the operation two lines down, his understanding of the material will suffer. Acronyms and initialisms are also hard to read: the human eye expects capital letters to signal the start of a new sentence or a proper noun. The eye (at least one not accustomed to reading DOD documents) struggles to absorb sentences with random groupings of capital letters scattered throughout.

(The difference between an acronym and an initialism is that the former can be pronounced as a word, like LIDAR or MRAP, and the latter cannot, like CIA, which is pronounced as a series of individual letters.)

**Short sentences consisting primarily of nouns and verbs.** Readers absorb small bites of information more easily than big paragraphs. Adjectives (groundbreaking, excellent, high-performing), or adverbs (totally, quickly, surprisingly, really), especially those that cannot be substantiated, often just clutter up the scene. Nouns and verbs do the hard work. They carry the reader from what happened to who did it. If you overload them with a lot of description, they can't do their job as well.

> **Yes:** "The rain jacket performed well in the first round of tests. It kept participants drier than the previous version. Seven out of 10 Soldiers at the test said they liked the new design better."

**No:** "The rain jacket performed well, exceeding the performance of the previous jacket in terms of water repellence and user comfort, and earning unprecedented accolades from Soldier participants, seven of whom said they liked the new design better."

**The active voice.** The active voice provides information; the passive voice tends to hide it. "The decision was made to opt for a sole-source process" is in passive voice and leaves out a key piece of information: Who made the decision?

As a bonus, sentences in the active voice are often shorter. "The platoon overran the enemy position": six words. "The enemy position was overrun by the platoon": eight. Saving two words matters for documents long and short. In a long report, the word savings from consistently preferring the active voice add up. In a short email, shaving a few words means that readers can take in the whole email without needing to scroll.

**Each word gives the reader new information.** What does the reader get out of "The team identified, targeted and implemented new performance measures" that she doesn't get out of "The team implemented new performance measures"? Likewise, does "The team was able to improve its productivity" in fact mean "The team improved its productivity"?

**Dots connect.** Plain writing guides readers from point to point. Numbered or bulleted lists, outlines, section headings and subheadings, bullets and transition words such as "thus," "similarly" and "in contrast" help readers follow along.

**The most important information comes first.** Which is to say, BLUF—bottom line up front. The most important sentence in the paragraph should be first, and, generally, the most important paragraph in the document should also come first. If the reader needs to take action, that piece of information is often more important than others and should appear sooner.

**Yes:** "The Office of Small Business Initiatives requires competitors to submit Form TX89 by May 1. Email office@smallbiz.gov to request a copy of the form. On the form, you will report your business's past dealings with the Army. This is an important part of your application."

**No:** "A high-level description of a competitor's prior history with, and access to, the Army Office of Small Business Initiatives (AOSBI), is an important part of an application packet. Copies of Form TX89 are distributed to competitors by email; contact the AOSBI for more information. For those wishing to apply, the form is due May 1."

### WHY IT MATTERS

Think of how you feel when you receive a packet of bewildering corporate-speak from your insurer or cable provider, filled with acronyms and asterisks and fine print. You know you have to do

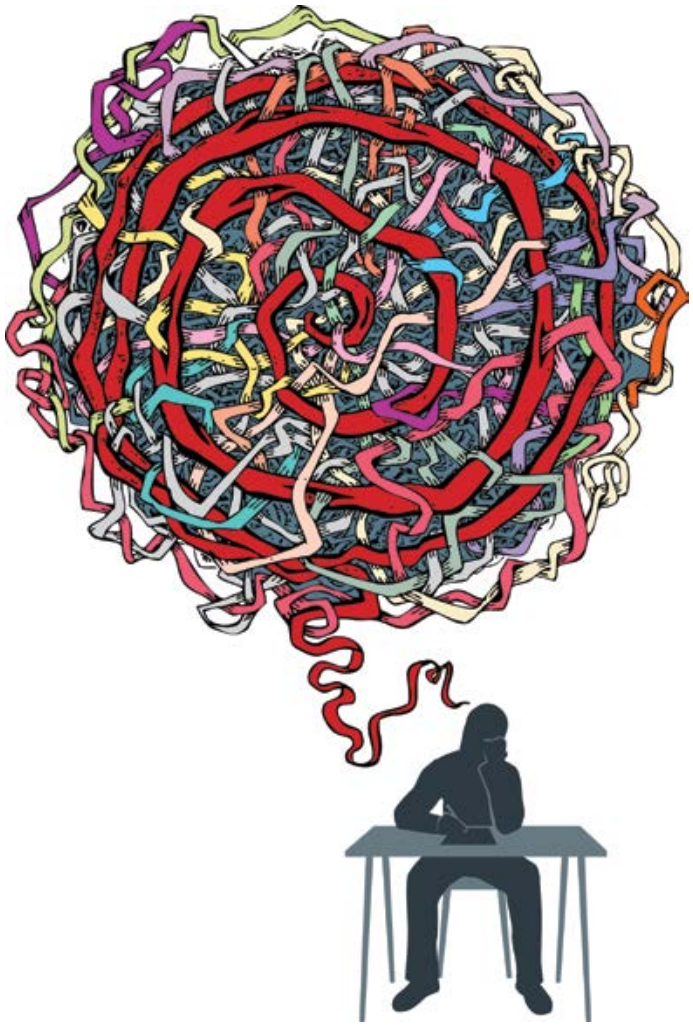
## GREETINGS, 'CAREERIST' JERK

Folks who work in government say things seldom heard outside of government. We are also prone to "vogue phrases," or locutions that seem to catch fire in our organizations and soon everyone is saying them. Most of these are innocuous. Some, such as "the art of the possible," which we see too often in draft articles for Army AL&T, are so overused as to become meaningless. That's because, in all their popularity and our eagerness to repeat them, we often get them wrong. Otherwise very smart authors use that particular phrase to mean something exactly the opposite of its real meaning, which is compromise.

Sometimes, however, we come across things that are so wrong that it bewilders our pointy editorial heads. Case in point is "careerist." My colleagues and I have seen this in a number of articles and edited it out because it is 100 percent pejorative. Not long ago, I got an email from an unattended Army mailbox with the salutation, "Greetings Careerist." I was insulted. It was like getting an email from my employer saying, "Greetings, Unethical, Machiavellian Jerk." There is nothing nice about a careerist: It is someone whose only focus is getting ahead, regardless of the costs or consequences or utter lack of ethics. As such, it goes against everything acceptable in Army acquisition careers.

Try, "Greetings, Acquisition Professional." It's much nicer—and accurate. When communicating effectively, it's a great idea not to insult your audience right at the top.

***—MR. STEVE STARK***



**I DIDN'T MEAN WHAT YOU THINK I SAID**

Plain writing for the defense community can be frustrating: A lot of government writing is already unclear, and ambiguity carries over from laws to regulations to policy statements. Ultimately, members of the acquisition workforce have difficulty complying with rules they don't understand. (Image courtesy of Digitusmedius/iStock)

something—and probably soon—but can't figure out how or why. Does it feel like they're on your side? Or do you feel annoyed, helpless, confused, like they're trying to pull a fast one?

It's important to talk about what we in Army acquisition do in language that the taxpayer can understand. Communicating with taxpayers and citizens is part of our job; words are tools, and it's important to use them correctly. When you're soldering a switch to a motherboard, you would not say to yourself, "Well, a wrench would do just as well as a blowtorch here." When you are telling the taxpayer what you've done with their money, "A groundbreaking SWDA-compliant discrete force multiplier" will not do as well as "a water-resistant storage container with discrete compartments, which complies with the Stop Water Damage Act." Every after-action report, solicitation, user manual or website presents an opportunity to demonstrate that we take our obligation to the Soldier and the taxpayer seriously. Plain language can help us meet this obligation.

On the other hand, if we give in to the pull of bureaucratese—"I don't have time to revise this"; "it's basically clear, my co-workers get it"—the potential consequences can be serious. Citizens give up, bewildered, in the face of impenetrable thickets of jargon. Companies that wish to do business with the Army can't figure out what the Army is asking for.

Unclear language also risks violating the spirit of ethics guidelines, if not the absolute letter. One example: Experiment participants have to give informed consent. If the form participants have to sign is gobbledygook, how informed is the consent?

## CONCLUSION

The Center for Plain Language notes:

> *When federal agencies publish regulations and guidance in legalese, people can't*
>
> - *Fill out forms or report data correctly.*
> - *Access benefits that they need and are entitled to.*
> - *Follow the law.*
>
> *When people or businesses don't follow laws correctly, federal agencies need to follow up, figure out why and fix things. We believe that the follow-up-and-fix efforts cost time and money unnecessarily. If laws and regulations are written in plain language, people can understand and follow them confidently and correctly the first time.*

Plain language is the answer. It saves time and money, it helps us earn citizens' and Soldiers' trust, it's the law and it's part of our job. It's a challenge well worth mastering, and it gets easier with practice.

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**MISSILE MISSION**

A team from the Arkansas Army National Guard's 1st Battalion, 142nd Field Artillery fires an ATACMS at White Sands Missile Range in July 2015. The system saw combat service in the Persian Gulf War, Iraq and Afghanistan, and is still in production. (Photo courtesy of Arkansas Army National Guard)

# BEEN THERE, DONE THAT

# PREPARATION FOR OPERATIONAL TESTING

Rapid and evolutionary acquisition bring some changes to how the Army conducts operational testing of new system increments, but some things will remain constant—like surprises.

