ARMY AL&T

EXPERIMENTATION

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says it's essential to 'go deep'

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FEATURES

ON THE COVER
From technology to prototypes to human behavior, a look at how the Army embraces experimentation for effective acquisition.

FEATURES

100

119

152

From the Editor-in-Chief

Since joining Army acquisition back in 2010, I've routinely heard the old engineering adage: "Faster, better, cheaper: Pick two." The basic premise is that any two choices negate the third. But there is another way to look at those three parameters, and that's from the perspective of getting needed capabilities into the hands of warfighters sooner given world events and economics. And here, you get only one choice. In a period of huge defense budgets and seemingly never-ending conflict, "faster" rules.

At such times, much effort goes into rapid fielding initiatives like those associated with special operations forces and their time-sensitive needs. While such initiatives are good at getting needed equipment to the field, turning them into Army-level requirements to meet institutional Army needs proves difficult.

Less conflict and tighter budgets mean that "cheaper" rules the day. You get there by reducing the workforce, reducing the quantity of materiel, extending timelines, decreasing services, decreasing budgets or delaying much-needed updates—yet the Army still needs high-quality equipment to perform its mission and build for the future.

Then, there is the great middle ground of "better," when the world is at relative peace and economic times are good. In this perfect world scenario, the Army delivers a good solution at a reasonable pace and cost. Not the fastest, not the cheapest, but better overall.

But what if there were a way to have it all? The holy grail for achieving the nirvana of faster, better, cheaper just may be the very theme of this magazine: experimentation. No, we're not talking about mad scientists in labs with shrink rays (maybe in a later issue?). Rather, we're talking about what Army leadership and others have been saying for some time now: Fail early. Disrupt the current overly cautious development process and employ experimentation, technical demonstrations and prototyping early in development to see if a solution works the way we want it to. "Off-ramping," or fixing projects as needed, can speed up acquisition to get capabilities into the hands of warfighters sooner. Done correctly, experimentation is the critical path by which faster, better and cheaper can coexist.

Everyone in leadership wants to see the current, industrial-age, linear model that takes so long to deliver fade into history.

In the words of Lt. Gen. Paul A. Ostrowski, the principal military deputy to the Army acquisition executive, "I've got to get that capability out there faster. I've got to think of innovative ways to do so." Experimentation may be the way.

In this issue, hear from Dr. Alexis Lasselle Ross, the new deputy assistant secretary of the Army for acquisition reform, as she

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discusses her work with the task force shaping the Futures Command, which will take experimentation to a whole new level ("From Quick Wins to Deep Change," Page 14). Talk about experimenting with a concept right from the start—join the Army Rapid Capabilities Office and the U.S. Special Operations Command in early assessments of new or emerging position, navigation and timing technologies from defense industry, tech startups and academia in "On the Ground Floor," Page 20. Finally, the Network Integration Evaluation exercises adopted experimentation early on in an operational setting. In "Starting With an Ending," Page 50, learn how the Army is transitioning from the old Network Integration Evaluation concept to the new Joint Warfighting Assessment model to assess experimental capabilities, help evolve mission command capabilities and network strategy, and shape requirements.

Not only are these exciting times in Army acquisition, but for Army AL&T magazine as well. On behalf of the secretary of the Army, the Office of the Chief of Public Affairs acknowledged this magazine as the Best Publication in the Army, as selected in the 2017 Maj. Gen. Keith L. Ware Communications Awards Competition. This is but one of many awards Army AL&T has garnered over the years. While the magazine gets the award, the real winners are the numerous contributors across the Army that take the time to tell their stories so that others may learn and understand what our acquisition professionals do, day in and day out, to ensure that our Soldiers have the very best. Next stop: the annual DOD Defense Media Awards. Wish us luck!

If you have a story idea or an actual story you would like to share, please contact us at **ArmyALT@gmail.com**.

Nelson McCouch III
Editor-in-Chief

BUILDING
the ARMY *of the*
FUTURE

Army acquisition has an opportunity to make its voices heard at this critical juncture

A recruiting commercial for the U.S. Army encourages young viewers to "join the team that makes a difference." It says that "our next mission could be anything, so we prepare for everything." (You can view the commercial at ***https://www.ispot.tv/ad/w8ZT/us-army-prepare-for-everything#*** or ***https://www.youtube.com/watch?v=ovYhA26jK4Q***)

When I saw the spot, my thoughts turned to our unique and solemn responsibility, as leaders in Army acquisition, logistics and technology, of acquiring and providing the right materiel solutions to our Soldiers so they are always ready for any mission. They depend on us to get it right. Throughout the history of the Army Acquisition Corps and larger Army Acquisition Workforce, when given a set of requirements, we executed the acquisition function. If the requirements were overly ambitious, there likely would have been problems with cost, schedule and performance that hindered overall program success.

Now, as the Army's cross-functional teams and the Army Futures Command come online, we have a seat at the table to help generate aggressive yet viable requirements before executing them. If something doesn't look right from an acquisition perspective, we have the responsibility to make our voices heard.

PARTNERS IN PRODUCT IMPROVEMENT
Jette, center, and Lt. Col. Joseph Novak, left, receive a briefing from Nathaniel Klein, right, of Army Benét Laboratories, about product improvements for cannon systems on May 8 at Watervliet Arsenal, New York. Novak is with the Program Executive Office for Ground Combat Systems. (Photo by John Snyder, Watervliet Arsenal)

A SOLID FOUNDATION

We have an important role in modernizing our materiel capabilities to ensure continued near-term dominance while building the Army of the future, guaranteeing that it is on a solid foundation.

We must create an environment in which teaming, agility and rapid user feedback are integrated early to improve the decision-making process and overall program success. Close and continued collaboration with the cross-functional teams as well as our stakeholders in industry will be critically important in delivering capabilities to Soldiers—fast.

It is important at the early stages to include discussion of intellectual property (IP) and to negotiate prices for necessary technical data to support Army weapon systems. Not only will we need

the ability to upgrade our programs of record, but sustainers will need the ability to maintain and fix components on the fly. We need to know what IP we need and what we do not. I will provide a separate article addressing just this in a coming issue.

DECISION-MAKING AND COMPETITION

Along these lines, we are empowering and trusting subordinates to do what is best for the Army. Senior leaders must set the example by allowing their staff members to do their jobs, to make decisions, to manage risk and to execute at the lowest possible level.

This requires good leaders to be good mentors who outline acceptable and unacceptable risk, then patiently grow subordinates. If you find there are ways to accelerate a program, let

leadership know. If you find policies that are cumbersome or don't make sense, tell someone so we can correct them.

To increase competition, decrease costs and gain access to innovative technologies, we are seeking to leverage the talent of small, aggressive companies with revolutionary approaches to the challenges we face. Private sector innovation, especially from nontraditional sources, is critical to the Army's future.

In testimony to Congress on two occasions, I stated that there are about 5,000 government contractors but about 23 million corporations in the United States. We must make it attractive to do business with us. At the assistant secretary of the Army for acquisition, logistics and technology, we are working to develop new outreach programs like a "Shark Tank" as a catalyst for the Army to engage with the nontraditional business sector, and to create mechanisms that greatly simplify the process for a small business doing their first business with us.

In line with the experimentation theme of this edition of Army AL&T, through our cross-functional teams, we are using technical experimentation and demonstrations, in conjunction with increased engagement with industry and commercial sector partners, to inform prototype development and reduce the requirements process.

Prototyping and experimentation not only provide faster solutions to fulfill operational needs, but also serve to inform by

THE MORE IDEAS, THE BETTER
The Army is considering four vehicles in a competition to fill the role of the Squad Multipurpose Equipment Transport, to transport 1,000 pounds of gear that Soldiers now carry, and thus increase the Soldier's operational agility. Competition is a goal in itself for Army acquisition, to reduce costs and broaden access to innovative technologies. Clockwise from upper left are the RS2-H1 system developed by Howe and Howe Technologies Inc., HDT Global's Hunter WOLF, the Multi-Utility Tactical Transport of General Dynamics Land Systems and the MRZR X system from Polaris Industries Inc., Applied Research Associates Inc. and Neya Systems LLC. (U.S. Army photos)

helping us obtain Soldier feedback earlier in the development cycle. The bottom line is speed in getting needed capabilities to Soldiers with a well-thought-out experimentation plan. Speed without valuable output is a waste of time and money. A negative result can be very useful if answering a planned thesis.

In the National Defense Authorization Act for Fiscal Year 2016, Congress provided authority for the Department of Defense to use alternative processes to foster innovation, including establishing a "middle tier" of acquisition programs to rapidly prototype and field programs within two to five years. With this authority, there is significant flexibility compared with the

My objective is to empower and enable our workforce professionals to think differently and act appropriately to deliver real value.

AIMING HIGHER
The Gray Eagle unmanned aircraft system enables combatant commanders to conduct long-dwell, persistent-stare, wide-area reconnaissance, surveillance, target acquisition, communications relay and attack missions. The U.S. Army Research Laboratory (ARL) has partnered with industry and academia to improve the performance and efficiency of the Gray Eagle and unmanned vehicles even further with the creation of the Center for UAS Propulsion, part of ARL's Open Campus. (Photo by Sgt. Ken Scar, 7th Mobile Public Affairs Detachment)

Joint Capabilities Integration and Development System process and "DOD Instruction 5000.02, Operation of the Defense Acquisition System." Rapid prototyping can lead to rapid acquisition. Let's take advantage of this authority wherever possible.

A well-planned other transaction authority can facilitate this transition. We are also exploring other innovative contracting methodologies such as cost-plus, fixed-price incentive fee, and other options, including the right contracting mix for the work we are trying to accomplish. It is important to know contracting and your contracting officer well. It is, ultimately, the program manager's responsibility.

CONCLUSION
A ready and modernized Army is critical to defend the nation. We must continue to improve our acquisition process, and for that we will continue to depend on our people—the Army's greatest asset.

My objective is to empower and enable our workforce professionals to think differently and act appropriately to ensure that our organizations, policies, processes, and tasks that consume time, money and manpower deliver real value. 🏴

Senior leaders must set the example by allowing their staff members to do their jobs, to make decisions, to manage risk and to execute at the lowest possible level.

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- *Major General Harold J. Greene*

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FACES
of the
FORCE

MR. SCOTT M. BRADY

COMMAND/ORGANIZATION: Medical Communications for Combat Casualty Care Product Management Office, Program Executive Office for Enterprise Information Systems

POSITION AND OFFICIAL TITLE:
Assistant product manager

YEARS OF SERVICE IN WORKFORCE:
12.5

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

EDUCATION: MBA with specialties in finance, public management and human resources management, Hood College; Graduate Certificate of Science in marine biology, James Cook University; B.S. in computer engineering, Georgia Institute of Technology; Project Management Professional certification

AWARDS: Commander's Award for Civilian Service (3); Achievement Medal for Civilian Service (3); Army Medicine Wolf Pack Award

Finding acquisition skills in unexpected places

Cat herder, line dancer, program manager. Rarely are those six words in one phrase of any kind, but for Scott Brady, they form the core of his approach to supporting the Theater Medical Information Program – Joint (TMIP-J) for the Program Executive Office for Enterprise Information Systems (PEO EIS).

As assistant program manager for TMIP-J, which is part of the Medical Communications for Combat Casualty Care Product Management Office, he's helping to oversee the materiel release and fielding of the last planned version of the legacy electronic health record for operational medicine. In addition, he manages integrated product teams (IPTs) from a variety of specialties, organizations and locations, provides overall program direction and briefs the milestone decision authority on progress.

"As an IPT lead, I herd cats," he said. "Cats are patient and smart. But they are easily distracted and do not automatically coordinate efforts effectively. They're also the scientists of the animal kingdom, periodically pushing items off the counter for no other reason than to verify that gravity is still a thing."

Brady's role is to provide direction and focus. "When a cat gets distracted, I attempt to determine if the string that one cat is focused on is a string that we all should be pulling, or if their efforts should be redirected. As an IPT lead, I'm also looking externally to determine if the environment has changed enough that it makes sense that we should do another gravity check, or if that test is simply a waste of resources."

Brady got his start in acquisition nearly 13 years ago, when he was hired as a logistics engineer for the U.S. Army Medical Materiel Agency (USAMMA). "The more I know about the government's hiring process, the less I understand how I landed my first job," he said. After running out of funding while pursuing a master's degree in marine biology in Australia, Brady decided to pursue a career that would leverage

his undergraduate engineering degree. An online search led him to USAMMA. The work—organizing environmental tests for medical equipment and ensuring that the correct items were included in the startup kits for major medical end items so deployed units could use the devices immediately on the battlefield—was not what he expected. "I had an engineering degree and wanted to work more on engineering than in logistics, but I decided to give it a year before looking to leave," he said.

During that year, the biomedical engineer on the team left and Brady unofficially took over those duties, working with companies on modifying commercial off-the-shelf items for a deployed environment. "It still wasn't what I would consider true engineering work, but I enjoyed it," he said. Not long after, USAMMA became a life cycle manager for medical devices after a reorganization of the U.S. Army Medical Research and Materiel Command. Brady officially transitioned to a biomedical engineer position and began managing acquisition programs through milestones B and C, full-rate production, deployment and sustainment. "I found that work challenging and rewarding," he said.

When he's not at work, Brady is involved in a variety of activities, including line dancing, strategy board games and scuba diving. It's an eclectic mix, and there's considerable crossover to his work for PEO EIS. "Having varied interests and being able to rapidly switch between them helps with managing an IPT, because there are so many moving pieces and you can't just focus on one aspect and expect to be successful," he explained.

Take line dancing, for example. "With line dancing, there are specific choreographed steps for each dance. Like DOD Instruction 5000.02, those steps provide the framework for accomplishing the task and also allow for some variation," he said. "Maybe a dance calls for a grapevine to the left, but a turning grapevine might also work. But there may be someone to my left who's not quite keeping up. Should I continue the grapevine to the left and run into the other person, or should I just walk in place so as to not cause a collision?"

And those board games? "Both acquisition and strategy games have many moving pieces, and the better you can keep track of all of the different aspects of what's going on and change your strategy

to adapt to changing conditions, the better your likelihood of being successful," Brady said.

Earlier this year, Brady completed the Competitive Development Group (CDG), a three-year developmental program that provides members of the Army Acquisition Workforce with expanded training through educational, leader development and broadening assignments. Through the program, he's seen a broad swath of acquisition, transitioning from managing the acquisition of medical devices to managing the development of chemical defense pharmaceuticals to treat nerve agent poisoning, then serving as a DA system coordinator for the Integrated Air and Missile Defense Battle Command System before taking on his current role at PEO EIS.

"The CDG program reinforced—for me and others I worked with—that acquisition is acquisition, and the same skill set is required whether you're managing a missile system, an information technology system or the development of a new medical device," Brady said. For him, acquisition boils down to three things: Know your people, know your product, and know DOD 5000.02.

"Whether it's a successful milestone review, getting buy-in from the Food and Drug Administration or securing POM [program objective memorandum] funding for a program that was below the cut line, getting a team to succeed in its mission is extremely satisfying," he said. "Celebrating small successes along the way to providing a capability to the warfighter makes being an Army acquisition professional meaningful."