*by John T. Dillard, Col., USA (Ret.)*

Many years ago, Dr. Philip E. Coyle III, the long-experienced, former DOD director of operational test and evaluation, cautioned program managers (PMs) about program risk in the new era of evolutionary acquisition—fielding capabilities in sequential increments.

What he suggested back then was that even with evolutionary acquisition, we would likely be fully testing each of the system capability blocks individually. In that vein, he presented some salient points about past programs' readiness for what he called the binary or pass/fail environment of operational testing, and how PMs often "rush to failure."

In the November – December 2000 issue of Program Manager magazine, Coyle wrote: "Over the past three years or so, the Army has seen that 80 percent of their systems have not met 50 percent of their reliability requirements in operational tests. In the Air Force, AFOTEC [Air Force Operational Test and Evaluation Center] has had to stop two-thirds of their operational tests because the systems were not ready."

Sadly for all of us, the numbers have not improved much in the past decade or two. Coyle's principal advice to program managers—paraphrased and reduced to its simplest terms here—was to:

1. Reschedule program test events as the program schedule slips to avoid being ill-prepared and poorly positioned for an adverse event.
2. Test every operational environment in advance of OT via developmental testing (DT).
3. Fully load systems in DT, especially interoperable automated systems.
4. As they become clearly defined, plan on fully testing each of the program's evolutionary requirements as time-phased capability increments.
5. Don't skimp on DT.
6. Use modeling and simulation correctly: to interpolate, not extrapolate, results.
7. Coordinate with operational testers early to address all needs and avoid conflict.

Most PMs know that much, if not all, of this advice is easier said than done. However, with a DOD 5000.02 framework that specifies an operational assessment before milestone C, followed soon after by an initial operational test and evaluation (IOT&E) in the production and deployment phase and perhaps even a follow-on operational test and evaluation, there should be ample opportunity to exercise Coyle's advice. Thus we facilitate our own learning and confirm system performance while accomplishing our shared test objectives.

Fortunately, despite differing programs and technologies, requirements, etc., we can often learn from the experience of others. The difficulty, of course, is in being able to share knowledge that is sufficiently useful across unique acquisitions. Following are some useful examples of what Coyle was cautioning PMs about as he prepared to leave office in January 2001, from the perspective of a PM going through operational testing of a major weapon system.

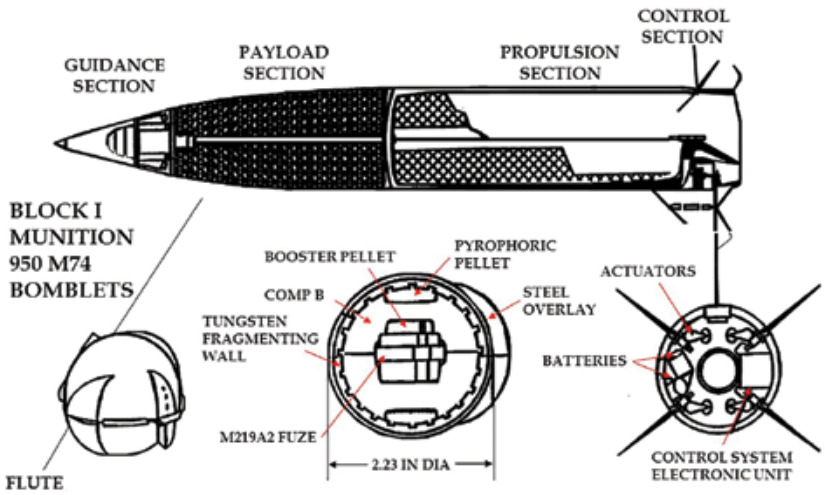
## INCREMENT BY INCREMENT

The Army Tactical Missile System (ATACMS) is probably one of the most distinct major-system examples of an incremental development process. Born in 1986 from a Defense Advanced Research Projects Agency project called Assault Breaker, the missile was an extended-range weapon to be fired from an existing vehicular platform, a Multiple Launch Rocket System. It would initially deliver about 1,000 M74 anti-personnel bomblets per missile, with preplanned incremental upgrades to eventually enable precision anti-armor submunitions. Thus, while a desired end-state capability was identified early on, all of the system requirements were not. Future increments would depend upon threat changes, technology maturation and user experience with the initial increments.

More than a program with preplanned product improvements, ATACMS was ahead of its time in current policy terms. Initially fielded just in time for the first Gulf War, the system continued in its evolutionary development through the 1990s, went to war again in Iraq and Afghanistan and is still in production today. The program gave rise to several advanced and unplanned variants, with capability increments managed and operationally tested as unique acquisitions. There were many operational realizations about ATACMS' advancing capabilities along the way, not the least being a

### ATACMS LAUNCH POINT

Block I ATACMS, shown here in its major system components, featured nearly 1,000 M74 anti-personnel bomblets. Preplanned incremental upgrades ultimately would incorporate precision anti-armor submunitions. The ATACMS program, begun in 1986, was one of evolutionary development that continued through the 1990s. Each capability increment was managed and operationally tested as a unique acquisition, giving rise to many operational realizations about advancing capabilities and their testing. (Image courtesy of the author)



**BURSTING IN AIR**

In this photo taken by high-speed camera at White Sands Missile Range, an ATACMS missile travels at Mach 2 with its nose skins peeling off to commence its bomblet dispensing sequence during OT in spring 1990. Weighing just over 1 pound each, 968 bomblets rapidly dispersed into a gigantic "beehive" and arrived in the target area just after the missile body impact. (Photo courtesy of the author)

necessary clarification of joint service roles and missions as the Army extended ATACMS' battlefield reach into U.S. Air Force mission areas.

On the tactical level, what we in the PM office found out about our own system's Block I during IOT&E was quite surprising.

We tested the first incremental block operationally in spring 1990 in a three-month series of ground and flight exercises at White Sands Missile Range, New Mexico, with an entire field artillery battalion as the test unit, the 6th Battalion, 27th Field Artillery Regiment. The battalion became the first unit equipped and subsequently the first to use ATACMS in combat operations during Operation Desert Storm. This IOT&E of a major defense acquisition program was one of the most successful ever but still managed to provide the program management office (PMO) with plenty of surprises.

The lessons we learned from the extensive IOT&E were numerous, and remain relevant. I'll frame them in parallel with Coyle's advice to PMs.

**Rescheduling test events when necessary—**Our PMO actually had to slip IOT&E for six months within a 48-month advanced development program that was being executed on a firm-fixed-price contract. Driven by both DT missile reliability failures and subcomponent hardware availability, the delay did not cause an acquisition program baseline breach, but neither was it inconsequential.

We were at the very end of the contract performance period. Our periodic operational test readiness reviews (OTRRs), which began about a year before the original start date, did not predict the slip as an eventual imperative. No one wants to slip IOT&E until it is fully necessary, given the many organizations disrupted (i.e., test unit, range personnel, OT agencies, user representatives, contractor and others). The PMO had proposed a three-month delay to allow for completion of DT, but in fact we needed the entire six-month delay that the operational testers from the Army Operational Test Agency and DOD's director of operational test and evaluation (DOT&E) "gave" us.

The lesson learned was that once a PMO has exceeded the allotted time, it might no longer be able to prescribe program events. It was also our first solid realization of the OT paradigm: The PM is no longer doing the testing. The PM's system is being tested. That's a big shift in both thinking and authority that affects approaching activities.

**Test all operational environments in DT—**It's still impossible to schedule rain at White Sands Missile Range. Actually, given the sum of various range safety and availability constraints for a major range and test facility base, it can be difficult to schedule anything. We had launched only 27 missiles in DT, with just 15 more planned for IOT&E. At that point we had fired only in good weather. In fact, we had fired only on an azimuth of true north—i.e., in one direction—because of constraints at the firing range.

For environmental stress testing, we used various test chambers to the fullest extent possible to simulate heat, cold, fog, rain, vibration, etc., for weeks, but until IOT&E we had never actually transported the missiles on their designated prime mover, a Heavy Expanded Mobility Tactical Truck, across rough terrain. Fortunately, our DT environmental stress

**ROAD TEST, PASSED**

A Heavy Expanded Mobility Tactical Truck loaded with four missiles conducts mobility road testing and cargo handling on dirt roads at White Sands Missile Range in March 1990. Unlike with other elements of stress testing, the IOT&E for ATACMS marked the first time that the PMO transported the missiles on the truck, their designated prime mover, across rough terrain. However, DT environmental stress testing had been so rigorous that no related problems surfaced in IOT&E. (U.S. Army photo by Tom Moore)

**INSTRUMENTATION CAN MEAN COMPLICATION**

Contractor support personnel from SAIC install instrumentation and wiring on a Multiple Launch Rocket System launcher, the vehicular platform for the ATACMS, at White Sands Missile Range in March 1990. There were nine platforms to be used during the system's IOT&E. Instrumentation delayed the start of testing because of concerns about uncertified hardware being placed on the system. Lesson learned: Instrumentation was the single most important consideration that the Block I ATACMS program had neglected in development. PMs must plan for it well in advance to prevent testing delays. (U.S. Army photo by Kenneth G. Schoultz)

testing had been so rigorous that we had no related problems in IOT&E. We'll probably never completely cover all of the operational variables in DT, but we have to try to minimize discovery in IOT&E by thinking critically about the spectrum of future environments and trying to include them.

**Fully load the system in DT—**Throughout DT, we sought to minimize variability in testing with fully charged batteries and comprehensive commercial equipment for circuit testing. Little did we suspect that run-down batteries would cause "ghost prompts" and other strange electrical phenomena, or that the simpler unit-level test, measurement and diagnostic equipment for missile testing would be a reliability and maintenance problem all through IOT&E. Nor did we fully consider tactical unit misfire procedures in a combat situation, having long been used to a tightly controlled DT range safety countdown sequence.

Further, we were unable to fully load our computing hardware and software components until a few months before the test, a situation complicated by successive software releases all the way up to the final OTRR's certification of readiness. We just ran out of time. A conscious effort to assemble an all-inclusive system-support package to accompany the test articles thus is another essential.

We got bitten by another foul-up, as well. For any spare "black boxes" that have had upgrades to the system, the package of spares sent out for OT must also have those upgrades. So one of our black boxes that hadn't been upgraded with a circuit card modification was hastily swapped out as a field repair.

**Test to the full requirements of each increment—**A capability increment to

*Fortunately, despite differing programs and technologies, requirements, etc., we can often learn from the experience of others.*

**THE ULTIMATE TEST**
The ATACMS launches from White Sands Missile Range on May 9, 1990, toward the end of the IOT&E. (Photo by Pfc. Tara Hutcheson)

be fielded to end users requires thorough verification and validation before handoff. To get the maximum benefit from DT and OT requires involving all stakeholders in joint test planning: users, PMs, DT and OT testers, system analysts and reliability specialists, contractors and others. This includes construction of the test matrix and laying down the ground rules to incorporate evolving configurations and various test scenarios.

There seems to be an inherent obstacle to learning everything about the systems we manage, even during DT—an aversion to "discovering" system failure. We don't want to fail, so sometimes we intentionally don't push the system, certainly not beyond what we know it will do or has to do. A target beyond estimated maximum range, for example, will not be attempted to ascertain system margin, because any miss will likely be scored a miss. The same pitfall exists for other areas of testing, such as vulnerability or survivability.

**Don't skimp on DT—**As the variability of events increases in OT, you will inevitably begin to discover new things about your own system, despite years of experience in its development.

Once, IOT&E presented us with an abnormally large area target—one desirable for firing multiple rockets, the platform's initial and primary munition, but not individual missiles. So our system used a software algorithm to automatically shift the missile aim point to obtain a better sheaf (coverage) effect, one appropriate to the outsize target. We'd overlooked the existence of this "Fendrikov algorithm" within fire control system software during the entire development effort. Fortunately, we got permission to negate this in follow-on operational test launches, after negotiation with the operational testers.

**PERFORMANCE AS EXPECTED**

This overhead view shows the target area at White Sands Missile Range, with "soft" targets shredded by the bomblets dispersed by ATACMS. The crater at the center of the target set was where the ATACMS rocket motor body impacted, precisely where it was supposed to. (Photo courtesy of the author)

During another launch, we experienced a safety delay because of animals in the impact area. The missile already had been initialized, and it remained activated and elevated in the launch position, which affected the missile's inertial guidance set, causing it to degrade slightly. It was just another thing that hadn't happened in over two years of DT and went beyond our system specification.

Being placed in a situation beyond any operational scenario we'd anticipated—one that limited us to only a few minutes in the firing position—showed us something new, however, albeit at the cost of an accuracy loss. Once again, we changed the ground rules for the rest of OT to re-initialize missiles if such a delay occurred.

**Use modeling and simulation—**Our investment in developmental hardware-in-the-loop simulation not only reduced the requisite sample size of live missiles, enabling a full-rate production decision based upon only 42 flights, but it actually served us in anomaly discovery. That brought home to a lot of us just how important our modeling and simulation investment was. The closer the model is to reality, the more we could actually learn about our own invention.

When missiles didn't fly according to their predicted operational profile, even if they succeeded against the targets, we knew to investigate for a cause that might cascade or proliferate. (Of course, the model must not be of such high resolution that it actually incorporates the fault or deficiency!) Other unanticipated factors crept in, as well. The most interesting discovery of accuracy loss was the result of an operational stack-up from the use of three different mappings of the Earth, called World Geodetic Survey spheroids, for three different elements of testing: target coordinates, firing point benchmark and onboard navigation system software.

**Coordinate with operational evaluators early—**Instrumentation is the single most important consideration that our Block I program had neglected in development. The thirst for system data is unfortunately huge, and we collected more than anyone needed or analyzed.

However, in the minds of many, the need still exists to answer all possible questions that could arise from an OT. Conflict with operational testers can occur when they seek to capture previously captured developmental or technical data. Stakeholders have to draw the line somewhere. We felt we lost (broke) at least one missile because of dozens of firing circuitry interruptions to analyze a system subcomponent during OT—steps inappropriately seeking technical specification-compliant data, DT-style, rather than seeking to prove whether the system works in an operational environment.

The best way to ensure that instrumentation is reliable, does not interfere with the system's operation and yields valid data from the system is to "require" it in the specifications derived from the capability development document and capability production document.

The PM most likely will want to assign responsibility for this vital effort to the system contractor during development, lest the contractor later try to blame a system failure on nonsanctioned or uncertified hardware added to the product. Instrumentation must not corrupt the data as it flows through the system.

Even the earliest coordination with other OT stakeholders still may leave some issues unresolved until testing begins. Selection of other-than-planned live-fire targets, additionally imposed target location errors and other late-breaking "requirements" should not come as surprises, but as the predictable result of players changing in the long life of a developing system. PMs don't have to accept employment of the system outside

the bounds of its expected operational use. But they should be ready for the "surprise" requests to do so, and anticipate how to handle them.

Case in point: DOT&E asked us to fire ATACMS off the side of the launcher instead of its prescribed operational mode, firing directly over the crew cab. It had never been done in DT, and the user community had no desire to do so, but the demand still came. We resolved the issue by promising to demonstrate the possibility and safety of this new mode after the IOT&E and to render a technical report once we had conducted our own pretest analysis of the factors involved.

**PERFORMANCE NOT AS EXPECTED**

A Soldier from the 6th Battalion, 27th Field Artillery Regiment, the test unit for the ATACMS' IOT&E, operates the missile monitor test device, with which the ATACMS was supposed to be interoperable. However, not having received sufficient emphasis before OT, the device surprised the PMO by testing good missiles to be bad and bad missiles to be good. (Photo courtesy of the author)

The simple fact is, you—the PM and PMO—are the ones who care most about the outcome of OT and must resolve the anomalies that occur as the test incident reports are written. The tester simply wants to find and score the anomalies and move on.

Plan for the statutorily restricted roles of system and supporting contractors during IOT&E. We cordoned ours off into a marked, private area, even requiring that they wear red baseball caps, which alerted troops to stay away from them. They kept a "hot mockup," a spare MLRS launcher, in their area, which helped greatly to resolve anomalies; we could easily replicate the anomalies on the spot and feed information back to the PMO over the many days of testing. A daily journal and after-action review are good ways, not only for the executors of the OT but also for the PM representative, to recap what has happened and what is planned next.

## CONCLUSION

Coyle's advice to PMs still holds true, if we can just frame in our own minds how to apply it. The lessons we learned back then during the ATACMS tests are also timeless, as I have heard over the years from PMs for systems as diverse as underwater robotics, communications gear and ground vehicles. They have described their experiences with the OT community relationship, test range constraints, instrumentation demands, late-breaking ideas for testing changes, technical "discoveries" and the like.

Today's PMs, take note, if an operational test is going to occur in your program in the next several years: It's always best to learn such lessons without the accompanying penalty of failure.

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*JOHN T. DILLARD, COL., USA (RET.), is the academic associate for systems acquisition management at the Graduate School of Business and Public Policy at the Naval Postgraduate School (NPS) in Monterey, California. He began his Army service as a Ranger-qualified infantryman and master parachutist, serving in the 1st Infantry and 82nd Airborne divisions, and joined the NPS faculty in 2001 upon retiring from the Army after 26 years of service. He spent 16 of those years in acquisition, most recently as commander of the Defense Contract Management Agency, Long Island, New York. He has also served on the faculty of the U.S. Army War College and as an adjunct professor of project management for the University of California, Santa Cruz. He holds an M.S. in systems management from the University of Southern California and is a distinguished military graduate of the University of Tennessee at Chattanooga with a B.A. in biological sciences.*


## LT. COL. JAMES E. HOWELL III

**COMMAND/ORGANIZATION:**
Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology

**TITLE:**
DA systems coordinator for defensive cyber operations; Handheld, Manpack and Small Form Fit tactical radio program; and the Joint Tactical Networking Center

**YEARS OF SERVICE IN WORKFORCE:** 7

**YEARS OF MILITARY SERVICE:** 23

**DAWIA CERTIFICATIONS:**
Level III in program management

**EDUCATION:**
M.A. in procurement and acquisition management, Webster University; master of communications technology, National Radio Examiners; B.S in psychology and political science, Campbell University

**AWARDS:**
Bronze Star (3), Meritorious Service Medal (4), Army Commendation Medal (2), Joint Service Achievement Medal, Afghanistan Campaign Medal (1 campaign star), Iraq Campaign Medal (3 campaign stars), Combat Action Badge, Master Parachutist Badge, Air Assault Badge, Army Staff Identification Badge

# Capitalizing on a fresh start

Lt. Col. James Howell is the first to admit he wasn't what you'd consider a poster Soldier when he enlisted nearly 25 years ago. "As a young man, I got into some trouble and I wasn't doing well in school before enlisting in the Army. So I am eternally grateful to our nation and our Army for this opportunity."