—MS. SUSAN L. FOLLETT

ON THE SPOT
Brady, right, and Skip Boston, chief systems engineer for the Medical Communications for Combat Casualty Care (MC4) Product Management Office, at the U.S. Army clinic on the Kuwait Naval Base in January, during the initial fielding of TMIP-J 2.3.1.3. (Clinic information was removed from the board for security reasons.) TMIP-J manages the electronic health records used by military medical personnel in operational environments. (Photo by Michael McAllister, MC4 Product Management Office)
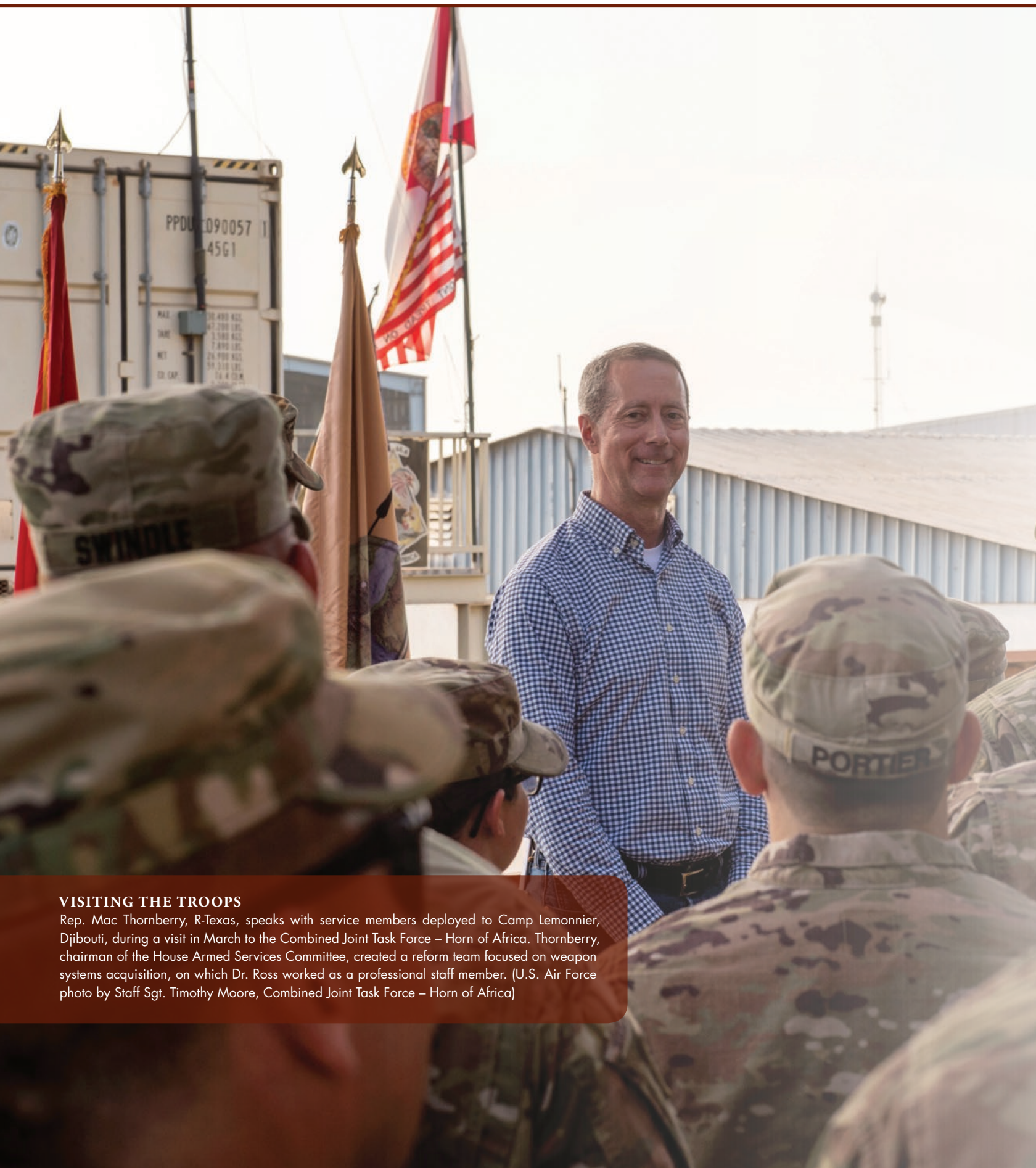
VISITING THE TROOPS

Rep. Mac Thornberry, R-Texas, speaks with service members deployed to Camp Lemonnier, Djibouti, during a visit in March to the Combined Joint Task Force – Horn of Africa. Thornberry, chairman of the House Armed Services Committee, created a reform team focused on weapon systems acquisition, on which Dr. Ross worked as a professional staff member. (U.S. Air Force photo by Staff Sgt. Timothy Moore, Combined Joint Task Force – Horn of Africa)

From QUICK WINS to DEEP CHANGE

The new DASA for acquisition reform discusses her work with the task force shaping the Futures Command, and why it's essential for reformers to 'go deep.'

Dr. Alexis Lasselle Ross

by Ms. Claire Heininger

For program managers, logisticians, financial experts and most others across the Army acquisition community, reform is a luxury—something they can get around to thinking about when, or if, there is a gap in their day jobs.

For Dr. Alexis Lasselle Ross, reform is the day job. And it's an all-consuming one. As the Army's newly created deputy assistant secretary of the Army (DASA) for strategy and acquisition reform, Ross is at the center of efforts to remake the Army modernization enterprise, as well as discussions about how those changes will actually be implemented by the practitioners who develop and supply weapon systems to Soldiers.

After authoring many recent reform proposals while serving as a professional staff member for the House Armed Services Committee (HASC), Ross moved into a Pentagon office this February, working right next door to the Army acquisition leaders who must translate that legislation into real-world institutional improvements. She says it's exactly where she wants to be.

LOOK TO THE FUTURES
Lt. Gen. Edward C. Cardon leads a roundtable session at AMC headquarters in April 2017. Ross works closely with Cardon and the Army Futures Command Task Force to develop the model of the new modernization enterprise, as well as related processes and policies. (U.S. Army photo by Elizabeth Behring, AMC)

"Reform is really just a good idea until it's been implemented," Ross said. "Until it's been implemented, and implemented well, it might not achieve its results. So I wanted to be on the other end of it—where you can drive for reform from within, and have an opportunity to see it through."

During an interview on April 25, Ross discussed her office's priorities for change, her work with the task force shaping the new Army Futures Command, and why it's essential for reformers to "go deep" in diagnosing, treating and perhaps eventually curing what ails the acquisition process.

Heininger: To start off, why did the Army create this position, now within the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA(ALT)), and how does it fit into the larger modernization goals of the Army?

Ross: As you know, two of the secretary of the Army's top priorities are modernization and reform, which warranted creating a deputy assistant secretary of the Army to spearhead acquisition reform. To place it in ASA(ALT) was the natural place to put it. My role is to operationalize the secretary's vision, and the way I do that job is by guiding reform initiatives from the early phases—the identification of a problem, the analysis of the issue—through to development of different policy options and alternatives, and then finally through implementation, which includes writing policy, revising regulations and communicating with the field about the change.

Heininger: Identifying a problem that's ripe for reform can come from different sources—it can be something the Army senses isn't working, or something written in legislation and Congress has told us, "You have to do this better." Can you elaborate on that?

Ross: Yes. The need for change—the idea that there is a need for change—comes from a lot of different sources. Oftentimes senior leadership wants to do something. Sometimes it's external sources, like the legislative branch, asking the executive branch to perform better. Sometimes it's our own observations from the field indicating that certain programs aren't working well. And it's not always problems—sometimes it's opportunities.

So my focus for this job is threefold. Right now, the Army is undergoing a large restructuring of its enterprise. So, that is one key area. Another focus of mine is that there are many additional improvements that can be made to our system and our processes. The restructuring will go a long way to streamline

Sometimes the quick and easy solution that might save you some money doesn't address the real problem.

things, but there are still core acquisition processes and functions that need to be looked at. The third focus is strategies targeted at areas of opportunity and ongoing, vexing challenges. Sometimes it's not just leadership saying, "Do acquisition better"—sometimes out in the commercial sector there are new ways of doing things that we can pull in.

Heininger: In terms of the restructuring of the enterprise, how much is this office serving as ASA(ALT)'s conduit for the changes that are taking place with the Army Futures Command and the cross-functional teams?

Ross: It's hard to talk about what the end state will look like, because it's an ongoing process and decisions are underway right now with the "Big Four" [the secretary of the Army, chief of staff of the Army, undersecretary of the Army and vice chief of staff of the Army]. I'm working routinely with the Army Futures Command Task Force, led by Lt. Gen. [Edward C.] Cardon, on developing the model of the new acquisition enterprise, which would entail the Futures Command, TRADOC [the U.S. Army Training and Doctrine Command], ASA(ALT), AMC [the U.S. Army Materiel Command] and others. And it truly is a whole new model. It's a whole new way of doing business, so a lot of work goes into deciphering exactly what parts of the current puzzle will go where. It's a team effort—there are a lot of people in ASA(ALT) that help with that and are right alongside me as we discuss things with the task force.

Heininger: Once those puzzle pieces do come into place, I would imagine you would have a role in helping to communicate those changes, new steps and new relationships throughout ASA(ALT) and the program executive offices.

Ross: When the Army Futures Command is finalized and [the details about its structure are] communicated, there will still be a lot more work to do. That's just the first step. There will be a domino effect, where everyone who was touched by that decision will then need to evaluate and perhaps alter their operations, missions, roles and functions. We will also have to look at all the related processes and how a program actually proceeds through the acquisition system, now that there will be a different partner involved. So there will be a lot of

> *There will always be an interest in immediate successes, and lots of times when senior leaders identify a problem they want a solution quickly, but sometimes you have to dedicate some time to really move the needle.*

work that this office will be doing in putting out policy and revising regulations accordingly—which is also a good time to look carefully at those processes and make sure they are as streamlined and as efficient as possible. That's what I mean when I say that second focus area is additional process improvements and improvements to the system.

Heininger: It's good that some of that work is happening pre-emptively, now, before the Futures Command officially stands up.

Ross: There is no interest in doing things slowly, that's for sure. To do it iteratively, to set up the structure and then determine better processes, [won't work]. It really needs to be done simultaneously.

Heininger: To switch gears and talk about your background, you spent time working for the Army previously, and as a professional staff member on Capitol Hill. Some of your time working in Congress was spent focusing on these exact issues of acquisition reform across the armed services. How does this issue look different from the outside and the inside to you, and why did you decide to come back now and work within the system to help make it better?

Ross: Several years ago, I started getting more attracted to reform work. My doctorate is in public policy, but a lot of the research had to do with how policy change happens, how the legislative and executive branches work together—the conflict and compromise that happens between those two branches in changing policy. I specialized in military pay and benefits, and used that as a case study. But it's all the same—you're studying the theory of how policy change happens.

Professionally, I got hooked on reform while at the Military Compensation and Retirement Modernization Commission, which reported out to the president and Congress on a new system for pay and benefits for the military and its beneficiaries.

That got me interested in really focused reform. I don't mean just process improvements or policy changes, but actually strong, systematic, fundamental shifts. When I learned that the HASC chairman was standing up a reform team to do just that,

it sounded kind of intriguing. They were doing weapons acquisition reform, which was a different application, but it's the same fundamental work.

[While working for the HASC], I got really involved in a lot of issues like intellectual property, the acquisition of services, and sustainment considerations early in the acquisition of a weapon system. By that point, after having worked reform in a couple of different settings and on a variety of issues, you start to see the trends and the themes, and you start to really specialize in that as a function. So I was approached to come here, to work for the secretariat to do this work, and I was intrigued because, one, I wanted to continue with reform. I really do enjoy it and wanted to specialize in it.

And two, I had not yet had the chance to work reform from inside an organization, which is very different. You can be in Congress and you can write a law to push reform onto an organization, but reform is really just a good idea until it's been implemented. Until it's been implemented,

and implemented well, it won't achieve meaningful, lasting results. So I wanted to be on the other end of it—where you can drive for reform from within, and have an opportunity to see it through.

Heininger: I know it's early in your tenure, but do you feel like you're getting to do that?

Ross: I do, because I feel like this is much more involved. Take a look at just one thing I'm working on, the Futures Command. There's a lot that goes into redesigning the Army enterprise. The Army Futures Command Task Force is fully engaged in a variety of implementation aspects, and so being able to participate in that is fulfilling.

Heininger: In that vein, this mission seems like a huge undertaking. How do you, with your staff, rank and prioritize what the office does first?

Ross: What you do first is the Futures Command, because that is of critical importance to the Army. It was already

When the Army Futures Command is finalized, there will still be a lot more work to do.

HOOKED ON REFORM
Sgt. Maj. Ronald Green of I Marine Expeditionary Force talks with representatives of the DOD Military Compensation and Retirement Modernization Commission at Marine Corps Base Camp Pendleton, California, in March 2014. Working at the commission, which reported to the president and Congress on a new military pay and benefits system, got Ross interested in systematic, fundamental reform. (Photo courtesy of I Marine Expeditionary Force)

underway before I got here, and it's a fast-moving train, so it's critical to put that first, to prioritize that, and to make sure that we have the best acquisition system for the Army.

Heininger: What comes next on the list, in terms of priorities?

Ross: There are a few things that we are working on simultaneously, including three that are of interest to [Army Acquisition Executive] Dr. [Bruce D.] Jette, that we've put a strong effort into right out of the gate. One is developing an Army policy on intellectual property [IP]. There's a requirement from Congress to develop a department-wide policy, so the Air Force and the Navy and OSD [the Office of the Secretary of Defense] are all coordinating right now on what the policy would be.

We need a balanced approach, one that meets the needs of both government and industry, because we can no longer expect commercial industry, especially innovative, nontraditional companies, to be responsive to our demand signal if their proprietary data is at risk. And, because the government needs to be able to exercise the option to have access to data it paid to develop.

We want to encourage the program managers to tailor their IP needs and requests based on a variety of factors and considerations—not only the unique characteristics of a weapon system, but also things like what the commercial market bears and what their product-support strategy is for that system. We want them to consider IP much earlier in the process, and we want to promote upfront negotiations, to ensure that both parties are really clear about what they need, what will be delivered, with what markings, when and at what price. And we need to encourage that conversation to happen early. Dr. Jette likes to say that "contracts and lawyers keep friends friends." So if you negotiate everything in good faith up front, everyone's on the same page, and there's going to a be a lot fewer disputes down the road.

The other thing we're working on is teaming up with the DASA for procurement, Mr. [Stuart A.] Hazlett, on services contracting. There are many service contracting initiatives going on at OSD and at the Army level, and there's going to be some quick wins. In addition to all that, he and I are looking at ways to do deeper, more significant reforms to address some of the underlying issues and factors in the contracting of services. That is a perfect example of the way I like to work and what this office will be doing. There will always be an interest in immediate successes, and lots of times when senior leaders identify a problem they want a solution quickly, but sometimes you have to dedicate some time to really move the needle.

You have to look at the system holistically and deeply, and you need to assess what the underlying causal factors are and what you can do to address those factors. Otherwise you're just treating the symptom of the disease.

The third initiative is data-driven decision-making. Dr. Jette is very interested in being able to make smart decisions at the enterprise level, but finds we lack a lot of the data we need to do that. The Department of Defense has a mountain of raw data. But the ability to access it, analyze it and use it for decisions is really limited. Today, if you want some information, if you want to understand something to make a decision, you have to do an old-fashioned data call. So Dr. Jette is very eager to develop some kind of mechanism where he can have access to more data. It's data transparency, but more than that, it's actually using the information in a way that enables real decision-making. We're far behind commercial industry in this. The private sector is able to use big data in a way that's fascinating.

Heininger: That distinction between quick wins and real change seems to be the great value of your office. You have the luxury of time and a dedicated team to look deeply at the system, whereas most acquisition professionals and practitioners have their own goals and missions to meet on a daily basis, so they don't get around to deep change.

Ross: Exactly. Deep change is different than quick wins. They are both worthy, complementary endeavors and can be done simultaneously. Also, sometimes people want savings, and that can be a very good reason to seek change, but it is not the only reason. I would argue that sometimes the quick and easy solution that might save you some money doesn't address the real problem. So I commend the secretary for creating this position, because at times like these, when a lot of change is needed and we have a resource-constrained environment and a lot of evolving threats, I think it's critical that you dedicate the resources to having a person with a small staff whose job it is to look at the system and the processes very carefully, to promote real change.