He has made very good use of his chances, starting as a repairman for radio, satellite, networking and communications security equipment and eventually becoming a signal officer and an acquisition officer. He's currently a DA systems coordinator (DASC), advising leadership for the assistant secretary of the Army for acquisition, logistics and technology on the cost, schedule, performance, risk and political and economic issues affecting successful program execution for defensive cyber operations, the Handheld, Manpack and Small Form Fit tactical radio program within the Program Executive Office for Command, Control and Communications – Tactical (PEO C3T) and the Joint Tactical Networking Center.

Howell coordinates and briefs all proposed Army positions with the associated PEO and program manager, the Army Budget Office, G-8, G-3, G-6, the Office of General Counsel, congressional liaisons and staffers and Joint Staff. He also prepares senior leadership for congressional testimony, and reviews and staffs all programmatic documentation, including procurement and research and development forms, requirements documents, weapon system handbooks and U.S. Government Accountability Office reports.

"A DASC must understand and remain focused on our strategic, operational and tactical goals," he said. "Our capabilities must fit in our echelons and enable mission accomplishment in a coalition, joint or Army environment." Staying informed and coordinating across all of the organizations

he's involved with are the biggest challenges he faces, Howell said. He addresses them with good planning and a strong backbone—"having the moral courage to disagree with anyone, regardless of rank or position, who is moving us away from the chief of staff of the Army's No. 1 priority, which is readiness of the Total Army." Asking a lot of questions and inviting himself to every meeting have also been important. "If you smile, you can usually stay in the room for those meetings you're not invited to," he added.

Howell joined the Army Acquisition Corps in 2010. Before becoming a signal officer in 2001, he earned electrical engineering and networking certifications that introduced him to the development, production and maintenance of communication networks. He spent a lot of his time as a signal officer supporting tactical special operations units and light infantry units in deployments to Iraq and Afghanistan.

Over the course of his career, Howell has picked up a variety of tools and experiences that he now applies to his work in acquisition. The three years he spent in Iraq and Afghanistan "have proved the most powerful and influential in my career," he said, and the memories of those years remind him of his responsibility to all of his fellow Soldiers, "from our newest private to our chief of staff." His Lean Six Sigma Black Belt certification showed him that everything can be made more efficient, and attending the Captains Career Course at the Marine Corps Expeditionary Warfare School taught him the importance of coordination with the other services. "The Marines do a great job of joint integration planning in preparation for combat operations," he noted.

But it was a recent tour as executive officer (XO) to the PEO C3T that he found had the biggest impact on his career. "As the XO, I was able to serve the program executive officer, Maj. Gen. Daniel P. Hughes, and the great people of the organization. Hughes, he continued, "did an amazing job of connecting with everyone and showing his appreciation for the work they were doing, and instilled confidence throughout the organization that they were making a difference for our Soldiers."

Col. Greg Coile, project manager for Warfighter Information Network – Tactical at PEO C3T, "taught me the importance of building simplicity into our capabilities and building effective teams," Howell said. "Both of these great officers taught me to aggressively look at ways we can make our capabilities simpler, more intuitive and easier to employ, integrate and maintain on the battlefield."

Howell's acquisition career began in the U.S. Army Special Operations Command (USASOC) under Patrick O'Brien, chief of the USASOC Combat Developments Division. He credits O'Brien with teaching him the importance of focusing on the Soldier and understanding how a capability supports Soldiers in an operational environment. "He showed me that my most valuable asset is my combat experience, taught me how to look for and understand our Soldiers' needs and demonstrated how our capabilities enhance mission success."

His DASC leadership—Col. Mark Evans, director of Mission Command, and Dan Joyce, deputy director of Mission Command—have helped with information coordination and synchronization. "Both of these great leaders helped me understand the art and science and the importance of coordinating our Army positions through integrated product teams, coordination meetings and our necessary formal actions—configuration steering boards, defense acquisition boards, etc. Stakeholder coordination and integration is a critical element in a successful program's execution and integration," Howell said.

Late last year, Howell received honorable mention in the future operations category of the Maj. Gen. Harold J. "Harry" Greene Awards for Acquisition Writing. Howell had the opportunity to meet Greene, who was a close friend of Hughes. "Maj. Gen. Greene always made sure we remember our link to the battlefield," Howell said. His entry in the writing contest was "actually a letter to our leaders to continue to analyze and care for our forced entry units. It's my attempt to leave a legacy that reminds us that our call is constant, urgent and sobering." Greene was killed on Aug. 5, 2014, while serving as the deputy commanding general of the Combined Security Transition Command – Afghanistan.

Howell will finish his work as a DASC over the next few months before moving to a leadership role with a classified program in U.S. Special Operations Command. He urged those interested in a similar career "to remember that you—as a Soldier, civilian or contractor—represent the warfighter in every meeting, in every discussion, in every forum or exchange of information. All of our competence, or lack of it, will manifest itself on the battlefield. Be the acquisition expert our Army needs. Our career field is complicated, our tasks are not easy and our future challenges will increase on today's battlefield. Master your craft."

***—MS. SUSAN L. FOLLETT***

FROM THE DIRECTOR,
U.S. ARMY ACQUISITION SUPPORT CENTER

# TOUGH CHOICES, POWERFUL TOOL

## Senior Rater Potential Evaluation holds key to identifying the AAW's future civilian leaders

***Craig A. Spisak***
*Director, U.S. Army Acquisition Support Center*

Nothing that I or any other leader within the Army Acquisition Workforce (AAW) does is more important than identifying and developing the AAW's talent. The Senior Rater Potential Evaluation (SRPE) is one of our best tools for identifying individuals with future leadership potential and documenting that potential. The SRPE provides our civilian acquisition professionals with a view of where opportunities may lie from their senior rater—someone higher up than the person who supervises them on a day-to-day basis. Yes, doing the evaluations is more work for supervisors. But taking care of their people is the crux of what leaders do.

Years ago, the acquisition community recognized the need for professionals, both civilian and military, to perform certain functions. And so we created best-qualified boards, originally for the program management community, whereby military and civilian acquisition professionals compete for leadership positions. We knew we'd need civilian program managers in the future because we wouldn't have enough military personnel to go around.

One of the earliest challenges we recognized was that officer evaluations had always been forward-looking, but civilian evaluations were backward-looking. In the military, the officer evaluation has a senior rater section, which is widely recognized as the most important part, assessing not whether the officer has done a good job but whether he or she has developed the skills and the potential to do a good job at the next level. It's really the best way the Army can identify future talent as well as an individual's potential for increased responsibility.

If I'm trying to pick somebody for the next level of responsibility, a backward-looking evaluation might not give me enough information to decide whether someone has the skills to take on this more complex role. Regulations govern the content and execution of civilian performance appraisals and prohibit the assessment of potential in addition to performance. The answer to this dilemma was to create the SRPE to measure the potential of civilian acquisition professionals.

## WHAT IT IS AND ISN'T

Over the years, we've modified the SRPE to mirror the evolving officer evaluation system. In July 2015, the director of the Army Acquisition Corps signed a policy mandating SRPEs for all GS-12 through GS-15 (or payband equivalent) civilian acquisition professionals. This mandate took an iterative approach. For FY15, it required GS-14 civilian acquisition professionals to have a completed SRPE. In October 2016, the mandate expanded to include GS-13s and their payband equivalents. In October 2017, the requirement for a SRPE will expand to GS-12s, and in October 2018 to GS-15s. By 2018, all civilian acquisition professionals from GS-12 to GS-15 will have one or more completed SRPEs.

Remember: The SRPE and the annual civilian performance evaluation reports are not the same and are not linked to each other. The SRPE is a talent management tool to evaluate the potential of civilian acquisition professionals at designated points in their careers to perform in positions or opportunities of increased responsibility. The various performance management systems evaluate the employee's performance in his or her current duties and contributions to the mission, as measured against the employee's performance standards for a given annual rating cycle.


**LOOKING TOWARD THE NEXT LEVEL**

SRPE is one of many tools the DACM Office uses to help senior leaders identify and develop the next generation of acquisition professionals and provide them with career-broadening opportunities at every level of their careers. (Image courtesy of the U.S. Army Acquisition Support Center/alexdndz/iStock)

SRPEs, like officer evaluations, are what we call "managed profiles." Less than half of the population profile can receive the top block of excellence. SRPEs are not used to determine tenure, plan reductions in force, make selections for awards or anything of that nature. The SRPE requires the senior rater to distinguish who the top acquisition professionals with potential are, compared with their peers, which then allows selection boards to find civilians who are ready for the next level of responsibility.

A major initiative within the AAW Human Capital Strategic Plan, under the goal of leader development, is use of the SRPE. This focus on talent management will ensure that as we grow, develop and groom civilian acquisition professionals, we consider opportunities to broaden their leadership skills at every level of their careers. Just as the individual development plan is a good tool for a first-line supervisor to discuss with an acquisition professional all career development goals and planned initiatives, the SRPE is a good tool for a senior rater to discuss leadership potential with acquisition professionals, then coach and mentor them as they move forward.

## HONESTY IS CONSTRUCTIVE

Not everyone can be the best. Having candid conversations about talent and potential is not easy work, but it needs to be done. In my experience, civilian supervisors have not done a great job of conducting frank and honest conversations about performance and potential. There has been a tendency just to tell everybody they're doing well, and unfortunately the data exist to back that up when most people are rated in the very top block of excellence.

Anyone who understands data and statistics at all knows full well that the "best" of a group cannot be a majority. We need more differentiation. Additionally, not all who perform well in a job have the desire or potential to perform well at higher-level positions or opportunities with greater responsibility.

However, if you want people to grow, develop skills and be able to take on new, more complex responsibilities to lead and manage people in the future, you have to identify their strengths as well as their weaknesses and have honest, constructive conversations: "You're really good at this, but you need some work at that. You're great at what you do, but maybe you're not cut out to be the next ACAT I project manager." And that's OK. There are 36,000-plus civilian professionals in the AAW. Not every one of them is going to be a Senior Executive Service member. Only a small percentage are.

In the past, SRPEs were required only for civilian acquisition candidates before a selection board. But if a candidate with just one SRPE goes before a board along with other candidates who have multiple SRPEs, that's a big disadvantage. Someone evaluating the group of candidates is going to have greater confidence in a group of data points on one candidate's potential versus just one data point for another candidate. And military acquisition professionals have many years of senior rater potential blocks on their evaluations. In a best-qualified board, a history of SRPEs can make or break a selection.

With SRPEs instituted across the whole acquisition community, civilians who decide they want to pursue a more challenging position will have a history of these documents on potential as well. They'll have multiple opportunities for someone to have said, "Hey, I think Jane walks on water, and here's why. She's ready for the next opportunity."

## CONCLUSION

With this new talent management tool come challenges for senior raters. It forces them to have tough, honest yet positive conversations to articulate to an individual their strengths and weaknesses. That senior rater will have to be able to say, for example, "Look, first of all, this has no negative impact on your career. I'm not saying that you're not doing a good job today. And if you don't aspire to something bigger, then this document will never really even be used. But if you do aspire to something bigger and better or more complex, here's why I said where your strengths were and what you're suited for. This is where I think you need to work and develop your skills so that the next time we do one of these, you might be ranked higher compared with your peers."

Although these conversations will be difficult at times, at the end of the day, you'll help your people much more effectively than those raters who just give everybody the same pat on the back and say, "You're doing a good job, keep going." I don't know how we as a community get better if we don't truly make an attempt to use an analytical tool that enables us to provide constructive criticism.

We recently concluded our second iterations of SRPEs for the AAW, and I'm eager to see the positive impact on our upcoming best-qualified boards. I anticipate that we will continue to see a larger percentage of civilians with exceptional or high-potential ratings on their SRPEs—the acquisition community's "best and brightest"—selected in head-to-head competitions for high-level career positions and leader developmental assignments. And I expect to see an increased interest in the centralized acquisition education, training and leadership development opportunities managed by the Army Director for Acquisition Career Management (DACM) Office.

I understand the concept of rating civilian potential is a culture change. It will take time for our acquisition community to realize the SRPE's full and positive impact on the talent management of our civilians. It is an exciting opportunity for the civilian acquisition professionals of the AAW, as there is now a mandatory tool to ensure that senior raters are taking the time to have those discussions that are so important in developing our professionals to their full capacity.

Senior leaders can and should impart their wisdom and guidance to the next generation of senior leaders. Although it may create extra work in the interim, over the next several years it will become part of our culture and ultimately support Army readiness, as those of us in leadership positions groom the next set of acquisition leaders. We should always strive to leave the acquisition community in a better place than we found it. The SRPE is one initiative to ensure that we do.

CAREER NAVIGATOR

# A PLAN *for ACHIEVING* CERTIFICATION

Earning DAWIA certification is challenging but not impossible, and it creates a smarter, stronger acquisition workforce.

There are jobs, and then there are careers. And for those who have careers in the Army Acquisition Workforce (AAW), developing that career means compliance with Defense Acquisition Workforce Improvement Act (DAWIA) requirements to complete certification within 24 months of being hired. Getting that certification isn't rocket science, but it does take a little planning, some effort and an investment of your time.

Regardless of the career field, AAW members should have a plan to accomplish required training and establish early on a rhythm of work and training to meet future certification requirements. That rhythm will be important, because down the road, even after certification, every acquisition employee has continuous learning requirements that must be completed every year, in addition to the annual training that DOD personnel must undergo.

For example, earning DAWIA Level II certification in program management requires approximately 163 hours of Defense Acquisition University (DAU) online courses, 36 hours of facilitated online training and five days in the DAU classroom. Online courses must be completed within a 60-day window. Each course has several modules, and each has at least one exam. The student must get 100 percent on each exam, and has three tries to do so. Failing to get a perfect score by the third exam means restarting the course from the beginning.

DAU provides a time estimate for each of its courses, but that figure could vary with each student. Someone with a free week to devote to a course with an estimate of 35 hours might be able to complete it in that time. On the other hand, someone who has to spread that course over the entire 60-day period could take significantly longer to complete the material.

## SUPERVISOR PARTICIPATION

Each member of the AAW must meet career field certification requirements within the 24-month period, and most succeed. As of Feb. 12, 2017, 80.9 percent of the AAW were certified and 17.8 percent within the 24-month grace period. To achieve this success rate—and individual employee success—it is crucial that the supervisor play a role. At a minimum, the supervisor needs to

make clear to a new employee the importance of certification and what it takes to achieve it. Given that employees will pursue certification during work hours, the supervisor and employee should have an agreement as to when the employee will do the training as well as a timeline for completing it.

"Even in the face of significant time constraints in our work and personal lives, the acquisition workforce has a statutory requirement to meet," said Wen Lin, chief of the Acquisition Qualifications and Support Branch in the Army Director for Acquisition Career Management (DACM) Office. "One of the major objectives of DAWIA is to professionally develop military and civilian members of the workforce. Once a workforce member has met their certification requirements, they need to continue to grow within their position," Lin said.

One tool in facilitating that growth is the individual development plan (IDP). Every member of the AAW has an IDP, which the employee and supervisor use to document and plan short- and long-range objectives. IDPs should be reviewed at a minimum every six months; such reviews are an opportune time for the employee and supervisor to discuss and update plans and timelines for when an employee will complete certification training.

Failing to meet certification requirements can have negative outcomes. According to a Jan. 30, 2012, memorandum from the DACM on enforcement of Army policy on DAWIA certification, acquisition personnel who fail to obtain certification within the grace period may be subject to "reassignment, reduction in grade/payband, loss of consideration for promotion or future employment into another acquisition position; or separation from federal service." Moreover, workforce members cannot take advantage of the centralized training opportunities unless they have achieved their certification requirements.

**ADVANCE PLANNING PAYS OFF**

Earning DAWIA certification is the cornerstone of an acquisition career. The task of achieving that certification can be made easier through thoughtful planning and communication between employees and supervisors. (Image by the U.S. Army Acquisition Support Center/Art-Y/iStock)

Certainly there are entirely justifiable circumstances that can prevent an employee from completing certification within the grace period, and employees should discuss such circumstances with their supervisors.

## CONCLUSION

It is hard work but entirely possible to achieve certification within the 24-month grace period—if there is a plan in place. Thousands of acquisition professionals have succeeded in doing so. The training is absolutely necessary: The acquisition enterprise is large and multifaceted, the acquisition process is exceedingly complex, and the products and services acquired for the warfighter can mean life or death.

*For more information, go to* ***http://asc.army.mil/web/dacm-office/****.*

***—MR. ROBERT E. COULTAS***

# LEARNING *to* TAKE *the* LEAD

A new class from the DAU Senior Service College Fellowship graduates in May, fresh from an intense, 10-month look at the whole Army and what's at stake for acquisition leaders.

*by James R. Oman, Col., USA (Ret.)*

For the past 10 years, Defense Acquisition University's (DAU) Senior Service College Fellowship (SSCF) has provided civilian acquisition professionals with leadership education that previously was available only to military personnel.

DAU-SSCF traces its beginnings to 2005, when the late Hon. Claude M. Bolton Jr., assistant secretary of the Army for acquisition, logistics and technology (ASA(ALT)), and Lt. Gen. Joseph L. Yakovac Jr., principal military deputy to the ASA(ALT) and Army director for acquisition career management, identified the scarcity of leadership education available for civilian acquisition professionals at the GS-14 and GS-15 levels. Bolton and Yakovac turned to DAU to develop a course to address this educational shortfall. Its SSCF became a nationally recognized program designed to develop strong, effective senior leaders for the DOD acquisition community.

On May 15, 2006, Yakovac announced a pilot program for DA senior-level civilians in the Huntsville, Alabama, area. After the pilot's success, the program expanded to Warren, Michigan, in 2007, and then to Aberdeen Proving Ground (APG), Maryland, in 2009. These sites were selected because they were home to the U.S. Army Aviation and Missile Life Cycle Management Command (LCMC), the U.S. Army Tank-automotive and Armaments Command (now TACOM LCMC) and the U.S. Army Communications-Electronics Command, respectively, after the completion of organizational movements associated with the 2005 report of the Defense Base Realignment and Closure Commission. On March 28, 2013, the Army G-3 granted Military Equivalency Level 1 for fellowship graduates. DAU-SSCF is the only fellowship of its kind developed exclusively for senior civilian acquisition professionals.