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GPS NO-GO ZONE

Muscatatuck Urban Training Complex in Butlerville, Indiana, offers an urban environment complete with more than 200 structures, subterranean tunnels, downed aircraft, a church and a bus station, among other useful features. The site served as the location for a SO-COM technical experimentation event March 26-29 in which the Army RCO led an assessment of new technologies to keep warfighters mobile and safe in environments where GPS doesn't work. (U.S. Army photos by Nancy Jones-Bonbrest, Army RCO)

ON THE GROUND FLOOR

Army RCO joins SOCOM in early assessments of new or emerging technology from defense industry, tech startups and academia.

by Ms. Nancy Jones-Bonbrest

On a rainy afternoon in March, technology developers gathered to show their latest position, navigation and timing (PNT) solutions. There were no traditional marketing brochures, trade show booths or giveaway trinkets. Instead, these developers—from big industry, tech startups and academia alike—were there to demonstrate emerging capabilities and get feedback directly from the operators who may one day use the technology on the battlefield if their GPS is ever jammed, tricked or dropped.

To carry out the event, organizers found a former Indiana state hospital, now a National Guard base with a 1,000-acre urban training complex that developers could use to assess their PNT technologies. They trekked through concrete subterranean tunnels, filled with several inches of water, weaving for 1.5 miles under structures that were both abandoned and still in use. They drove across rocky terrain, on paved roads with traffic circles and overpasses, and through mock villages. They navigated their way on foot

PNT IN MOTION

Mounted special operators drive through a village center at the Muscatatuck Urban Training Complex during the SOCOM-led technical experimentation event in March. The Army RCO was a partner in the event, assessing PNT technologies that operate in a GPS-denied environment. Nine technology developers participated in the PNT assessment with capabilities for both mounted and dismounted Soldiers.

through an old prison complex, a collapsed parking garage and a five-story hospital. A variety of scenarios brought the technology to life, providing the next step in assessing it beyond a PowerPoint presentation or white paper.

Dubbed a technical experimentation, this event was one of several that occur throughout the year to rapidly assess the technical maturity and possible use of new or emerging technology based on specifically identified areas of need. While technical experimentations are business as usual and have been for more than a decade at the U.S. Special Operations Command (SOCOM), for the Army it marked a pivotal first, with its Rapid Capabilities Office (RCO) leveraging the event to lead the PNT excursion. This is just one of many avenues the Army is looking at through the eyes of SOCOM to gain insight into streamlining acquisition processes. (For more on the SOCOM acquisition model, see "Aggressive. Innovative. Fast," Page 112.)

"The Army participated in these events in the past as assessors or evaluators, but this is the first that we know of where we were able to lead a portion of the event, in this case PNT," said Rob Monto, director of RCO's Emerging Technologies Office. "SOCOM took a leap of faith and partnered with us because it was a technology they were interested in as well. So it set up this unique collaboration that was beneficial for both, and we hope will lead to future joint efforts."

Among the more than 200 buildings, abandoned cars and rubble that make up the Muscatatuck Urban Training Center in Butlerville, Indiana, the Army RCO led the PNT portion of SOCOM's Technical Experimentation 18-2, which took place March 26-29. While the RCO evaluated PNT technologies, the SOCOM event was much larger, evaluating such things as optics, biometrics, advanced sniper rifles and cognitive enhancement as well.

The technical experimentations bring together the users, the program offices and the technology developers to evaluate promising new capabilities in a flexible, unclassified, operational environment. These events, which SOCOM holds a few times each year, allow for detailed user feedback and discovery of new or emerging technologies while also promoting information exchange and risk reduction.

"I talk about this three-legged stool, where, if you don't have all three players involved, you're going to have some level of disappointment," said Dan Bernard, the SOCOM acquisition, technology and logistics lead for the technical experimentations. "The technology developers are essentially showing their kit to the user and the program offices at the same time. We're looking at early development. It does no good to do this with finished products. That's just shopping."

'LOW THRESHOLD OF ENTRY'
Falling under the Special Operations Forces Acquisition, Technology and Logistics Center, the technical experimentation events take place at military sites across the country. They focus on various technology areas of need, identified by the SOCOM service components and program offices. Having identified a need, SOCOM posts a request for information (RFI) for the experimentation event on the Federal Business Opportunities website. Anyone interested in participating simply responds to the RFI. After the event, the participating companies receive detailed assessments of how their technologies performed.

"We treat everyone like they are our customers and we want everybody to go home satisfied, feeling like they got something out of it," said Bernard. "We're doing this early in the development process. So if there's a company pursuing a

SEEKING NEW SOLUTIONS
Having navigated to the top of a partially collapsed parking garage, an operator uses a dismounted device to check position and time. The scenarios for those demonstrating dismounted systems also incorporated a subterranean tunnel and multilevel jail. The technologies for dismounted service members included one that uses an inertial navigation unit worn on the foot and communicates with a smartphone via Bluetooth.
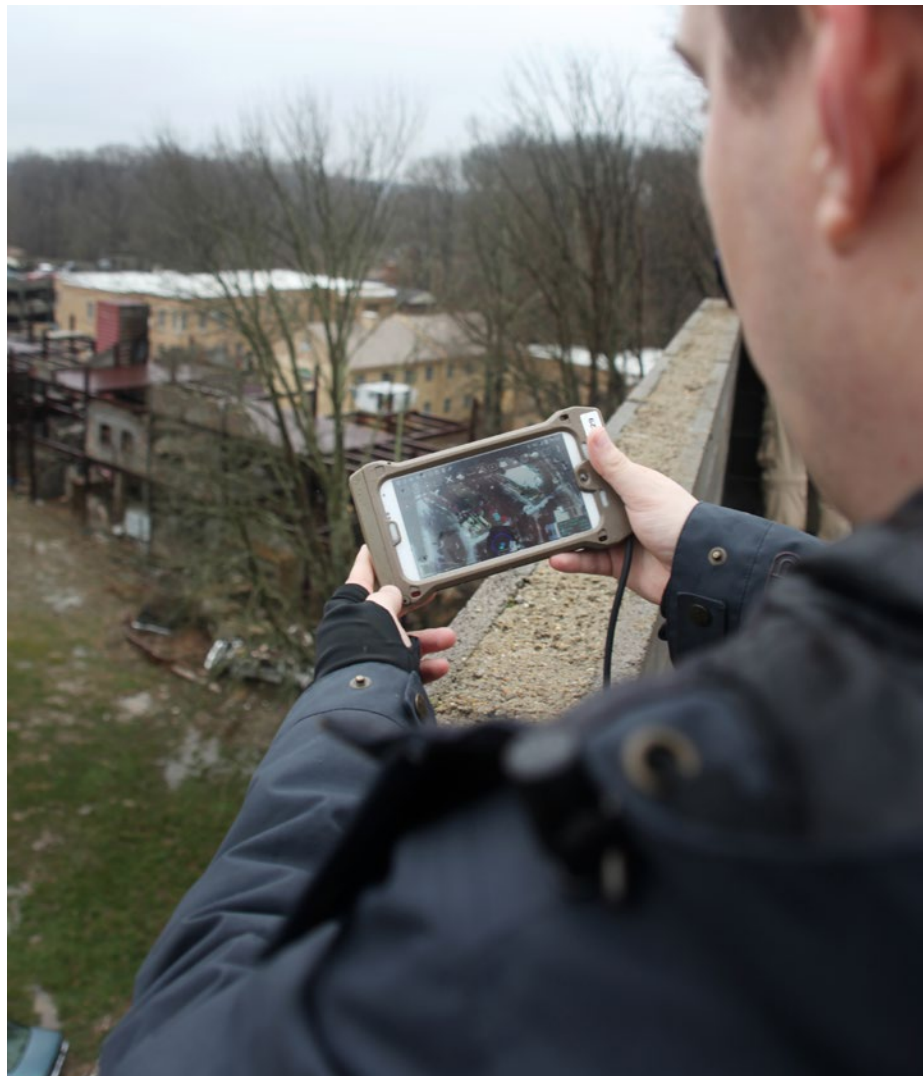
technology and they get this sound bite from an operator—that can really help to shape their thinking.

"Feedback could be, 'It needs to be lighter,' or, 'This is great, but if I have to carry that, then something has to come out of my rucksack,'" he explained. "That's news to a lot of people. If you are a tech developer, you're thinking, 'This is a cool thing, and I don't understand why they don't want to carry it.' But they have to understand that it is going to have to be good enough to replace something [Soldiers] are already carrying."

This feedback, combined with the three-pronged approach of having the program offices, users and developers working together in one place at the same time, is what attracted the Army RCO to participate, Monto said. "This is a low threshold of entry, where you have very small tech companies standing shoulder to shoulder with traditional defense companies, and you can assess the technology in an operational environment with the actual users," he said. "Being able to participate in this SOCOM-led event meant the Army could determine if the capabilities were tangible now, while also giving us a better understanding of what technologies are out there."

The SOCOM technical experimentation provided the ideal venue to host an initial RCO "burn-off" event. Both the SOCOM event and RCO burn-offs emphasize the value of bringing together commercial capabilities or emerging technologies in an operational demonstration to size them up against a set of criteria with a very low barrier to entry and without the pressure of a formal test. By being able to use the SOCOM event, the RCO can better prepare for its first solo burn-off, expected later this year.

'DOES SOMEBODY … WANT TO USE IT?'

Technologies demonstrated during the PNT portion of the technical experimentation included radio-frequency range finding, atomic clock systems and inertial navigation unit technology. Each presented innovative ways to overcome jamming, which occurs when an adversary overpowers signals from GPS satellites so that receivers in certain areas cannot operate, and spoofing, or tricking a GPS receiver into calculating a false position.

In the driving rain at Muscatatuck, mounted operators attempted to keep their vehicles on course without GPS while driving through various scenarios and settings. The different scenarios helped the Army measure technology performance and run comparisons, since one solution might do well driving around a planned course but drop in performance on a rough patch of road or an unplanned detour. Similarly, while a dismounted system could perform well for Soldiers climbing the stairs of the parking garage, it might not do as well within an enclosed concrete tunnel. Yet for a Soldier using the technology, all situations are relevant.

To track the results, the RCO provided a GPS logger that recorded the ground-truth data to compare against the log files of the demonstrated systems. Additionally, they took distance and location measurements for the buildings and tunnels where GPS was not available.

In all, nine developers participated in the PNT portion of the technical experimentation at Muscatatuck. They demonstrated technology that included, for example, a mounted device with a PNT-reliant system that can operate despite GPS disruption by using inertial measurement units and precision timing technology. The device combines PNT functions typically achieved through multiple independent systems.

Another company demonstrated a dismounted system that uses an inertial navigation unit that users wear on the foot. It communicates with a smartphone via Bluetooth and uses robust algorithms to communicate during failures and dropouts.

A third showed how three antennas prepositioned on the rooftops of nearby buildings provided triangulation to enable radio-frequency ranging for both mounted and dismounted operators.

The Georgia Tech Research Institute assisted in developing the various demonstration plans and provided quantitative analysis of the data collected. "At an event like this, you get two things. On one side, you get the quantitative analysis that we are doing, and that answers, does this system really work? Does it actually provide position with some reasonable amount of accuracy?" said James Perkins, principal research scientist with the institute. "But I think the other side you get is the operational side: So, does somebody who is a boots-on-the-ground Soldier actually want to use it? Seeing the operational perspective and seeing what real operators think about a system is important early in the development."

CONCLUSION

As the RCO uses different burn-off events throughout the year to determine if a new technology can be used to meet a specific need, it has gained important experience from the Muscatatuck event and anticipates partnering again with SOCOM.

For industry, the burn-offs provide a chance to showcase capabilities and receive formal and informal feedback. For the Army, they yield a greater awareness of what promising new technology is available now and how it performs under different conditions. The PNT project manager and the Army Futures Command's cross-functional team also participated at Muscatatuck to facilitate potential future capability efforts, which can help build unity of effort to enable faster, more streamlined modernization efforts.

"Bringing the Soldier and developer together early on allows the Army to speed up the requirement development process," said Benjamin Pinx, product director in the Emerging Capabilities Office of the Project Manager for PNT. "During this particular event, we received immediate feedback from our dismounted operators and learned a lot. What we learn in these early experiments will influence how the Army continues to modernize the force and enable faster development and fielding of enhanced PNT capabilities for Army platforms and the Soldier."

"This event allowed vendors to demonstrate both dismounted and mounted PNT capabilities our warfighters need today to fight and win against near-peer threats in an electromagnetic-warfare contested environment," said Lt. Col. Brian Mack, the emerging technologies coordinator for the Army network cross-functional team. "Equally as important, it demonstrated a commitment of Army modernization change agents like the Rapid Capabilities Office, the Army's Network Cross-Functional Team and the Army's Position, Navigation and Timing Cross-Functional Team to come together, collaborate, team and solve some of our most challenging capability gaps facing the warfighter."

LANDSCAPE OF POSSIBILITIES
An operator walks through city rubble at the Muscatatuck Urban Training Complex during the technical experimentation event. "It gave us a feel for the art of the possible, what's out there," said Douglas K. Wiltsie, then-director of the Army RCO, who observed parts of the event. The Army RCO led the PNT portion.

*For more information on the technical experimentation events, go to **http://www.socom.mil/sof-atl/pages/technical-experimentation.aspx**. For more information on the Army RCO or its Emerging Technologies Office, go to: **http://rapidcapabilitiesoffice.army.mil/** or **http://rapidcapabilitiesoffice.army.mil/eto/**.*

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GETTING SOLDIERS INVOLVED

Soldiers assigned to 1st Battalion, 155th Infantry Regiment work to establish communications during a field training exercise in April near Camp McGregor, New Mexico. "One of the biggest changes now that we have this early and aggressive experimentation, with Soldiers involved in the process, is that we're able to get feedback on the applicability of technical solutions before we settle on a formal requirement," said Bassett. (U.S. Army National Guard photo by Sgt. Timothy Russell)

'WHAT' and 'HOW' of ARMY NETWORK

Leaders of new cross-functional team, PEO C3T discuss how they're working to shape a future vision of the Army's network.

by Ms. Bridget Lynch

The Army is committed to delivering a tactical network that will guarantee preparedness and victory over any adversary, but ensuring that success requires significant institutional and cultural change in how the Army modernizes the network. At the forefront of this effort is Maj. Gen. Peter A. Gallagher, director of the new Network Cross-Functional Team, one of eight established by the Army to pursue its six modernization priorities: network communications; long-range precision fires; next-generation combat vehicles; future vertical lift; integrated air and missile defense; and Soldier lethality. Under his leadership, the cross-functional team is shaping the future vision of the network, in accordance with the four lines of effort within the Army's network modernization strategy. Tasked with turning that vision into a reality is the Program Executive Office for Command, Control and Communications – Tactical (PEO C3T), under the leadership of Maj. Gen. David G. Bassett. This dynamic partnership is leveraging experimentation, prototyping and real-time Soldier feedback to acquire and field capabilities that will keep pace with emerging threats and prepare the Army to fight and win.

Gallagher and Bassett sat down for an interview on April 11 to discuss key experimentation and fielding efforts, industry collaboration and the importance of the evolving relationship between the Network Cross-Functional Team and PEO C3T.

WANTED: INDUSTRY INPUT
Bassett offers a "PEO perspective" during the Army Network Technical Industry Forum at Aberdeen Proving Ground, Maryland, on Feb. 6-7. The event was attended by 576 people from 204 companies, many of which were not traditional defense contractors. (U.S. Army photo by Sean Kimmons, Defense Media Activity – Army)

Lynch: What makes this cross-functional team construct different?