"The goal," DAU-SSCF Executive Director Mark Lumb recently said, "is to produce leaders who have strong critical thinking skills and who can thrive in leading environments of uncertainty and chaos."

The fellowships are open to permanent DA acquisition civilians in grades GS-14 or -15 or broadband equivalents. Non-Army DOD and non-DOD candidates (federal or not) also may apply. Those selected for DAU-SSCF will remain on their current organization's roster while attending the program. Members of the Army Acquisition Workforce (AAW) should obtain approval of their application through the appropriate command channels. (For more information, go to **http://asc.army.mil/web/career-development/programs/defense-acquisition-university-senior-service-college/**.)

*"The entire SSCF program was a once-in-a-lifetime opportunity to grow, learn and be a more effective leader and person."*

**BUILDING NEW PERSPECTIVES**
The May 2016 Huntsville class of fellows, from left: In the back row, Fred Little, Angela Jones, Ruby Price, Shawn Gresham and Daniel Hernandez. In the front row: Bob Domitrovich, Jennifer Stephenson, Cheryl Hickman, Noel Paschal and Nate Curry. The fellowship, offered at three locations, is designed to cultivate civilian acquisition leadership by offering educational and professional development opportunities similar to those available to military personnel. (Photo by Debbie DiCesare, SSCF director, Warren, Michigan).

Key components of the fellowship include multiple joint courses and learning experiences designed to maximize each fellow's understanding of DOD. The core areas of the fellowship are:

- Leadership, graduate studies and a strategy research project.
- The program manager's course (PMT 401) and the national security policy and strategy course.
- Mentoring.
- The distinguished speaker series.
- Site visits.

Courses overlap these core areas to maximize the values of an iterative learning process. In the leadership area, fellows attend and receive credit for participation in master's degree-level courses focused on leadership that are embedded within the curriculum, as well as the following DAU courses: PMT 401; ACQ 450, Leading in the Acquisition Environment; ACQ 452, Forging Stakeholder Relationships; and ACQ 453, Leader as Coach. DAU also provides extensive leadership training through interactive courses by the corporate training company VitalSmarts, including crucial conversations, influencer and crucial accountability, the ethics and FranklinCovey Co. course Leading at the Speed of Trust. Fellows without master's degrees may opt to pursue a fully funded master's degree in management and leadership during off-duty hours, through a program that runs concurrently with the SSCF.

## RESEARCH AND DOCUMENTATION

An intrinsic component of the program is the intensive strategy research project. Fellows begin the process with the selection of a leadership topic of interest to the acquisition workforce. Working with the APG SSCF director and project advisers from the DAU faculty or acquisition community, the fellows then conduct research and produce papers.

To date, several SSCF graduates have used their strategy research project as a starting point for additional research and have produced articles that were published in acquisition publications, contributing immeasurably to the body of knowledge associated with the profession. Larry Muzzelo, APG SSCF Class of 2013, in partnership with his project adviser, DAU professor Craig Arndt, wrote "Data Rights for Science and Technology Projects," which appeared in the April 2014 edition of the Defense Acquisition Research Journal. Most recently, Nick Saacks, APG SSCF Class of 2016, published "Reforming Motivation" in the October-December 2016 edition of Army AL&T magazine, which encourages submission of DAU-SSCF research papers.

## MENTORING, TRAVEL, STUDY

The mentoring component of the program fosters a cooperative, supportive and encouraging relationship between an experienced acquisition professional as

counselor and someone with less experience who wants to learn and gain valuable insight into a particular area. "My bag of leadership tools is much deeper and broader," Jim Muldoon, Warren SSCF Class of 2015, said after working with his mentor over the academic year.

The national security component of the fellowship includes a Capitol Hill workshop as well as multiple opportunities that examine the variables affecting national security policy. Through a partnership with the U.S. Army War College, the fellows participate in small-group seminar discussions and attend security strategy conferences. Fellows also visit geographical combatant commands to gain a practical understanding of the elements of power and the international system and environment.

Visits to those commands, in the United States and in Europe, combined with stops and briefings at NATO, Supreme Headquarters Allied Powers Europe (SHAPE) and U.S. Army Europe (USAREUR), provide further context, understanding and linkage from the national strategic level to the operational level. Each of these experiences underscores the volatile, uncertain, complex and ambiguous environment that will characterize the fellows' post-graduation assignments. "The overseas visit to EUCOM [U.S. European Command], USAREUR and SHAPE in Mons, Belgium, as well as visits to all of the training centers, was a great opportunity to speak directly with users and key decision-makers in the operational environment," said Daniel Schwartz, APG SSCF Class of 2016.

The fellowship's distinguished guest speakers and site visits provide the fellows with opportunities to listen to and interact with senior leaders and experts in a variety of fields and see for themselves the operations

## TWO DAYS IN 'THE SAUSAGE FACTORY'

In September 2016, 25 DAU-SSCF fellows spent two days on Capitol Hill. This is a standard part of the fellowship and provides each participant with a deeper understanding of the workings of Congress, its relationship to DOD and the substantial role Congress plays in the acquisition process. Over the course of the workshop, fellows heard from a variety of speakers: current and former newsmakers, journalists, consultants, former congressional staffers and lobbyists. The speakers addressed a multitude of topics and shared their viewpoints and perspectives on policymaking, national security and the geopolitical environment.

Walter Oleszek, senior specialist in American national government at the Congressional Research Service, a division of the Library of Congress, described the evolution of power in Congress and discussed the nuances of divided power, partisanship and their impacts on policymaking. Former Rep. Marty Russo, D-Ill., who represented Chicago from 1975 to 1993 and is now a lobbyist, shared recollections of his years in Congress and addressed the importance of lobbyists. Sid Davis, a former vice president and Washington bureau chief of NBC News with more than 40 years of reporting experience, shared observations of the presidency, addressed the responsibilities of the press and discussed their profound impact on politics. Yuri Maltsev, a defector from the former Soviet Union and a former senior economist at the Academy of Sciences of the USSR, discussed Russian President Vladimir Putin and Russia's growing worldwide influence. Jon Etherton, a former professional staff member with the Senate Armed Services Subcommittee on Acquisition and Technology and currently a defense and intelligence consultant, provided his insights on acquisition policy, reform and human capital initiatives, as well as his observations on the politics of acquisition, describing the interactions of Congress, DOD and industry.

Author and occasional TV pundit Gordon Chang, a subject matter expert on China and North Korea, kicked off the second day on the Hill with a sobering assessment of the near-term goals and long-term objectives of China and North Korea and their likely impact on the national interests of the United States. Lucian Niemeyer, a former professional staff member with the Senate Armed Services Committee, addressed his role as a committee staffer and described its functions and responsibilities.

The fellows used their remaining half-day on Capitol Hill to sit in on congressional hearings, observe votes and visit their members of Congress.

"Having the ability to listen to professional staffers, media personnel and one of the 10,000 registered lobbyists gives me a greater awareness of the policymaking process," said Jerry Harper, APG fellow and seminar chair, at the conclusion of the workshop.

*—JAMES R. OMAN, COL., USA (RET.)*

**VISITING CAPITOL HILL**

Fellows from the SSCF classes from APG, Huntsville and Warren spent Sept. 12-13, 2016, on Capitol Hill, hearing from current and former newsmakers, journalists, consultants, congressional staff and lobbyists. Fellows take a deep dive into acquisition policy through travel, lectures from guest speakers and book discussions, in addition to DAU coursework. (Photo courtesy of the author)

of many organizations. These include visits to DOD organizations, command centers, industry and local battlefields. Readings selected from leadership-themed books, culminating in fellow-led and facilitated reviews, offer additional opportunities to understand relevant perspectives, along with supplemental tours and other activities.

> *"I am a better leader, employee and family member since taking SSCF."*

## CONCLUSION

Over 10 months, fellows are required to work hard, develop their intellects, sharpen their understanding of acquisition processes and enhance their leadership skills. SSCF requires students to read and study, in order to acquire knowledge; to discuss, in order to subject their views to the rigors of thoughtful examination; to investigate, in order to learn how to ask the right questions and find the right answers; and, finally, to write, in order to impose structure on their thoughts. "I am a better leader, employee and family member since taking SSCF," said Colleen Setili, Warren SSCF Class of 2013.

While AAW members make up the majority of DAU-SSCF participants, acquisition workforce members of the other services as well as DOD agencies are welcome to apply as long as they meet eligibility requirements. To date, after 10 years of classes, the DAU-SSCF has educated, developed and graduated 215 senior civilian acquisition professionals. All of the graduates are contributing in positions of greater responsibility, with many performing in key leadership roles such as product and project managers, program executive officers and other acquisition positions where they make significant contributions on a daily basis.

On May 23, 25 fellows will join the ranks of SSCF alumni and begin to make their marks within the acquisition community. Recent graduate Schwartz summed up his feelings about the experience: "The entire SSCF program was a once-in-a-lifetime opportunity to grow, learn and be a more effective leader and person." Wing Young, also of the APG Class of 2016, added, "Applying to the program is one of the wisest decisions I made."