Gallagher: For the Army, it's an institutional change at the highest level, and it's bigger than the network. The whole construct of the Army developing cross-functional teams to execute the top modernization priorities to help our warfighting capability is significant. This construct is different because the general officers and SESes [Senior Executive Service members] leading the teams have a direct report to the undersecretary of the Army and the vice chief of staff of the Army. These modernization priorities have been determined by the secretary of the Army and the chief of staff, who in turn have established and empowered the cross-functional teams to execute them.

The difference here is that, on one team, you have experts from across the Army who are narrowly focused on delivering capabilities to meet the needs of the Army quickly. Inside the assistant secretary of the Army for acquisition, logistics and technology [ASA(ALT)] community, we are working with PEO C3T and PEO Soldier, which gives us the acquisition expertise we need along with the ability to deliver agile acquisition

with focused integration and disciplined innovation. We are a team of experts, from not only the acquisition community, that has come together to represent the Army's interests, and it's the focus of that collective team working across the Army to execute these priorities that makes [this construct] pretty powerful.

Lynch: What is the PEO's role within the cross-functional team?

Bassett: The cross-functional team is driving what the network is going to be in the future. As Maj. Gen. Gallagher and the cross-functional team define what that future looks like, it is the PEO's responsibility to execute the "how" so that we are able to deliver those capabilities in an enduring way across the Army. We bring the structure, workforce and expertise that allow good ideas and experimentation to turn into enduring capabilities.

Lynch: How do you intend to streamline the requirements process to further innovation and to infuse industry technology into the Army's network design?

Gallagher: One of the first things we have to do as we continue refining the network is to examine the requirements as written and try to figure out why the capabilities being delivered are not meeting the needs of our operational warfighting commanders.

In many cases, it's because we tend to overspecify our requirements in a way that ends up boxing us in. As a result, the acquisition community delivers to a specified set of technical requirements, but the capability is not truly meeting the needs of our warfighters. Instead, what we are trying to do now is anchor our requirements on the first principles of preparing for and fighting in war. We need to determine what characteristics

> *"It's not enough to have a good technology. We must show how that technology can be applied within the tactical space to provide an even greater capability."*
>
> **—Maj. Gen. David G. Bassett**

and standard requirements will help us operationally, and not specify and direct the technical requirements.

We need to give industry more freedom of action to come to us with solutions that will deliver capabilities to help us do that. We have to inform the requirements process through Soldier feedback and demonstrations of capabilities, and not rush into defining the requirement early on. We need to start with an operational need and a warfighting requirement. We will figure out the technical specifications as we go, based on demos and experimentation that will help us refine the technical specifications, so Maj. Gen. Bassett and the technical community procure capabilities that are more capable of meeting those operational needs.

Lynch: What types of experimentation and demonstration does the cross-functional team plan? What have you learned so far?

Gallagher: We've been experimenting at a battalion-size formation, but moving forward, we want to assess the scalability of these capabilities to take it beyond an infantry battalion by looking at other types of maneuver formations such as the Stryker brigades and armored brigades.

Our experimentation and demonstration thus far have been focused on simplifying the network and making it more usable in a fast-paced, mobile, scalable operation. We are currently examining how we can manage the boundaries within our secure network to give us more flexibility at the tactical edge. We're also looking at advanced networking waveforms, which will allow us to conduct a mobile ad hoc network for our battalion formations that will operate in a variety of situations. Additionally, we're experimenting with radio gateway devices, small aperture satellite capabilities and access to airborne tactical data links. Our goal is to create an ecosystem that will help our joint and coalition interoperability at the lowest tactical edge, while also experimenting

with capabilities that will simplify our network. We need to make warfighting more capable to execute through simpler systems that allow the users to be connected.

Lynch: How will program offices use the experimentation efforts?

Bassett: One of the biggest changes now that we have this early and aggressive experimentation, with Soldiers involved in the process, is that we're able to get feedback on the applicability of technical solutions before we settle on a formal requirement. We're starting with an idea of a capability we'd like to deliver, or a technology that the cross-functional team has identified as particularly applicable, rather than solidifying a requirement up front. In the past, we've written formal requirements only to discover a few years later that they couldn't be used within the formation the way we envisioned.

We are using these experimentation efforts to learn these lessons sooner, so

ON THE SAME PAGE

Secretary of the Army Dr. Mark T. Esper, second from right, views the U.S. Army Tactical Network Modernization Demo at Joint Base Myer-Henderson Hall, Virginia, on March 19. From left are Col. Gregory Coile, Project Manager for Tactical Network within PEO C3T; Bassett; Maj. Gen. James J. Mingus, director of the Mission Command Center of Excellence; Esper; and Gallagher. "We are a team of experts that has come together to represent the Army's interests," said Gallagher. (U.S. Army photo by Bridget Lynch, PEO C3T)

that by the time we reach a requirement, it has already been informed by the following criteria: technical feasibility, the way it will be integrated into the formation and how it will be used by Soldiers. Learning from these experimentation efforts, through our partnership with the cross-functional team, is tremendously valuable to the program offices because it will result in a significantly higher possibility that the capabilities we deliver will be accepted and informed by Soldier feedback.

Lynch: What are the key efforts the team is collaborating with the Army science and technology community on?

Gallagher: First and foremost, we had to learn and understand what the S&T community was actually working on across the Army. There's an incredible amount of innovation taking place on multiple fronts within the S&T community. Initially, it was about information gathering to discover who is doing what in the network space. From there, we began working with [the U.S. Army] Communications-Electronics Research, Development and Engineering Center and [the U.S. Army] Research, Development and Engineering Command in order to focus their efforts on modernization priorities aligned to the Army's four network modernization lines of effort.

As an example, the first line of effort is to create a unified network transport that ensures connectivity in a contested environment against a peer adversary. Much of our cross-functional team efforts to date have been focused on that priority. If there's a peer adversary with advanced electronic warfare capability or advanced cyber capability, it presents us with a threat to challenge us in a network environment, so we need to make sure we're leveraging the Army S&T community to help address that threat.

As we look at focusing efforts within the S&T community, one of the biggest things we need to pay particular attention on is moving beyond the stages of studying and analyzing so that we can execute the delivery of capabilities. We are working

diligently with the S&T community and our PEO partners to ensure that there is a transition plan, so the efforts we're working on will ultimately lead to either improving our existing programs or helping us to develop new programs to capitalize on these efforts.

Lynch: What are some of the key network attributes or capabilities that the community is focused on integrating and fielding?

Bassett: We remain focused on shifting tasks off the Soldiers and onto the platform by automating capabilities and reducing the amount of direct touch that the Soldiers need to have with the system in order to operate and maintain it. We are also working to ensure that our mission command systems provide the right combination of simplicity and power. Users are sometimes forced to choose between a tool that is really simple to operate for common tasks, or a tool that gives them a tremendous amount of performance and flexibility to execute complex tasks. We are working to strike a balance that allows systems to provide both a simple and advanced interface, that allows simple tasks for most operators to be executed quickly, but still gives more advanced users the ability to tailor the system to the needs of the commander in the field.

Lynch: How are you working differently with industry?

Gallagher: One of the most powerful things we've done so far was back in February, when the Network Cross-Functional Team and PEO C3T conducted an industry technical exchange forum at Aberdeen Proving Ground [in Maryland]. We brought in 576 members of industry from about 204 different companies, many of which were not your traditional defense contractors. Of those, about 87 were small businesses. The event was a focused industry exchange on assured network transport, in which we were able to discuss with industry our focus areas and challenges we're facing with the network. It was a spirited dialogue with a wealth of good feedback, and we intend to conduct additional tech exchange meetings

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THE FOUR LINES OF EFFORT FOR THE ARMY NETWORK MODERNIZATION STRATEGY ARE:

Unified network—*Ensure an available, reliable and resilient network that provides seamless connectivity in any operationally contested environment.*

Joint interoperability, coalition accessible—*Ensure that Army forces can more effectively interact (technically and operationally) with joint and coalition partners.*

Command post mobility and survivability—*Ensure command posts' deployability, reliability, mobility and survivability.*

Common operating environment—*Ensure a simple and intuitive single-mission command suite that is easily operated and maintained by Soldiers.*

CRITICAL FEEDBACK

Gallagher speaks to industry partners about the Army's network modernization strategy during the Army Network Technical Industry Forum at Aberdeen Proving Ground. Balancing ease of use for Soldiers and greater power and technical ability in the Army's network technologies is a challenge Gallagher's team seeks industry help to tackle. (U.S. Army photo by Sean Kimmons, Defense Media Activity – Army)

across the four lines of effort of the network modernization strategy.

Since then, we put out a request for information on FedBizOps and have received over 200 white papers detailing options on how industry believes they can help us leverage their research and development efforts to provide capabilities that could either establish short-term opportunities for us to experiment and demonstrate with, or long-term solutions that will help us address the threat and exploit advanced technologies to our advantage going forward.

Bassett: By working together as we approach industry, we've been able to take one good idea or proprietary product and

show how it fits and could be integrated into a unified network. It's not enough to have a good technology. We must show how that technology can be applied within the tactical space to provide an even greater capability. It must be applied in a way that keeps many of those attributes in mind that Maj. Gen. Gallagher talked about earlier: How can we bring it without adding complexity to the user? How can we provide it without adding contract or logistics support on the battlefield? How can we provide it in a way that adds capability without adding a burden to the Soldiers that are employing it? How can we avoid increasing the training burden that Soldiers have to go through to install, operate and maintain that network? By working together to answer those questions, we will be able to determine a set of good capabilities that we want to experiment with and eventually field to our Soldiers.

Gallagher: Together, we are working toward a common solution, and we are speaking with one voice on behalf of the Army. We're not working around the acquisition community, but by, with and through them. It's important for industry to see that unity of effort from the Army and senior leaders as we continue our relationship with industry.

*For more information, go to the PEO C3T website at **http://peoc3t.army.mil/c3t/**.*

MS. BRIDGET LYNCH has provided contract support to PEO C3T since 2012. She is a public communications specialist for Bowhead Business and Technology Solutions, and holds a B.S. in mass communication from Towson University.

> "We need to make warfighting more capable to execute through simpler systems that allow the users to be connected."
>
> —Maj. Gen. Peter A. Gallagher

EXTENDED RANGE AT COST

The M777A2 and M777ER side by side at a test site. Retrofitting an M777A2 howitzer into an M777ER—the "ER" stands for extended range—only requires changing five components, which add little additional weight or cost. The long-range cannon project team is evaluating whether equipping artillery batteries with the extended-range howitzer plus new radar and tracking systems can increase their firepower while the Army develops more significant modernization solutions for long-range precision fires. (Photo courtesy of the authors)

LONG RANGE, SHORT TERM

PEO Ammunition, ARDEC and the Army Rapid Capabilities Office come together at Picatinny Arsenal with near-term plans for improving long-range precision fires.

by Capt. Steve Draheim and Maj. Paul Santamaria

O f the Army's "big six" priorities driving its new modernization strategy, long-range precision fires is at the top of the list.

The ability to execute accurate strikes at significant distances is critical to ground operations in any theater, against any adversary—especially a near-peer threat that can restrict U.S. maneuver through anti-access and area denial systems and techniques.

Now, the experts at Picatinny Arsenal, known as the Army's Center of Excellence for Guns and Ammunition, and the Army Rapid Capabilities Office (RCO), which is the service's acquisition shop for quickly addressing critical capability gaps, have joined forces to deliver a suite of technologies that can extend the range of cannon artillery and are mature enough for a system-level assessment in less than three years.

This effort, termed the long-range cannon project, focuses on a specific subset of fires capability and is complementary to the broader initiatives pursued by the new long-range precision fires cross-functional team. The project's objective is to assess long-range

cannon capability by rapidly prototyping and equipping an artillery battery with the M777 Extended Range (M777ER) howitzer, a new projectile tracking system, survey device and rocket-assisted projectile in under three years. If successful, the long-range cannon will nearly double the range of cannon artillery for the Army and Marine Corps, thus providing an interim solution that bridges a critical capability gap while informing the development of future long-range precision fires systems.

RAPID ALIGNMENT

The RCO is a key participant in the long-range cannon effort. The RCO executes rapid prototyping and acquisition to deliver urgently needed capabilities to the field, bridging strategic gaps against rapidly modernizing adversaries. Since its founding in August 2016, the RCO had focused primarily on expediting electronic warfare and position, navigation and timing systems to address operational needs. However, in February 2018,

Army Chief of Staff Gen. Mark A. Milley elected to prioritize long-range cannon among all RCO efforts.

The Project Manager for Towed Artillery Systems (PM TAS), part of the Program Executive Office (PEO) for Ammunition, and the Army and Marine Corps center of excellence for cannon artillery took on the lead integrator role for the long-range cannon project, with RCO providing oversight. This organizational model may carry over to similar efforts in the future, especially as the RCO branches out beyond its initial focus areas to take on projects of increasing scope.

MORE THAN THE SUM OF ITS PARTS

The mature products that the RCO is interested in adapting, accelerating and fielding vary as to their position in the acquisition life cycle. Some are poised to become programs of record in their own right, while others exist only as science and technology demonstrator projects.

This spectrum of capability is reflected in the components of the long-range cannon project.

PM TAS manages the M777A2 howitzer, a combat-proven artillery system in use by the U.S. Army, the U.S. Marine Corps, and the Australian and Canadian militaries. Through a close-knit partnership with U.S. Army Armament Research, Development and Engineering Center (ARDEC) engineers at Picatinny Arsenal and Benét Laboratories in Watervliet, New York, the PM TAS team developed an extended-range variant, the M777ER, which has only five major components requiring modification. The cost to retrofit an M777 is comparable to that of a standard depot reset, and the weight increase is minor. With few changes to the howitzer's operation, it offers the warfighter enhanced lethality at a cost the Army can afford.

The Projectile Tracking System Radar began in ARDEC as an element of the

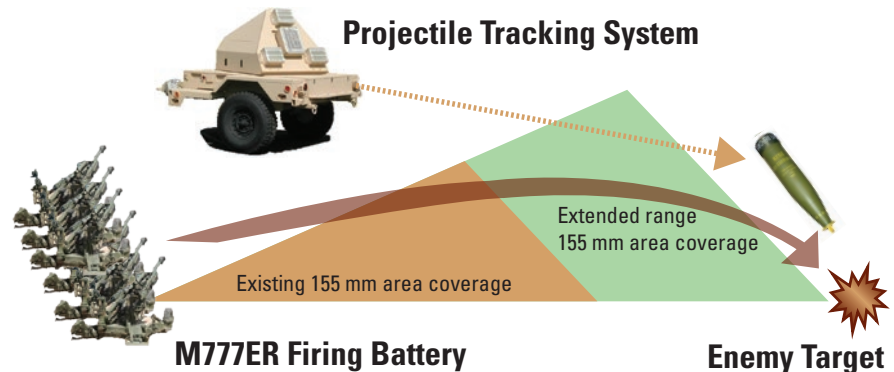**AN ADDITION FOR ACCURACY**
A towed radar similar to what the future Projectile Tracking System radar might look like. The long-range cannon team is reusing this system developed for a now-discontinued artillery project. The tracking system follows projectiles in flight to predict where the rounds will hit, allowing Soldiers to make corrections for subsequent shots. (Photo courtesy of the authors)

now-defunct Crusader and Non-Line-of-Sight Cannon projects. It provides enhanced accuracy and new capabilities for artillery. By tracking projectiles in flight, it predicts an impact point, allowing the fire control system to make corrections for subsequent shots. Circular error probable, an inverse measure of artillery accuracy, decreases substantially. The Projectile Tracking System can also communicate with a round in flight.

The Location and Azimuth Determining System (LADS) program serves as a single survey device replacement for two systems: the Improved Position and Azimuth Determining System and the Gun Laying and Position System. Already under development, the LADS will enable survey teams to register more accurate survey control points in a smaller form factor. Soldiers and Marines can use the man-portable LADS in a wider variety of conditions than the vehicle-based Improved Position and Azimuth Determining System.