*For more information, go to* ***http://www.dau.mil/SSCF/default.aspx****.*

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*JAMES R. OMAN, COL., USA (RET.), is SSCF director for DAU at APG. He holds a Master of Strategic Studies degree from the U.S. Army War College, an M.A. in management from Webster University and a B.S. from Bowling Green State University. He retired from the Army in 2008 after 30 years of service, serving his last five years on active duty as chairman of the Department of Command, Leadership and Management at the U.S. Army War College. He joined DAU in September 2008. He is a member of the Defense Acquisition Corps and is Level III certified in program management.*

# ON THE MOVE

## HALLOCK RETIRES AFTER NEARLY FOUR DECADES

**Harry P. Hallock**, former deputy assistant secretary of the Army for procurement (DASA(P)), retired in January after 36 years of service to the Army with a ceremony Dec. 15 in Arlington, Virginia.

The son of an Air Force technical sergeant, Hallock was born in Germany, moved to the U.S. at a young age and was raised in Frederica, Delaware. He entered public service in 1980 as a GS-5 contract specialist intern for the DA Materiel Development and Readiness Command (now the U.S. Army Materiel Command) in the U.S. Army Tank-automotive and Armaments Command (TACOM) Acquisition Center in Warren, Michigan.

During his time at TACOM, Hallock held various contracting and acquisition functions, including procuring contracting officer for the five-ton truck and heavy tactical truck programs and the Bradley Fighting Vehicle System (BFVS); M113 programs group leader for combat and commercial vehicles, including BFVS, materiel handling equipment and commercial construction equipment; associate director for the Heavy Combat Commodity Business Unit, overseeing the M1 Abrams tank program and related combat vehicle systems; and chief of research and development and the Unit of Action Future Combat Systems Contracting Division. Hallock was named executive director of the TACOM Contracting Center in 2007 after receiving a promotion to the Senior Executive Service (SES).

Hallock was also selected to participate in two details, one with the U.S. Army Contracting Command in Huntsville, Alabama, as the deputy to the executive director, and the other as the acting deputy principal assistant responsible for contracting at the U.S. Army Corps of Engineers in Washington.

In July 2013, he was selected as the DASA(P).

In that capacity, he supported the annual award of over 297,000 Army contracting actions, valued at more than $74 billion, at 272 field contracting activities worldwide. In particular, he was responsible for establishing the first general officer-level operational contract support integration cell in the U.S. Central Command area of operations. Hallock also has been a regular contributor to Army AL&T magazine; his most recent article, "Dreaming of a Strategy," appeared in the January - March 2017 issue.

**Lt. Gen. Michael E. Williamson**, military deputy to the assistant secretary of the Army for acquisition, logistics and technology (ASA(ALT)) and director of the Army Acquisition Corps, presented Hallock with the Decoration for Exceptional Civilian Service and a DA Certificate of Appreciation at the Dec. 15 ceremony.

Succeeding Hallock in an acting capacity is **Brig. Gen. Michael D. Hoskin**.

## NICHOLS ENDS 42-YEAR CAREER

**Maj. Gen. Camille M. Nichols**, director of the Sexual Assault Prevention and Response Office within the Office of the Secretary of Defense, will retire from the Army April 1, following 42 years in service. **Gen. Gustave F. "Gus" Perna**, U.S. Army Materiel Command commanding general (CG), presided over Nichols' retirement ceremony Feb. 23 at Fort Myer, Virginia.

Nichols, a manager and assistant coach for the 1984 U.S. Olympic Women's Handball Team, spent more than 25 years in Army acquisition, serving as the first CG of the U.S. Army Contracting Command and the Program Executive Office (PEO) for Soldier. In addition, she was the director of business operations in the U.S. Army Office of Business Transformation and deputy CG of the U.S. Army Installation Management Command. She also served as a company-grade officer in several command and staff positions in engineer units in the U.S. and South Korea.

She enlisted in the Army in 1975 and entered the U.S. Military Academy at West Point in

1977, in the second class open to women. Her time in the Army has been an "amazing journey," she said in an interview with DOD News in March 2016. She would "sign up in a minute" to do it all again, she said, especially considering the expanded roles of women in today's military.

"Women have been asked to serve. They have volunteered to serve. They serve admirably, and with great distinction," DOD News quoted Nichols as saying. "I am proud to have served beside many women. I am proud to have served in combat myself." Nichols commanded Joint Contracting Command, U.S. Forces – Iraq during Operations Iraqi Freedom and New Dawn.

As an engineer, acquisition officer and then PEO for Solder from April 2011 to May 2012, Nichols said, she was able to help the warfighter and strengthen national defense. "I can think of no better place that I could have done my life's work than to serve in the military."

Nichols' education includes a Ph.D. in engineering management from George Washington University, an M.S. in national resource strategy from the National Defense University, an M.A. in national security and strategic studies from the Naval War College, an M.S. in systems management from the University of Southern California and a B.A. from West Point.

Her awards and decorations include the Distinguished Service Medal; Defense Superior Service Medal (with two bronze oak leaf clusters (OLCs)); Legion of Merit (two bronze OLCs); Bronze Star Medal; Defense Meritorious Service Medal (one bronze OLC); Meritorious Service medal (one silver OLC); Army Commendation Medal (two bronze OLCs); Army Achievement Medal; Parachutist Badge; and Air Assault Badge.

## *DASA FOR RESEARCH AND TECHNOLOGY (DASA(R&T))*

### NEW DASA(R&T) AND ARMY TOP SCIENTIST SELECTED

**Dr. Thomas P. Russell** was appointed as the DASA for research and technology (DASA(R&T)) and Army chief scientist on Dec. 11, 2016.

He is responsible for policy and oversight of the Army's R&T program, which spans 16 laboratories and research, development and engineering centers; employs nearly 12,000 scientists and engineers; and has an annual budget that exceeds $2.4 billion. He is charged with identifying, developing and demonstrating technology options that inform and enable effective and affordable capabilities for the Soldier.

Russell had been serving as the acting DASA(R&T) and Army chief scientist since April 2016. Previously, he served as director of the U.S. Army Research Laboratory (ARL); director of the Air Force Office of Scientific Research (AFOSR); director of the Aerospace and Material Sciences Directorate, AFOSR: and director of the Research, Development, Testing and Evaluation Directorate at the Naval Surface Warfare Center.

He has a Ph.D. in chemistry from the University of Delaware and a B.S. in chemistry from Muhlenberg College in Pennsylvania. He is Level III certified in engineering, a member of the Army Acquisition Corps (AAC) and a recipient of the Navy Superior Civilian Service award.

### NEW DIRECTOR FOR TECHNOLOGY

**Jeffrey D. Singleton** was selected for the SES and assigned as the director for technology for the DASA(R&T), effective Jan. 22.

Singleton has spent more than 30 years in federal service, most recently as the Army's director for basic research and educational outreach in the Office of the DASA(R&T). He has also served as a research engineer with ARL and the U.S. Army Aviation Systems Command, which later was folded into what became the Army Aviation and Missile Life Cycle Management Command.

He holds an M.S. and a B.S. in aerospace engineering from the Georgia Institute of Technology and West Virginia University, respectively. Singleton is a recipient of the DA Superior Civilian Service Award; the ARL Honorary Award for Leadership; and the American Helicopter Society International Howard Hughes Award as team leader for the Army/NASA/Bell Quad Tiltrotor Aeroelastic Test Team. He has authored more than 60 journal articles, scientific conference publications and invited presentations.




## U.S. ARMY COMMUNICATIONS-ELECTRONICS COMMAND

### 1: CECOM ILSC DIRECTOR PROMOTED TO SES

**Liz S. Miranda**, director of the U.S. Army Communications-Electronics Command (CECOM) Integrated Logistics Support Center (ILSC), was selected to the SES on Jan. 8.

Miranda serves as the command's senior leader in developing a vision, strategy and implementation plans to achieve an integrated enterprise approach to logistics for command, control, communications, computers, intelligence, surveillance and reconnaissance weapon systems.

She provides leadership and guidance to a global organization of more than 2,000 employees in more than 20 countries and 100 sites, with an annual budget in excess of $1.2 billion. She leads the eight ILSC directorates in core competencies of national inventory control point, national maintenance point, life cycle and logistics support planning, production and industrial base management, field training and technical assistance, performance-based logistics, security assistance to allied nations and communication security logistics.

She holds an M.S. in management from the Florida Institute of Technology and a B.S. in business administration with concentration in accounting from the University of Puerto Rico. She is a member of the AAC, the American Society of Military Comptrollers and the Armed Forces Communications Electronics Association. She is Level III certified in business cost estimating and financial management and is Level 3 certified in DOD financial management.

## U.S. ARMY TACOM LIFE CYCLE MANAGEMENT COMMAND

### 2: ACTING EXECUTIVE DIRECTOR NAMED AT TACOM ILSC

Officials with the DA Senior Executive Talent Management Program appointed **Marion G. Whicker** as acting executive director of the TACOM ILSC at Detroit Arsenal in Warren, Michigan, effective Feb. 19.

"Ms. Whicker will oversee the readiness of the majority of Army maintenance, fielding, new equipment training, supply chain management and systems readiness," said **Brian Butler**, TACOM's deputy to the CG. "She has the full confidence and support of the TACOM commanding general and myself, and we look forward to what will most certainly be her positive contributions to the command."

The TACOM ILSC sustains warfighting readiness and manages a large part of the Army's investment in warfighting capacity, integrating nearly 3,000 weapon systems. The ILSC's approximately 3,500 active-duty Soldiers and Army civilians are charged with complete life cycle support of aircraft armaments, small arms, field artillery, mortars, tools and training systems, tactical vehicles, light and heavy combat vehicles, watercraft, Soldier biological-chemical systems, and deployment and support equipment.