Another program in advanced stages of development before its inclusion in the long-range cannon project is the XM1113 rocket-assisted projectile. As a replacement for the M549A1 rocket-assisted projectile round in inventory today, the new projectile can be fuzed with a Precision Guidance Kit for improved accuracy. The XM1113 will provide a range increase in this class of projectiles with legacy artillery systems and offer an even greater capability with the M777ER armament. The PM for Combat Ammunition Systems is taking the lead on the XM1113, making it an integral part of the projectile and propellant work on the long-range cannon project.

The RCO developed the idea to integrate these capabilities, some already with a distinct strategy or funded by another

Projectile Tracking System

Extended range
155 mm area coverage

Existing 155 mm area coverage

M777ER Firing Battery

Enemy Target

WHAT M777ER OFFERS

The long-range cannon project is working to give artillery batteries longer range and the ability to communicate with rounds in flight and track their accuracy in less than three years. This gives the Army better range while the Futures Command and modernization cross-functional teams choose and field a more lasting solution to the long-range precision fires puzzle. (Graphic courtesy of the authors)

source, into the overarching project. This integration will provide not only the basis for an operational assessment but also the potential to assess other cross-functional team initiatives related to extended-range cannon artillery, thereby reducing risk for the cross-functional team. In the case of the M777ER howitzer, the long-range cannon project is the primary focus, but the operational assessment will add value for the other products by generating additional feedback on their individual capabilities.

STREAMLINED STRATEGY

The project and its emerging organization benefit from the relationships that PM TAS and the Picatinny Arsenal team already have with industry partners and the government arsenals.

Today's acquisition reform efforts seek to mitigate the sources of program delays, including contracting lead times and challenges in beginning new relationships with vendors. The initial long-range

cannon acquisition strategy avoids these pitfalls through a combination of innovative acquisition strategies and government prototyping capability. Government arsenals—including those in Rock Island, Illinois, and Watervliet—will manufacture several M777ER components. Final integration will leverage government-operated facilities. The arsenals and depots offer funding flexibility, enabling program managers to re-prioritize resources faster than in a commercial contracting environment. Additionally, existing contracting vehicles will provide an efficient means to execute delivery orders for prototype components.

Rapid prototyping and procurement of usable equipment for the operational assessment may also employ other transaction authority (OTA) agreements. One OTA-focused organization, the Department of Defense Ordnance Technology Consortium (DOTC), originated at Picatinny Arsenal as a partnership between DOD and the National Armaments

THE BASE IS HOT

Workers at a government arsenal pour molten steel into a mold. Government arsenals including those at Rock Island, Illinois, and Watervliet, New York, will produce several of the components for the extended-range variant of the M777 howitzer. Working with government depots and arsenals gives program managers flexibility, allowing them to move money around as project needs dictate without going through the steps required to change cost and schedule parameters under a commercial contract. (Photo by Kimberly Conrad, Joint Manufacturing and Technology Center)

Consortium. Operating outside of typical Federal Acquisition Regulation norms, DOTC contracts use a faster single-point contracting process for prototyping and research and development.

The long-range cannon project's schedule fits between the acquisition of commercial off-the-shelf items in under a year and traditional program schedules, as law and regulation still dictate numerous requirements before a materiel release. The planned operational assessment will address many of these requirements.

The project team continues to plan the scope and details of the operational assessment. The assessment will be warfighter-focused but will include evaluation tasks typical of an urgent materiel release. It will try to answer a fundamental question: Will the long-range cannon system, first envisioned sitting around a table at Picatinny Arsenal, meet the urgent needs of combatant commanders?

The RCO is focused on operational engineering, the gist of which is that allowing Soldiers to interact with the system under development sooner in its life cycle will get the system to technical maturity more efficiently. Instead of delivering the final product, only to find that users are dissatisfied, operational engineering seeks user feedback early and often. In line with this focus, the assessment will look not only at the materiel solutions offered but also at how operators employ them in the field. The user is the best evaluator. The event also will offer the field artillery community an opportunity to learn how its force structure and doctrine could adapt to the new capability.

As the Army's enhanced long-range precision fires capabilities continue to emerge, this interim long-range cannon system may illuminate challenges and offer solutions for the way in which forward observers communicate with artillery firing batteries. Questions include: How does this new capability affect maneuver force planning? How must the architecture of cannon-delivered indirect fires and the fire direction center adapt to the ability to shoot farther?

CONCLUSION

Before the Army delivers the major long-range precision fires systems under development, the long-range cannon project offers this interim solution to help the operating forces prepare to face near-peer threats. The project's innovative technical and organizational approach and the teaming across distinct organizations will provide flexibility and valuable feedback to stakeholders. The rapid development and integration of this affordable system offers Soldiers and Marines a powerful tool as they stand ready against our adversaries.

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RAPID RESULTS

For the Army Rapid Capabilities Office, fast solutions are the new black. As its former director heads for retirement, he looks back on the office's success and promise as a forerunner for the new Futures Command.

FRONT OF THE LINE

Undersecretary of the Army Ryan D. McCarthy, center left, and Gen. James C. McConville, the Army's vice chief of staff, center right, discuss emerging technology while inside the Mission Enabling Technologies – Demonstrator, a modified Bradley Fighting Vehicle equipped with several upgrades, during a tour Jan. 18 of the Army's Tank Automotive Research, Development and Engineering Center at the Detroit Arsenal in Michigan. RCO has pointed the way to getting new capabilities rapidly into the hands of deployed Soldiers. (U.S. Army photo by Sean Kimmons, Defense Media Activity – Army)

by Mr. Douglas K. Wiltsie

When the Army undertook its major modernization reform initiative this year, it had a running start. The Army Rapid Capabilities Office (RCO), launched in 2016, helped forge a path for the rapid prototyping approach now embraced by the cross-functional teams and the Army Futures Command. As Undersecretary of the Army Ryan D. McCarthy put it in October 2017: "The Rapid Capabilities Office is a foundational element where we want to scale that type of behavior and capability to the larger enterprise."

Focusing on high-priority projects that will enable the Army to better deter and defeat rapidly modernizing adversaries, and addressing combatant commanders' needs for solutions to critical capability gaps, RCO helped define the new possible in rapid acquisition. By uniting operational users and a specialized project team, and taking advantage of acquisition authorities that Congress and our charter provided, we demonstrated a way to deliver complex solutions, fast.

ELECTRONIC WARFARE UPGRADES
Paratroopers from 1st Battalion (Airborne), 503rd Infantry Regiment (1/503), 173rd Airborne Brigade air assault into a live-fire training exercise in Grafenwoehr, Germany, in April. In February, Soldiers with the 173rd were among the first in the Army to receive new electronic warfare prototype systems that enable the U.S. Army to contest and challenge near-peer adversaries in this critical domain. (U.S. Army photo by 1/503 Public Affairs)

After spending the last 19 months serving RCO—and watching it flourish, from idea to startup to enduring organization—I believe we have learned much that can scale up to the broader Army. We also know that some missions still will require a more tailored approach, and that RCO must keep evolving to reach its full potential. On April 15, the organization gained new Executive Director Tanya Skeen, a veteran of the Air Force RCO and a former naval officer.

Acquisition reform is complex, but it's clear that changing the paradigm only matters if it gets results. RCO already has put new capabilities in the hands of deployed Soldiers, and it will continue to push their needs to the front of the line.

Even though I write this in early May and will retire at the end of the month, I can say I am immensely proud of the results the RCO team has achieved, as well as the collaborative concept we have created with program executive offices (PEOs) and project managers. I am confident the organization will continue to break the mold to the benefit of the greater Army.

A NEW MODEL
RCO quickly went to work after its creation in August 2016. It reported to a board of directors—which included the secretary of the Army, the chief of staff of the Army and the Army acquisition executive—and prioritized projects for RCO to tackle. In short, our job was to fulfill these highest-priority Army requirements

and to deliver an operational effect on an accelerated acquisition timeline. From an organizational perspective, the goal was to work in the space between the program executive offices, which field long-term programs of record across the entire Army, and the Rapid Equipping Force (REF), which meets immediate, specific needs with off-the-shelf equipment. RCO, by contrast, focused on quickly providing solutions that integrated several different capabilities, and tailoring them for a specific theater and formation.

Together with the new cross-functional teams and the Futures Command, which focus on speeding requirements development for the Army's top six modernization

priorities, this setup gives the Army a range of options to deliver capabilities depending on urgency, complexity and intended scope. At the Association of the United States Army Global Force Symposium in March, McCarthy used the analogy of a golfer's short game to describe the benefit of having different acquisition options in the Army's arsenal.

"I look at the REF and the RCO, and they're like golf clubs. I need something now, I'm going to REF it: Here's the seven iron," McCarthy said. "If it might take longer, two to three years, the RCO is a wedge, and it might take a couple shots to get there. … They do remarkable work."

The wedge also takes some of the trickiest shots—consistent with our mission to give combatant commanders what they need to maneuver and succeed in contested environments. While answering these operational needs, RCO allows the Army to make small bets on promising new technology without necessarily committing to a program-of-record status. Through phased prototyping and direct feedback from Soldiers, RCO helped establish a new approach to acquisition that is now spreading across the Army.

OUT OF THE GATE: ELECTRONIC WARFARE FOR EUROPE

While it was still filling positions, finding office space and creating a battle rhythm, RCO hit the ground running, addressing an operational needs statement from U.S. Army Europe for integrated electronic warfare systems. These new, dedicated electronic warfare capabilities would be critical to ground forces' effectiveness on the continent. To maneuver, you have to be able to communicate—and know when your communication systems are compromised. Working hand in hand with the Project Manager for Electronic Warfare and Cyber (PM EW&C) and the PEO for Intelligence, Electronic Warfare and Sensors, RCO adapted existing systems for a different purpose by incorporating emerging technologies that provided new electronic warfare effects. The integrated capability enables ground maneuver freedom of action by providing mounted, dismounted and command-control electronic warfare systems for the first time at brigade and below. Soldiers can use the equipment to implement electronic protection for their own formations, as well as to detect and understand enemy activity in the electromagnetic spectrum and to disrupt adversaries through electronic attack effects.

These prototypes, assessed and delivered in less than one year after the capability was first envisioned, are now in the hands of Soldiers with the 2nd Cavalry Regiment, 173rd Airborne Brigade and the regionally aligned Armored Brigade Combat Team in Europe. Part of a phased fielding, this new approach to delivering prototypes instead of 100 percent solutions allows the Army to incrementally build electronic warfare capabilities while continuing to upgrade as new technology becomes available, such as aerial electronic warfare sensors and artificial intelligence and machine learning technologies for signal classification.

It also highlighted how a partnership between RCO and a project manager could be used to move a capability to the field faster by taking advantage of a manager's expertise, RCO authorities and resources from both sides. The

HIGH-LEVEL ASSESSMENT

Capt. Brigid Calhoun of the 173rd Infantry Brigade Combat Team (Airborne) briefs, from left, Dr. Bruce D. Jette, assistant secretary of the Army for acquisition, logistics and technology; Brig. Gen. Joel K. Tyler, commanding general of the Joint Modernization Command; and the author in April at Hohenfels, Germany. Various military and civilian officials came to Hohenfels to see how the Joint Warfighting Assessment (JWA) helps the Army evaluate emerging concepts. Among the capabilities evaluated at JWA 18 were improved electronic warfare systems that the Army RCO played a leading role in developing on an accelerated schedule. (U.S. Army photo by Staff Sgt. Kalie Frantz, 55th Combat Camera)

collaboration is now serving as an example for PEOs, project managers and cross-functional teams to leverage RCO as a way of getting capabilities into the hands of Soldiers quickly. This approach not only answers an operational need, but it also allows capability developers to begin to incorporate user feedback and inform requirements. RCO and PM EW&C worked together throughout multiple phases of technology development, integration and operational assessment. In the process, we provided early risk reduction for technical capabilities, learned how Soldiers will use the systems in a tactical setting and eliminated unsuccessful concepts earlier in the development cycle. The actual users—electronic warfare officers from the receiving units—were with us every step of the way. The cross-functional teams and the Futures Command can apply many of these same approaches to their work.

Based on the success of the rapid delivery of electronic warfare prototypes, RCO is now using that model to accelerate capabilities that address position, navigation and timing (PNT) assurance and

protection for ground combat vehicles in GPS-challenged environments. A Soldier-led assessment of a PNT prototype on these vehicle platforms, expected to take place later this year, will help inform an equipping decision for units in Europe. RCO is also moving out on new initiatives aimed at addressing critical gaps in other theaters, and expanding its capability portfolio to include chief of staff of the Army priorities, such as long-range cannons, optical augmentation and loitering air munitions. (For more on the long-range cannon project, see "Long Range, Short Term," Page 32.)

WATCH, ASSESS, EXECUTE

In approving the National Defense Authorization Act for Fiscal Year 2016, Section 804, Congress authorized alternative approaches to rapid prototyping and rapid fielding. Along with the RCO charter, this newly defined middle tier of acquisition enables RCO to streamline many aspects of capability development and delivery.

Within this framework, RCO determined it would need an internal process that enabled multiple efforts to run

simultaneously, instead of one that relied on tiered succession. The team established a "watch, assess and execute" process that shepherds projects through various stages of prototyping with the input of experts from program management, finance, contracting, testing, and science and technology.

The process enables RCO to actively monitor and prioritize emerging technologies (watch); create multifunctional teams that evaluate potential solutions to close a combatant commander's strategic gap (assess); and conduct operational assessments with the receiving unit to establish the doctrine, organization, training, materiel, leadership and education, personnel, facilities and policy (DOTMLPF-P) analysis (execute). Each stage is tailorable to the project and the need, acting as an outline rather than a checklist so we can go fast.

Another important factor in RCO's early success was the presence of a general officer from the operational side of the Army serving as director of operations. Our first director of operations was Maj. Gen. Walter E. Piatt, now commander of

PROTOTYPES IN SOLDIERS' HANDS

Soldiers from the 173rd Airborne Brigade prepare to participate in JWA 18 in Grafenwoehr, Germany, in April. The Army RCO and PM EW&C teamed with the 173rd, the 2nd Cavalry Regiment and other receiving units on a rapid prototyping approach to drive electronic warfare system design, performance, functionality and training to meet operational needs in the near- and mid-term. (U.S. Army photo by 1/503 Public Affairs)

RAPID DELIVERY
RCO and PM EW&C partnered to deliver, in less than one year, a new package of ground-based electronic warfare systems, including mounted, dismounted and command-and-control capabilities, to answer operational needs in Europe. (U.S. Army photo)

CONCLUSION

The Army Rapid Capabilities Office set out to do one thing: deliver urgently needed capabilities that bridge the gap against rapidly modernizing adversaries.

During my short time at the organization, we met that challenge by fielding equipment that allows brigades to understand the electronic warfare environment and incorporate electronic warfare threats and responses into their decisions. We established an RCO process and formed a small but fearless team to carry it out. We secured the resources to enable financial stability and future growth.

In doing so, RCO became a foundational element to Army modernization and acquisition reform. As the Army tackles its largest institutional transformation since the 1970s, the rapid way of doing business can help achieve our greater modernization goals.

the 10th Mountain Division and of Fort Drum, New York, and the second was Maj. Gen. Wilson A. Shoffner, now commander of the Fires Center of Excellence and of Fort Sill, Oklahoma. Both were instrumental in uniting the operational and acquisition communities to lay the foundation for rapid capability delivery. They applied their experience to align RCO projects with tactical operations and ensure that we captured DOTMLPF-P factors in capability solutions. For the same reasons, it is encouraging that the cross-functional teams are led by combat-experienced generals.

THE FUTURE IS NOW

As the Army Futures Command takes shape, RCO will be complementary to PEOs and cross-functional teams and a tool they can use. Much like a PEO, RCO can field capabilities, and much like a cross-functional team, it experiments and takes risks in order to move fast. Yet it operates in the near term, where there is a critical need. Equipping Soldiers in this time frame reduces operational risk and buys the Army time to get the program-of-record capability correct. And in some cases, RCO will prove essential in accelerating projects that fall outside a designated cross-functional team or that cross multiple cross-functional team portfolios.

Additionally, we expect the RCO role to continue to grow from its core of rapid prototyping. This growth would likely occur on both ends—in fulfilling immediate needs and in fielding more complete systems. This will allow the organization to stay flexible, agile and responsive to combatant commanders, as well as to Army senior leadership.

MR. DOUGLAS K. WILTSIE served as the first director of the Army RCO, from August 2016 through April 2018. He retired from civil service on May 31 after a 34-year Army career. A member of the Senior Executive Service, he previously served as the executive director for the assistant secretary of the Army for acquisition, logistics and technology's System of Systems Engineering and Integration Directorate; the program executive officer for Enterprise Information Systems and the deputy program executive officer for Intelligence, Electronic Warfare and Sensors. He holds an M.S. in national resource strategy from the Industrial College of the Armed Forces of National Defense University and a B.S. in mechanical engineering from Virginia Tech. He is Level III certified in systems engineering and in program management and is a member of the Army Acquisition Corps.

ANALYTICAL FRAMEWORK: *A SPACE FOR TRADING*

JPEO-CBRND portfolio and systems analysis framework informs future CBRN investment decisions.

by Ms. Gail Cayce-Adams and Mr. Michael Kierzewski

I t is simply impossible to maintain the old paradigm of developing new items as single, stand-alone products and retain the U.S. military's overmatch. It's no longer reasonable, if it ever was, to develop individual capabilities in a vacuum. Therefore, the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND) is moving toward a more holistic, portfolio-based approach to developing chemical, biological, radiological and nuclear (CBRN) warfighter protection with a new analytical framework.

A single capability in the field is just one small part of the toolbox available to our warfighters. So, it is important to consider how all of the available tools work best together to accomplish the mission. Requirements for a new capability may change if the new capability is assessed along with equipment already at play on the battlefield. For instance, if an individual's protection from CBRN contamination has been greatly improved by the fielding of a new protective suit, what effect does that have on the requirement for a more sensitive CBRN detector? Could it be less important to develop a new detector capable of detecting agents at lower concentrations if a protective suit can be developed that is comfortable and can be worn on a daily basis like any other uniform?

Multiple CBRN risk assessments have shown the need for solutions developed as integrated, layered systems of capability sets. The end result is sets of solutions that span the entire CBRN portfolio. The JPEO-CBRND has created an Analytical

Framework—a process that uses a combination of data, analysis methods and software tools to provide insights to support senior level decision-making—to better manage its portfolio of products. The Analytical Framework identifies gaps within the portfolio and systematically assesses new capabilities and how they work in conjunction with other capabilities for wiser investment decisions.

As much as possible, the Analytical Framework replaces subjective and qualitative judgments with objective and quantitative analysis. While the need for subject matter experts will never go away, data-driven analysis can demonstrate for stakeholders which course of action is best and show them why. The Analytical Framework is bolstering traditional approaches of expert panels and tabletop exercises with the insertion of measurable analytical results and data. In this way, personal biases and assumptions can be eliminated from the decision-making equation, leading to better protections against CBRN threats for warfighters in the field.

The Analytical Framework focuses on three key analysis areas: portfolio analytics, which identifies gaps and risks within the JPEO-CBRND product portfolio; system analytics, which demonstrate how system trades affect program cost, performance and mission; and combat analytics, which examine the effects of new capabilities on mission outcomes.

WHAT CAPABILITIES ARE WE MISSING?

The Analytical Framework's portfolio analysis efforts use existing defense guidance and planning resources such as joint publications, field manuals and tactic, technique and procedure documents for each of the military branches to determine the steps necessary to complete a given mission as well as the criteria to use for determining mission success. Then the team breaks down those steps into individual tactical tasks such as attack by fire, conduct dismounted road march and cross a water hazard.

Mapping of each of these tactical tasks back to the capabilities already within the CBRN portfolio needed to complete them then shows where gaps exist in the portfolio. A very simplified example would be a scout on a CBRN route reconnaissance mission: Some of the tactical tasks involved may be detecting whether a contaminant is present along the route and then identifying a clear route for the rest of the force to follow.

To complete those tasks, the scout might need equipment such as a CBRN detector, individual protective equipment such as a mask, a suit, gloves and boots, and possibly a CBRN reconnaissance vehicle to help identify a clear route. This equipment can then be compared to what's available in the JPEO's portfolio to identify where gaps exist.

We can then analyze the risks involved with those capability gaps and determine how well materiel solutions currently in development mitigate those risks. Findings from this portfolio analysis process are then further examined with a focus on systems analysis and combat analysis.

REDUCED COST, OPERATIONAL IMPACT

As much as possible, the Analytical Framework team has aggressively embraced tools that already have been developed by or for other government organizations. The team's motto for software applications is reuse, don't re-create. If a tool already has been developed that suits the team's purposes, the team leverages it rather than starting from scratch. The team goes to great lengths to locate and use tools that already exist. The Analytical Framework team is primarily using the Engineered Resilient Systems Trade

NEED TO BREATHE
Soldiers assigned to 3rd Squadron, 2nd Cavalry Regiment don gas masks and conduct patrol during CBRN training in February at a range near the Bemowo Piskie Training Area, Poland. The Analytical Framework will help to identify gaps in capabilities that will help get Soldiers the CBRN equipment they need for any mission. (U.S. Army photo by Spc. Andrew McNeil, 22nd Mobile Public Affairs Detachment)

Space Analysis Tool (ERSTAT) for systems analysis efforts (**http://www.erdc. usace.army.mil/Missions/Engineered-Resilient-Systems/**). "Trade space" is the virtual space in defense acquisition where developers can weigh cost, time and capabilities against requirements to look for the best, most rapid result. ERSTAT is a freely available, government-owned tool developed by the U.S. Army Engineer Research and Development Center.

The Analytical Framework team uses ERSTAT to build models of specific systems to demonstrate the relationships among their respective components and requirements.

ERSTAT includes not only a graphical representation but also mathematical relationships between system attributes. These mathematical relationships allow explicit trades between components and requirements. The ERSTAT tool can be used to analyze the effect of trades among thousands of combinations of attributes and to identify solutions that best satisfy the given requirements. As an example, when trying to determine a detector's trade space in the past, you might plot different attributes to see how they vary with the detector's size. You might plot the detector's response time versus its size, then create another graph to see how the detector's false alarm rate varies with its size, and on and on for all critical detector attributes under consideration. With ERSTAT, you can examine the relationships among all of the attributes at the same time and vary each to see how it affects the others.

ERSTAT allows users to better visualize the trade-offs between solutions and allows full, accurate assessment of solution sets in hours or days rather than weeks or months. It has the added benefit of being able to show a decision-maker
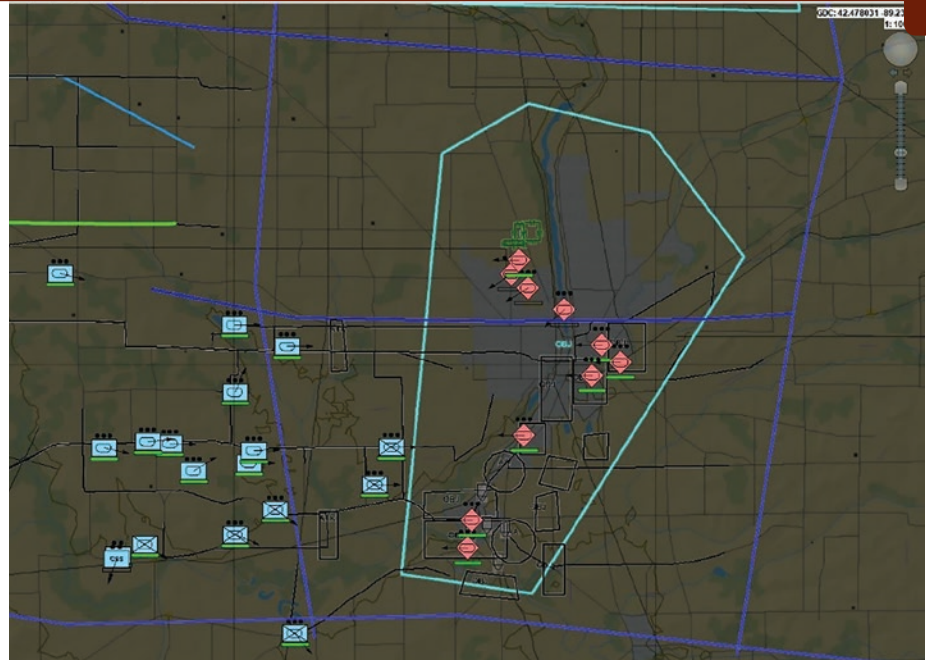
SIMULATING SUCCESS
OneSAF operators working in the Battle Lab Simulation Collaboration Environment can see CBRN effects at different geographic locations, including this screen shot depicting an armored force attacking an occupied objective to secure it and prepare for follow-on operations. Thanks to enhancements to OneSAF, the Analytical Framework can evaluate the mission impact of proposed CBRN capabilities to determine return on investment. The impact of a new capability can also be considered in the trade space analysis. (Graphic courtesy of JPEO-CBRND)

who may think the detector really needs to weigh less than five pounds, for example, how that requirement affects other factors such as response time or false alarm rate.

Candidate solutions can then be demonstrated in a combat simulation to further assess them and see what their actual impact is on mission success when considered with all of the other capabilities being used in theater.

NEW VS. BASELINE CAPABILITIES
The Analytical Framework team is using combat simulations to provide a system-of-systems view of CBRN capabilities to determine their effect on mission success—using a repeatable, quantifiable process for both current and proposed capability sets. Combat analysis allows for "what-if" drills to determine how to

reduce operational risk using force-on-force simulations. For example, if a new detector were designed to detect CBRN hazards 10 times faster than the currently fielded detector, what result would that have on the number of people killed or incapacitated during a given mission where warfighters are exposed to a contaminant?

The U.S. Army Research, Development and Engineering Command's Edgewood Chemical Biological Center conducted a market survey in 2015 for the Analytical Framework team to see what combat simulations already existed that included CBRN behaviors and effects. The team chose the One Semi-Automated Forces (OneSAF) simulation because it had some rudimentary CBRN behaviors and effects and is a government-owned, open-source software product that is freely available for use.

In 2016, the Analytical Framework team worked with the U.S. Army Materiel Systems Analysis Activity and the Edgewood Chemical Biological Center to identify gaps in the current CBRN representation within OneSAF. The JPEO-CBRND then partnered with the Program Executive Office for Simulation, Training and Instrumentation (PEO STRI), which develops OneSAF, and funded the first increment of CBRN behaviors and effects enhancements to the simulation. This initial effort provided sufficient representation to support near-term proof-of-concept CBRN analysis efforts.

In FY17, funding was provided by both JPEO-CBRND and PEO STRI to develop a second increment of enhancements to OneSAF to address additional shortfalls and further refine the CBRN behaviors and effects that were added in the first increment. Additional funding has been provided by the Army Modeling and Simulation Office to allow PEO STRI to add the capability to federate the CBRN enhancements across the Battle Lab Simulation Collaboration Environment in support of the experimentation community. This allows all OneSAF operators on the collaboration

environment that are at different geographic locations to see the CBRN effects, such as a chemical attack.

With these CBRN enhancements to OneSAF, the Analytical Framework has now begun to evaluate the mission impact of proposed new CBRN capabilities compared with existing capabilities to determine return on investment and to include a new capability's mission impact as a tradable parameter in trade space analyses. The team is also examining the mission impact of capability sets to see how different proposed capabilities interact with one another as well as other combat equipment in theater. Results from this analysis, such as reduction in casualties or ability to complete the mission, can then be passed back to the systems analysis trade space evaluation tools to further refine solutions.

CONCLUSION

The JPEO CBRND's Analytical Framework concept represents a shift in the way of doing business for the defense acquisition community. This concept embraces DOD initiatives to speed up the acquisition process and get new, more effective capabilities into the hands of warfighters

sooner. The Analytical Framework approach permits better-informed decision-making through the use of quantitative analytics and fosters fiscal responsibility by fully evaluating system designs and proposed new capabilities early in the acquisition life cycle when the greatest cost savings can be achieved. This approach is quite simply a smarter, more efficient way of doing business.

In addition, the JPEO-CBRND approach to standing up the Analytical Framework has been to reuse, not re-create, by leveraging existing government-owned tools whenever possible and partnering with other organizations for the mutual benefit of all involved. The Analytical Framework has benefited from the expertise of its partner organizations, and those organizations have gained access to the tools and software developed by or for the Analytical Framework.

The Analytical Framework is expecting a third round of enhancements to OneSAF to be completed and released by PEO STRI in July 2018. In addition, the Analytical Framework is developing text analytics applications to assist with searching military publications and

ADVANCE NOTICE
Airman 1st Class Tevin Miller and Airman 1st Class Amanda Button, 707th Communications Squadron client system technicians, update software for computers that will be used on Air Force networks in January at Fort Meade, Maryland. Joint forces, coordinating from command centers to the warfighter in the field, will use integrated software systems that allow for early warning and situational understanding. The Analytical Framework's goal is to get capabilities like these into the hands of warfighters sooner. (U.S. Air Force photo by Staff Sgt. Alexandre Montes, 70th Intelligence, Surveillance and Reconnaissance Wing)
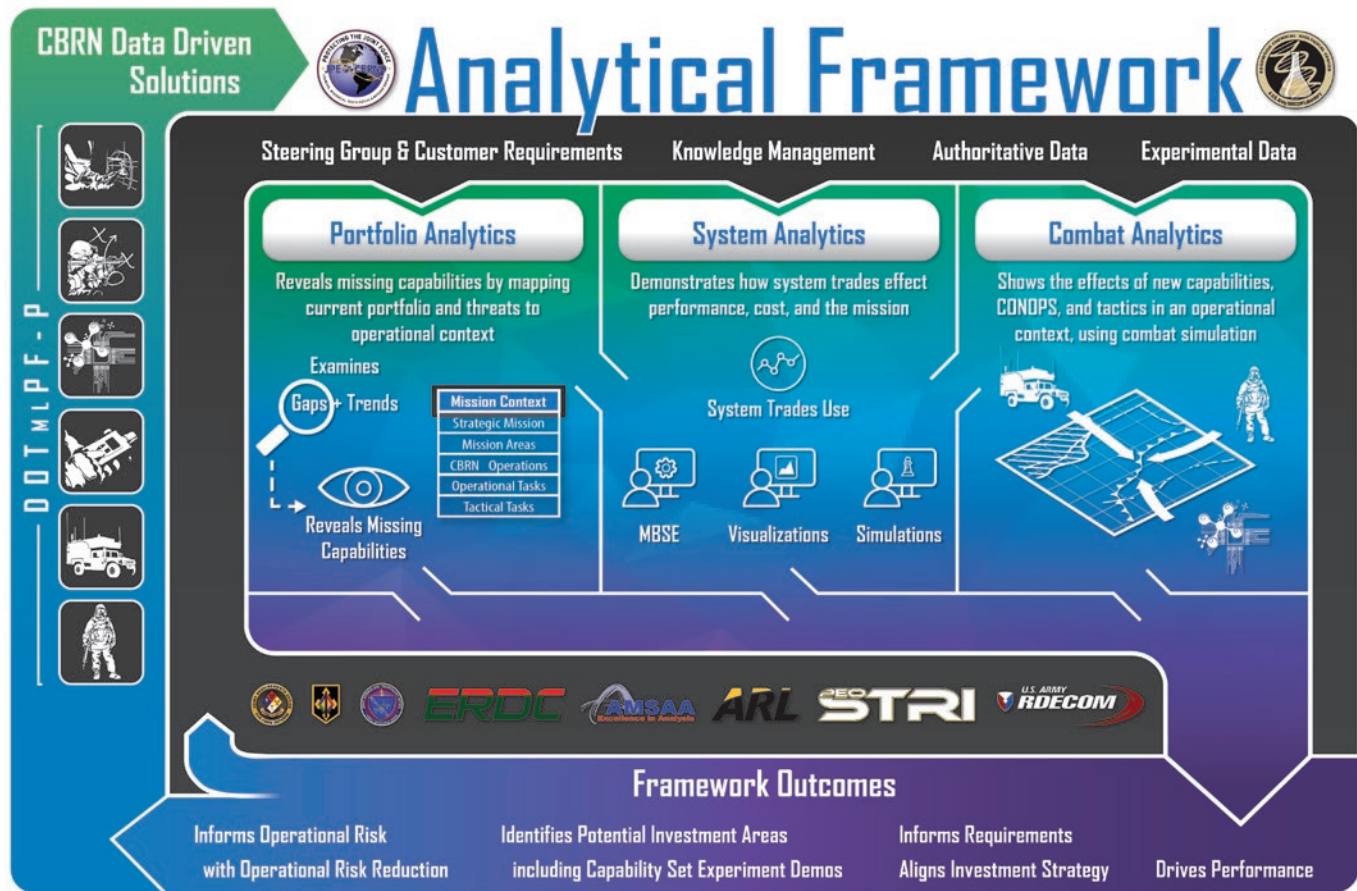
SHOW AND TELL
Three key analysis areas—portfolio analytics, system analytics and combat analytics—feed the outcomes of the JPEO-CBRND Analytical Framework. The framework's data-driven analysis can demonstrate for stakeholders which course of action is best and explain why. (Graphic courtesy of JPEO-CBRND)

decomposing missions to the tactical task level, as well as working to incorporate more of the functions available within the Engineered Resilient Systems tool in its systems analysis efforts.