Before this appointment, Whicker served as the command's deputy chief of staff since March 2015. A career Army civilian since 1984, she has held numerous supply chain, fleet planning, project management, asset management, fielding and training leadership and fiscal planning positions and is regarded as one of the Army's premier logisticians. A member of the AAC, she holds the Army's highest certification in life cycle logistics.

Whicker has an M.S. in administration with a concentration in leadership from Central Michigan University and a B.A. in business administration from Iowa Wesleyan College.

## PEO ENTERPRISE INFORMATION SYSTEMS

### 3: NEW CHIEF OF STAFF AT PEO EIS

**Col. Kevin Stoddard** became the new chief of staff to the program executive officer for Enterprise Information Systems (PEO EIS) in October 2016. Stoddard has a broad range of executive leadership responsibilities involving life cycle development, acquisition, testing, product improvement, fielding and sustainment of PEO EIS capabilities. He most recently served as the director of contracting for the deputy assistant secretary of the Army for procurement.




### 1: NEW PEO EIS APEO

**Col. Mike Sloane** was introduced as the new assistant program executive officer (APEO) for PEO EIS in November 2016. His responsibilities, include program management of more than 30 DOD and Army acquisition programs across the business and enterprise information environments with a special focus on enterprise resource planning systems.

Immediately before his position as APEO, Sloane served as chief of staff to the ASA(ALT).

### 2: PL WESS PROMOTED TO COLONEL

**William N. Phillips, Lt. Gen., USA (Ret.)** and former military deputy to the ASA(ALT), administers the oath of commissioned officers to **Col. Joel D. Babbitt**, the product lead for Wideband Enterprise Satellite Systems (PL WESS). The ceremony was held Jan. 17 at Fort Belvoir, Virginia. Babbitt, a regular contributor to Army AL&T magazine (see "The Multilingual PM," Page 111), will serve as PL WESS until July, when he reports for Senior Service College. (Photo by Racquel Lockett-Finch, PEO EIS).

### 3: ASSUMPTION OF CHARTER FOR NEW PROGRAM

**Michael Padden**, project manager for Installation Information Infrastructure – Communications and Capabilities at PEO EIS, hands the charter of the Product Manager for Defense Cyber Operations (DCO) to **Lt. Col. Scott Helmore** at an assumption of charter ceremony Dec. 8, 2016, at Fort Belvoir. DCO is a new program within PEO EIS. (Photo by Racquel Lockett-Finch, PEO EIS).

## *GENERAL OFFICER ANNOUNCEMENTS*

*The chief of staff, Army, announces the following officer assignments:*

**Maj. Gen. Paul C. Hurley Jr.**, CG, 1st Sustainment Command (Theater), U.S. Army Central, Fort Bragg, North Carolina, and Kuwait, to CG, U.S. Army Combined Arms Support Command and Sustainment Center of Excellence and Fort Lee, Fort Lee, Virginia.

**Maj. Gen. Walter E. Piatt**, director of operations and director of rapid equipment fielding, Army Rapid Capabilities Office, Office of the ASA(ALT), Washington, to CG, 10th Mountain Division (Light) and Fort Drum, Fort Drum, New York.

**Brig. Gen.(P) Robert L. Marion** assumed duties as the ASA(ALT) director for acquisition and systems management on Jan. 17, replacing **Maj. Gen. L. Neil Thurgood**, who is now serving as deputy CG for support for the Combined Security Transition Command – Afghanistan.

*The following general officer was promoted to the rank indicated below in January:*

**Maj. Gen. Kurt J. Ryan**, currently serving as CG, Military Surface Deployment and Distribution Command, Scott Air Force Base, Illinois.

*The following general officer was placed on the retired list effective Jan. 1:*

**Maj. Gen. Kevin G. O'Connell** completed more than 34 years of service, culminating as CG, U.S. Army Sustainment Command, Rock Island Arsenal, Illinois.

THEN & NOW
1971, 1988, 2017


# NOBODY, TAKE THE WHEEL!

Nearly 50 years ago, the Army began tinkering with driverless vehicles.

Almost every day we hear or read about advances in transportation technology—flying drones delivering packages over long distances, pilotless airplanes buzzing the skies, and driverless vehicles traveling across the country at 60 mph with a human "monitor" to be used only in case of emergency.

Vehicle manufacturers and large tech corporations around the globe are researching, developing and testing partially autonomous vehicles arrayed with cameras, lidar [light detection and ranging, a method of navigating by tracking light pulses], radar and GPS that would safely navigate, avoid obstacles and obey traffic signs. Their ultimate goal is to make completely autonomous vehicles, with passengers being the only human element.

But what we think of today as routine technology news would have seemed impossible nearly 50 years ago, when "WOW!" stuff was found mainly on "Star Trek" and in science fiction and spy movies and novels.

## EARLY AUTOMATION

"Army Depot Introduces Driverless Tractors" was the headline on a short article on Page 62 of the April 1971 edition of Army Research and Development magazine (a predecessor to Army AL&T). Ghosts "are driving tractors around warehouses at three U.S. Army depots these days," the article jokingly read. The explanation: The invisible drivers were actually "electronic controls" that guided the tractor on an electronic embedded track. It was one of the early uses of artificial intelligence in the logistics world. The U.S. Army Materiel Command was evaluating the driverless tractors at Sharpe and Sacramento Army depots in California and the Atlanta depot in Georgia. The Sharpe tractor was expected to save taxpayers about $28,000 annually (about $170,000 in 2017) in shipping and receiving costs "and many times that if the current experiences are successful, leading to installation of the system at other Army depots."

Almost two decades later, when autonomous vehicles were becoming more advanced, an article on Page 14 of the July – August 1988 edition of Army RD&A Bulletin (a later name for this publication) reported that the Defense Advanced Research Projects Agency (DARPA), with support from scientists at the Engineers Research Institute, U.S. Army Corps of Engineers (now the Army Geospatial Center), was developing technology to create an autonomous vehicle with "smart" capabilities "to guide itself on a planned route over rough terrain, avoiding obstacles, and, if necessary, change its route." Now the Corps boasts many remotely operated vehicles that can operate on land, water and in the air. They are used in search-and-rescue missions, conducting dam inspections for earthquake damage and collecting

**REMOTE RECONNAISANCE**
TARDEC robotics engineers went to the Woomera Test Range in South Australia in October 2016 to evaluate the resiliency of a Jeep Wrangler Rubicon "driven" from across the globe by TARDEC engineers in Warren, Michigan. The research effort brings autonomous vehicles closer to the products first envisioned by the Army some 40 years ago. (Photo by Isiah Davenport)

geospatial data—such as the Yeti robotic rover, whose ground-penetrating radar has been used to examine polar terrain for dangerous ice cracks and crevasses.

Though the Autonomous Land Vehicle project was an ambitious program, it wasn't until DARPA's first Grand Challenge, in March 2004, that technology had evolved sufficiently to really begin to achieve that earlier vision. At the DARPA Urban Challenge of 2007, some of today's players in self-driving cars were major sponsors of team efforts. Google, for example, was a sponsor of the second-place Stanford Racing team. The continuing competition among these players is bringing more sophisticated technology to bear in efforts to produce a completely autonomous vehicle.

## DRIVERLESS FROM AFAR AND DOWN UNDER

Ten years on, Army autonomous vehicles are emerging that will be operated remotely, from anywhere on Earth, during future military operations.

Consequently, speed and recovering from enemy electronic warfare attacks will become top priorities, according to a story published Oct. 6, 2016, by Jerome Aliotta of U.S. Army Tank Automotive Research, Development and Engineering Center (TARDEC) Public Affairs.

The article describes how, in late 2016, TARDEC robotics engineers traveled to the Woomera Test Range in South Australia to continue work begun in 2015 on the Trusted Operation of a Robotic Vehicle in a Contested Environment, a joint multiyear program to evaluate the resilience of autonomously operating a vehicle from across the globe—in this case, by other TARDEC engineers in Michigan. At Woomera, TARDEC engineers tested their robotic vehicle, a modified Jeep Wrangler Rubicon running the Robotic Technology Kernel, TARDEC's autonomous mobility system. This was coupled with an Australian-developed satellite-on-the-move system to transfer data between a control station and the moving robotic vehicle.

Although the data from the experiment is still under review, TARDEC engineer Keith Briggs confirmed for the article success with the autonomous vehicle's pathfinding algorithms and its ability to get up to operationally relevant speeds with minimal operator takeover. "With improvements in path planning, material classification and possibly utilizing a priori data, we expect to get the vehicle speed up in the near term," Briggs was quoted as saying.

## CONCLUSION

At General Motors' Futurama exhibit at the 1939 World's Fair in New York, the automaker envisioned "abundant sunshine, fresh air and fine green parkways upon which cars could drive themselves."

Now, almost 80 years later, that vision of a driverless world (and a whole lot more) may soon become a reality. In an interview with ZDNet.com, Jim McBride, Ford's autonomous vehicles tech lead, calls the coming developments "a paradigm shift"—a transition to driverless vehicles very similar to the transition from horse-drawn carriages to automobiles in the late 19th century.

For a historical tour of Army AL&T over the past 56 years, go to the Army AL&T Magazine archives at **http://asc.army.mil/web/magazine/alt-magazine-archive/**.

***—MR. ROBERT E. COULTAS***

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**Paul Scharre**
*Senior fellow and director of the Future of Warfare Initiative at the Center for a New American Security*
**Page 91**

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