The JPEO-CBRND Analytical Framework concept could be applied by all defense acquisition programs to help determine where capability gaps exist within their portfolios and what solutions for filling those gaps will provide the most bang for the buck. This process provides data-driven analysis early in the acquisition process to help determine the best solutions for new capabilities.

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FACES *of the* FORCE

MR. BILLY MCCAIN

'Listen more and speak less'

Take it from someone who knows: There's a lot of overlap between being a product support manager for an Acquisition Category I program and being a minister. That someone is Billy McCain. He's the product support manager for the Global Combat Support System – Army (GCSS-Army) at Fort Lee, Virginia, part of the Army Enterprise Systems Integration Program within the Program Executive Office for Enterprise Information Systems. He's also an ordained minister, having earned a master of divinity from Virginia Union University.

"In both vocations, I must be an effective communicator and understand the challenges my clergy and my co-workers face," he said. "Likewise, in both professions I work with others to conquer those challenges to make a better product and a better person." Given that perspective, it's not surprising that he said active listening—"to listen more and speak less"—is the most important lesson he's learned over the course of his career and something he tries to do every day. "I listen to accumulate a full understanding of the problems at hand so as to not overlook possible solutions. This way, I'm sure that my comments address the problems at hand. This conceptual approach ideally makes my input more applicable as well as credible in its application."

He added, "In the end, both areas are about people, and both groups face a lot of change. In the acquisition world and outside of work, we need to be flexible when changes come or when we're faced with difficulties. It's in times of change that learners inherit the Earth, while knowers find themselves equipped to deal with a world that no longer exists."

McCain leads the effort to field and sustain GCSS-Army, an enterprise resource planning system that replaces aging and stovepiped tactical logistics systems with a web-based, integrated logistics and financial system. Its fielding represents the largest resource planning deployment in Army history. Over the course of five years, McCain and his team—roughly 120 government civilians and contractors—enabled the successful data conversion of more than 20,000 legacy systems to GCSS-Army in

two fielding increments, improving the property accountability of over $104 billion in assets. He developed and sustained an online training center and improved help desk operations. McCain also led the effort to field 1,158 handheld terminals and train 674 users, ensuring that the terminals were compatible with the GCSS-Army software and that the Soldiers knew how to use them effectively.

"My greatest satisfaction with being part of the Army Acquisition Workforce is knowing that my efforts are arming our Soldiers with a near-real-time logistics solution while ensuring the highest operational readiness possible for our nation's defense," McCain said. With GCSS-Army, commanders have visibility of all of their assets in close to real time, and the accurate picture of their logistics readiness supports battlefield decision-making. GCSS-Army fully integrates information in one system, eliminating time-consuming and costly reconciliations of supporting activities, customers and the supply sources required with the legacy systems.

He noted that classroom work for his Level III life cycle logistics certification played a role in the successful fielding effort. There, he had the chance to interact with other acquisition professionals "who shared program similarities, uniqueness and challenges associated with life cycle management," he explained. "From these similarities, I learned the importance of incorporating integrated product support elements early on into the development of our product. I also had the chance to learn about best practices for enterprise software integration, which can be applied to future increments."

HONORED BY ASA(ALT)
Billy McCain receives the 2017 Army Acquisition Executive's Excellence in Leadership Logistician of the Year Award in January at the Pentagon. From left are Dr. Mark T. Esper, secretary of the Army; McCain; Dr. Bruce D. Jette, assistant secretary of the Army for acquisition, logistics and technology (ASA(ALT)) and the Army acquisition executive; and Jeffrey S. White, principal deputy to the ASA(ALT). (U.S. Army photo)

With the fielding of GCSS-Army completed, McCain's biggest challenge is transitioning from a fielding organization to one focused on sustainment. "We need to continue to support what's out there while also preparing for new increments," he said. "That requires us to take a look at our staff and to identify the right mix of talent that can support both of those efforts."

McCain became a part of the Army Acquisition Workforce in 2009, when he was assigned to the GCSS-Army program as a Soldier. "It was my first acquisition program, and I served as the government finance team lead and member of the functional integrated concept team, which aided in the development of the product." His last job in uniform was as a combat developer with the U.S. Army Combined Arms Support Command, which gave him exposure to the type of work and opportunities that acquisition could offer. "Once I retired, I continued my work on this program as a civil servant, first as the government finance lead, then retail supply and material management lead, followed by the finance deployment lead, and finally as the product support manager."

For McCain, the project's biggest appeal and its biggest payoff have been working with others. "What appealed to me about the work was the enormous collaboration that was required to get a product from conception to implementation. Collaboration with Army leadership, trading partners, Army commands and the lead system integrator was essential in producing a flexible and efficient product," he said. "I had no idea how rewarding it would be to be involved in this program, from the interaction I had with everyone involved to knowing that our work reached more than 100,000 Soldiers and made their jobs easier."

McCain's work earned him the Army Acquisition Executive's Excellence in Leadership Logistician of the Year Award. "I was very humbled to receive the award, and I think it's a testament to the team effort involved in the project," he said. "To me, it's the sign of a great organization and great personnel." He has had the chance to advise some junior acquisition personnel, and he noted that the best advice he has given is "to face planning and problem-solving with humility, to stay humble and be flexible, and to accept and expect constant change. We are in the business of producing effective products based on user requirements that often change. We must be receptive and adapt to that change to ensure that we are providing the best product possible."

—*MS. SUSAN L. FOLLETT*

LOOK OUT BELOW
U.S. Soldiers assigned to the 173rd Infantry Brigade Combat Team (Airborne) conduct an airborne training operation April 17 at Hohenfels Training Area, Germany, during the first JWA executed in Europe. The JWA helps the Army evaluate emerging concepts, integrate new technologies and promote interoperability within the Army as well as with other services, U.S. allies and other coalition partners. (U.S. Army photo by Spc. Tadow McDonald, 55th Combat Camera)

STARTING *WITH AN* ENDING

As Network Integration Evaluations come to an end, the Joint Warfighting Assessment takes on new importance.

by Col. J. Ward Roberts

On April 22, the Army kicked off a major joint operational exercise for future force development. Six separate three-star headquarters and more than 6,500 participants from 10 partner nations came together on foreign soil to execute realistic training scenarios against a near-peer adversary.

This view of future warfare, where joint and multinational interoperability is the norm—combined with a modernization effort focused on emerging capabilities and experimentation—is driving an adjustment in how the Army conducts two major operational exercises: the Joint Warfighting Assessment (JWA) and the Network Integration Evaluation (NIE).

Originally designed as complementary exercises, the JWA and NIE used Soldier feedback to evaluate, integrate and improve hundreds of government and industry technologies. Now, after serving the Army well, the NIE will end in November, while the JWA will continue as an annual event led by the U.S. Army Training and Doctrine Command (TRADOC) and its subordinate U.S. Joint Modernization Command (JMC).

In the future, the Army will use the JWA as one element in assessing experimental capabilities to help evolve mission command capabilities and network strategy, and

to shape requirements. Likewise, the JWA will continue to improve interoperability among joint and coalition partners while informing tactics, techniques and procedures. Together with a series of smaller events, the JWAs will support the new Army Futures Command and cross-functional teams to facilitate faster development of future capabilities.

Now, after executing the JWA in Europe for the first time, the Army will use lessons learned from the event as it moves the exercise to Joint Base Lewis-McChord, Washington, next year with a focus on the Pacific theater of operations, and as it continues to shift acquisition processes to support modernization.

NIE MISSION ENDS

When the 3rd Brigade Combat Team, 82nd Airborne Division (3/82) arrives at Fort Bliss, Texas, this November, it will close out the last NIE. While there, it will evaluate three systems under test: the Distributed Common Ground System – Army; the Mission Command Information System, part of the Command Post Computing Environment; and the Mounted Mission Command System, part of the Mounted Computing Environment. It will also conduct demonstrations of air-ground integration and tactical radios, including items that the network cross-functional team has recommended for assessment. After running through operational scenarios with the new equipment, the 3/82 will provide feedback to help inform procurement and fielding decisions.

In the 3/82, the Army will look to a rotational unit, in this case a light infantry unit, to provide feedback on how its Soldiers will use the tactical network, mission command capabilities and

communications for their unique missions. The 82nd Airborne Division has requested that scenarios at the NIE focus on joint forcible entry operations, to take advantage of the unique capabilities of the 82nd Airborne, which serves as the Army's rapid deployment force and must be able to respond to any threat worldwide with very little notice, flying from home station to seize key terrain inside a contested battlespace. And because two of the three systems under test are found in the command post, modeling and simulation will play heavily into the scenario, replicating maneuver companies so Soldiers can run multiple drills in the command post. All of this will take place in a heavily contested cyber and electronic warfare environment to fully stress the systems against replicate threats.

The NIEs, begun in 2011, made significant strides for the Army as a forcing function for integration. Up until that point, the Army developed and delivered individual components of its tactical communications network separately, leaving integration for the end. The NIE served to reverse that, bringing together numerous digital tactical communication systems at one large operational assessment, held twice a year at Fort Bliss and White Sands Missile Range, New Mexico. For several NIE cycles, Soldiers from the 2nd Brigade, 1st Armored Division were the dedicated test unit, trying out the gear in operational scenarios and providing operational feedback to inform procurement and fielding decisions.

The construct worked. Over the past seven years, the NIEs helped the Army integrate and fully test several major network capabilities under development, while shedding light on next-generation warfighting technologies. In all, more than 300 capabilities went through the NIE construct, leading to important advances in expeditionary networking and mission command. The NIE identified gaps across capability portfolios, assessed technologies for filling gaps and aligned programs of record to address shortfalls with interoperability.

However, as the Army steadily embraces rapid prototyping, experimentation and the "fail early" mentality of trying out a capability before making it a program of record, the NIE is no longer the best model for network modernization. In 2015, the Army decided to make the NIE an annual event, sharing time with a complementary new assessment, known as the JWA (originally named the Army Warfighting Assessment), which focused on experimentation, prototyping and joint and multinational interoperability. This year, the Army decided to move forward solely with the JWA, starting in FY19.

> *Originally designed as complementary exercises, the JWA and NIE used Soldier feedback to evaluate, integrate and improve hundreds of government and industry technologies.*

MILES TO GO

M2 Bradley fighting vehicles are lined up in Grafenwoehr, Germany, in April to be fitted with Multiple Integrated Laser Engagement System gear in preparation for a field exercise during Exercise Combined Resolve X. The JWA leveraged Combined Resolve X, along with the Air Force's Blue Flag, to create a more complex and realistic training environment while replicating the challenges of the modern battlefield. (U.S. Army photo by Spc. Dustin D. Biven, 22nd Mobile Public Affairs Detachment)

JWA MOVES FORWARD

This spring, for the first time, the JWA took place outside the United States. Units from the 2nd Brigade, 1st Infantry Division; the 1st Infantry Division headquarters; the 173rd Airborne Brigade and others gathered in Germany from April 22 to May 9 to assess new concepts and capabilities alongside joint and coalition partners that included brigade headquarters from the United Kingdom, Canada, France and Germany, a battalion headquarters from Denmark and participants from Italy, Australia, New Zealand and Spain. The JWA leveraged two other exercises taking place in Europe at that time, the U.S. Air Force's Blue Flag and the U.S. Army's Combined Resolve X.

The JWA 18 segment of the event required units to operate in a mission partner environment, meaning that U.S. mission command systems shared a common operating picture across U.S.

forces and coalition partners. Shared services included email, chat, chat rooms, order disseminations and SharePoint. The exercise assessed the integration of a three-star Army headquarters and three-star Air Force headquarters, which were required to pass information not only between commands, but also across the many participating countries.

The execution of the JWA in Europe—at Grafenwoehr Training Area and Hohenfels Training Area in Germany—brought new challenges for the acquisition team that supports the events. Up until last year, all NIEs and JWAs were planned and executed at Fort Bliss. This time, some planning and coordination happened at Fort Bliss, but the brunt of activities, from integrating vehicles to validating the networks needed for the exercise, occurred overseas.

One of the biggest challenges came in the form of network planning. Although there are some common international standards for sharing data, no two countries use exactly the same mission command systems. The Program Executive Office for Command, Control and Communications – Tactical (PEO C3T) brought deliberate network configuration, through the use of detailed architecture products, to the JWA to ensure that the different systems could communicate and execute vital messaging as seamlessly as possible. Two key pieces of early technology—Automated Communications Information Software and the Mission Command Information System—helped support this interoperability.

As part of JWA 18, the Capability Package Directorate, as the lead for the assistant secretary of the Army for acquisition, logistics and technology (ASA(ALT)), supported the JMC and several other partners in preparing and assessing solutions to the Army Warfighting Challenges. These warfighting challenges are

key areas in which the Army has deemed it needs either new capabilities or a better way of using what it has today. The concepts and capabilities were assessed through the lens of 18 of the 20 Army Warfighting Challenges, such as to "Ensure Interoperability and Operate in Joint, Interorganizational, Multination Environment" and to "Employ Cross-Domain Fires."

The Capability Package Directorate, with support from PEO C3T's Technology Management Division, Project Manager for Mission Command and Project Manager for Tactical Network as well as the Project Manager for Electronic Warfare and Cyber in the PEO for Intelligence, Electronic Warfare and Sensors, had to incorporate and validate almost 30 concepts and capabilities into the operational network for JWA 18. Three of the most mature systems included the Electronic Warfare Phase 1 systems developed by the Army Rapid Capabilities Office and the Project Manager for Electronic Warfare and Cyber, Project Manager for Mission

Command's Army Coalition Interoperability System and its early release of the Mission Command Information System, which will be under test in November.

Soldiers assessed additional concepts that included the tactical power management concept, ground mobility vehicle, mobile protected firepower and the robotic complex breach. Capabilities included short-range air defense at division and below and Stryker-directed energy at the forward edge. The team also integrated systems on vehicles, including capabilities for counter-unmanned aircraft systems, radars, navigation and coalition interoperability. Taking the exercise overseas for the first time required ASA(ALT) to coordinate these integration efforts with a variety of multinational players, and to teach new partners how NATO operates its technology and intelligence systems. These experiences and the lessons learned will benefit the execution of future JWA events, as well as real-world operations with allied nations.

WORKING TOGETHER
NIE 14.2, which took place in May 2014, featured more than 900 Marines, a British mechanized brigade headquarters and 3,800 Soldiers from the 2nd Brigade, 1st Armored Division, who fought side by side in a combination of live, virtual and constructive battles. Historically, the NIE complemented the JWA, gathering Soldier feedback to help improve government and industry technologies. (U.S. Army photo by Nancy Jones-Bonbrest, PEO C3T)

TUNE IN
The NIEs played an important role as a forcing function for integration. Before the NIEs, which began in 2011, the Army developed and delivered tactical communications network components separately and left integration until the end. (U.S. Army photo)

CONCLUSION

From now on, the yearly JWA, with its focus on emerging capabilities, experimentation and operational concepts, fits the Army's modernization strategy with alternating annual orientations in either the European or Pacific theater. JWAs will support three primary objectives: enhance training readiness; inform future force development; and enable joint, interorganizational and multination warfighting. Program managers can take advantage of the JWAs, inside those objectives, to get operational feedback on products before operational test events. Additionally, the Army will use a range of test and evaluation events from various other venues, including labs, warfighters, formations outside the continental U.S. and other events from company to corps size, to support traditional operational testing.

ASA(ALT) will continue to support these events with network planning, network integration, vehicle integration, management of field support representatives, new equipment training and other needs in support of TRADOC and JMC. As the Army's rapid assessment model continues to evolve, with JWA as the main mission complemented by a series of small and medium opportunities, ASA(ALT) is poised to apply expertise gained through the NIE and JWA to enable integrated and efficient evaluations of emerging concepts and capabilities. The Capability Package Directorate will continue to be a focal point to integrate program and project manager support into these missions. And as the U.S. Army Test and Evaluation Command drives the future planning requirements for large program-of-record tests that would have taken place at NIE, an ASA(ALT) team

will continue to assist in integrating network and mission command elements.

With JWA 18, the Army demonstrated the ability to execute a future force development exercise in the most realistic conditions possible. NIE 18.2 will close the book on seven years of informative tests and meaningful system-of-systems integration test events. Now, with Soldier feedback still at the core of the mission, the Army is ready to take the next step in evolving its evaluation events to enable modernization.

For more information, go to **https://www.bliss.army.mil/JMC/**.

COL. J. WARD ROBERTS is director of the Capability Package Directorate. He holds an MBA from Columbia Southern University and a master of strategic studies from the U.S. Army War College, as well as a B.A. in political science from the University of South Florida, where he received a commission of second lieutenant in the infantry. Roberts is Level III certified in program management and Level II certified in contracting, and is a member of the Army Acquisition Corps.

The NIEs helped the Army integrate and fully test several major network capabilities under development.

FACES *of the* FORCE

MR. MATTHEW WARNER

COMMAND/ORGANIZATION: Acquisition Reporting and Assessments Office, Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA(ALT))

TITLE: ASA(ALT) action officer

YEARS OF SERVICE IN WORKFORCE: 9

YEARS OF MILITARY SERVICE: 21 (11 years active duty; 10 years Army Reserve)

DAWIA CERTIFICATIONS: Level III in program management

EDUCATION: Master of strategic studies, U.S. Army War College; master of public policy analysis, University of Missouri; MBA and BBA, Western Michigan University

AWARDS: Army Meritorious Service Medal (3); Civilian Achievement Medal (3)

Bringing clarity to the mission

It has been a busy few years for Matthew Warner: As a fellow in the Competitive Development Group/Army Acquisition Fellowship program, he has completed several broadening assignments, including rotations as a project officer, source selection board chair and assistant program manager. The assignments reflect the program's overall goal to expose participants to the range of responsibilities and skills that an acquisition professional at the GS-14 level or above needs to successfully support the Army's acquisition mission.

"My greatest satisfaction from the program has been the broadening experience that the rotations provide," he said, noting that the program encourages participants to seek rotations that are outside of their comfort zone. Warner worked with his mentor, Mike Cadieux, now acting deputy project manager for the Joint Light Tactical Vehicle Program and formerly the acting deputy program executive officer for Combat Support and Combat Service Support (PEO CS&CSS), to map out assignments that augmented his program manager background with exposure to new areas.

Warner's most recent assignment, which began in November, supported the Acquisition Reporting and Assessments Office in the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA(ALT)), where he monitored changes to the National Defense Authorization Act and Title 10 and revised implementation guidance that affects DA system coordinators (DASCs) and the PEOs they represent. (The office was created earlier this year with the merger of the Army Systems Acquisition Review Council and the Office of Performance Assessments and Root Cause Analyses.) Additionally, he worked with experts in the areas of better buying power and should-cost management to update implementation guidance for annual reporting requirements and to staff several policy changes that affect the Defense Acquisition System, from senior leaders all the way up to the chief of staff of the Army.

While his official position was action officer, Warner noted that "jack of all trades" is a more appropriate title. "From the DASCs to the secretariat, there are no shortages of taskers that force me and my co-workers out of our comfort zones into areas where we may have no prior expertise," he said. "Taskers often require multiple iterations of horizontal communication with experts, and in many cases, there are no process owners, only an enterprise-wide effort to tie it all together."

Warner has been in acquisition since 2009, following 11 years as active-duty Army and two years with Jacobs Engineering Group Inc., supporting the Mine Resistant Ambush Protected (MRAP) Vehicle program within PEO CS&CSS. "When I left the Army, I had just completed a 15-month stint commanding a combat engineer company in Iraq, where I was responsible for route clearance on parts of Route Tampa in Baghdad, a supply route that runs from Baghdad to Fallujah. I knew firsthand we needed better route clearance equipment, and I wanted to continue to serve the Army as I transitioned from active duty."

He has been with PEO CS&CSS ever since, as the MRAP RG-31 program transitioned from a joint operational needs statement program to a program of record. (The RG-31 is a variation on the basic MRAP design.) He has overseen projects all along the system's life cycle, including design, production, fielding, engineering change proposals and block upgrades. Warner, who is a member of the Army Reserve, noted that his military background provides a unique perspective to his work. "As a Soldier, I understand the mission and what it supports. I know what warfighters need and why they need it, and since I've been there, I also understand the urgency."

He entered the Competitive Development Group/Army Acquisition Fellowship program in 2015. "I was surprised by how willing the program mentors and even the supervisors were to allow us to define our own work effort. There are no expectations about the left and right limits of the assignments," he said. Fellows "are required to solve unstructured problems and

to network across the enterprise. The program is really geared toward leadership and individual initiative."

During his second rotation, for example, he served as a project officer in the Project Manager for Transportation Systems (PM TS) within PEO CS&CSS. "The problem I addressed—declining trailer readiness—had no routine solutions and wasn't well-defined." Warner created and led an enterprise-wide integrated product team that evaluated the entire PM TS portfolio, eventually contracting for a capabilities-based assessment of the heavy trailer portfolio that would identify what an armored brigade combat team would need in 2025.

"That rotation was definitely the most impactful one I had throughout the program," he said. "It gave me a better idea of what goes into a capabilities-based assessment and how requirements are developed. Before the assignment, I had only worked on programs that were post-milestone C; I had a limited exposure to what went on before milestone C, and how complicated the requirements development process can be."

The program also gave Warner the opportunity to learn how to create structure out of ambiguity. "The assignments I was placed in did not have firm boundaries, processes or working networks. It took legwork to establish working teams and systems and to stand up structure where none existed," he said, adding that constant communication and solid problem-solving methodology were factors in his success.

"Whether using the Six Sigma DMAIC [define, measure, analyze, improve and control] approach, the military decision-making process or conceptual thinking, the key takeaway is that whiteboarding the problem to an acceptable level of detail and building a team of stakeholders to solve it is the only way to slow a moving target," said Warner. "It's also the only way to break the cross-functional stovepipes that prevent getting at root causes."

Warner has this advice for potential Competitive Development Group/Army Acquisition Fellowship participants: Do what he did, only backward. "My only regret is that I wasn't able to front-load my 179-day rotational assignment at the Pentagon. … Make a solid attempt to start that first. The perspective gained from exposure to the acquisition assessment and reporting process in the ASA(ALT) front offices in the Pentagon is an advantage that will aid other CDG rotations."

—*MS. SUSAN L. FOLLETT*

TEAM BUILDING
As an action officer in the Acquisition Reporting and Assessments Office, Warner, shown here with his team from ASA(ALT), analyzes how changes to the National Defense Authorization Act and Title 10 affect the Army. (Photo by Maj. Kralyn Thomas, ASA(ALT) Acquisition Reporting and Assessments Office)

RADICAL

RED LIGHT, GREEN LIGHT
A test vehicle approaches a checkpoint at ARDEC's Tactical Behavior Research Laboratory at Picatinny Arsenal, New Jersey. Researchers were studying how drivers reacted to different types of warnings and which nonlethal methods were effective in hailing and stopping approaching drivers. (U.S. Army photo by Robert DeMarco, RDECOM ARDEC)

FUTURES

ARDEC lab's test beds are laying the foundation for the future of the Soldier, one behavioral experiment at a time.

by Dr. Elizabeth Mezzacappa

The use of increasingly sophisticated tools over time is one of the defining characteristics of humankind. This trend's potential has been imagined in literature, often through fictional inventors such as Marvel Comics' Shuri (from "Black Panther," 2005) and Tony Stark ("The Invincible Iron Man," 1963), Ian Fleming's Q (James Bond series, 1958) and even Isaac Asimov's Susan Calvin ("I, Robot" series, 1945). These illustrate humans teamed with devices that are more than merely tools, but are engineered "entities"—robots, drones, swarms and other tools that their human creators have endowed with very human capabilities. Which means that humans will adapt quickly to these tools—and the better they are designed, the more quickly humans will adopt and evolve them.

From cybernetic enhancements to artificial intelligences based on human neuroscience, these technological developments require a merging of engineering and psychology. It is one thing to create the tools we need today. It is entirely another to envision the future and create the tools we will need then.

We know the future means humans even more closely teamed with their tools. A significant question for the engineers, scientists and psychologists who are developing future tools is, which fantastical elements invented by Q, Stark, Calvin or Shuri can (and should) be engineered in our real universe, with our real physics, and real flesh-and-blood Soldiers?

Combat occurs increasingly in complex urban centers and among noncombatant populations, so engineers must develop armaments and protection optimized for these settings. Most difficult is "engineering" the human psyche and human flesh into these created machines and integrating so seamlessly that the technological "magic" becomes mundane, as easy as putting on pants.

Engineers tend to lack a background in people sciences like psychology, so how do engineers generate the data about humans needed to create systems of human-machine symbionts ready for war in unfamiliar territories? Tactical behavior research is one way, an approach that looks to understand and improve human and machine performance in tactical, combat situations through close collaboration between human behavioral scientists and materiel developers who build armaments and other tools for Soldiers. Since 2004, the Tactical Behavior Research Laboratory (TBRL), of the U.S. Army Research, Development and Engineering Command (RDECOM) Armament Research, Development and Engineering Center (ARDEC), has conducted human tactical behavior research.

The laboratory's research looks at humans at both ends of the barrel. Focus areas include:

- Effectiveness of lasers, noncoherent light and windshield obscurants on stopping shooters and vehicles at a checkpoint under daytime and nighttime conditions.
- Soldier-system lethality analyses of different configurations of the Objective Gunner Protection Kit.
- Effectiveness of flash-bang grenades and other pyrotechnics on target suppression.
- Electrophysiology and decision-making during weapon operation (in consultation with the U.S. Army Natick Soldier Research, Development and Engineering Center and the U.S. Army Research Laboratory's Human Research and Engineering Directorate).
- Pain and motivational processes relative to blunt-impact weapons (all performed under protocols approved by research ethics boards and safety offices).
- Biomechanical analyses of forces needed to knock down a person.
- Indoor and outdoor studies of aggressive acts, and crowd (up to 89 people) behavior for modeling and simulation.
- Law enforcement officer and squad performance.

A description of the laboratory's development serves as an example of how other research, development and engineering centers might configure their own capability of tactical behavior research for their product domain, especially in support of the Army's modernization priorities.

HIGH-FIDELITY LABS AND TEST BEDS

For a Soldier standing watch, the minivan barreling down on the checkpoint is a life-or-death situation in which the Soldier has seconds to decide whether to open fire. Soldiers in a convoy of Army trucks facing a crowd of angry townspeople—blocking a road, chanting and throwing rocks—have to disperse the

ARMED AVATAR

A researcher wears a motion-capture suit as his computer-generated avatar appears on the screen behind him. Using computer-generated characters and avatars opens new avenues for armament and social-psychological experimentation. (U.S. Army photo by Hugh Huntzinger, RDECOM ARDEC)

Tactical behavior experimentation must bend psychological science in service to engineering, and adopt the mindset and constructs of acquisition science.

gathering of civilian men, women, elders and children to complete the mission.

The human science—the psychology of the Soldiers in these scenarios—is critical to understand. This can't be done by conducting research in the typical one-room psychology laboratory of a university or research institute testing undergraduate student subjects, or even the researcher's own co-workers.

To understand that psychology, we need research conditions that mimic these settings. That's what distinguishes tactical behavior research from typical psychology experiments. Behavioral science theories are used to guide the engineering of the test beds to create the appropriate psychological (perceptual, motivational, social) conditions for the experiment and to capture the appropriate data.

TBRL has created a number of indoor and outdoor laboratory conditions that simulate real-world tactical scenarios at its facility at Picatinny Arsenal, New Jersey. A sample of the test beds includes:

- Targeting and shooting facilities (including an arms room and explosives storage).
- Simulated minefields with controllable levels of visual obscuration (fog).
- A gas-vented range to test flash-bangs.
- A 1.5-mile-long convoy protection and aggressive acts test bed.
- Indoor and outdoor crowd test beds with motion capture (a way to digitally record human movements).
- Vehicles and tracks that automatically record driver behavior.
- "In vivo" testing in public locations such as theaters, religious buildings, schools, city subways and sports stadiums.

The largest test bed, the Squad Performance Test Bed, consists of both a large outdoor area of 700 by 500 meters (about eight football fields) and an indoor test bed. The outdoor area has instruments to capture behaviors of fire teams, squads, platoons or other groups during outdoor warfighter battle drills. Instrumentation includes video cameras and motion-capture sensors to record Soldier responses in a react-to-contact battle drill. The indoor structures were custom-built for room-entry testing and

are modifiable to be center- or side-fed rooms, since door location determines where the Soldier points the gun.

REAL SCIENCE, VIRTUAL TEST BEDS

One might ask: If test conditions are supposed to be close to combat conditions, how can TBRL test for urban or subterranean settings that don't exist near rural New Jersey? New levels of both realism and experimental control are now achievable with immersive virtual-, mixed- and augmented-reality laboratories. TBRL's first virtual-reality laboratory was built in 2010. Now in its third iteration, the testing facilities include multiple 360-degree mixed and augmented virtual-reality simulators in 30-by-30-foot octagons. In addition, TBRL has integrated a virtual-reality headset system that fully immerses viewers into the scenario. The virtual environments are developed in-house by ARDEC's Gaming and Interactive Technology and Media group, which allows researchers access to all aspects of the system to modify and extend their capabilities for experimentation.

One extended capability is achieved through combining the virtual environment methods with motion capture abilities—avatars. That is, the test bed virtual environment is brought to life by incorporating a wide range of avatar behaviors within the computerized scenery. Computer-generated characters and avatars greatly extend the capabilities for social-psychological experimentation into human-human or human-entity teaming. In the golden age of group dynamics studies, "stooges" (i.e., research actors with scripts) were used, unbeknown to subjects. These stooges acted to create a controlled social situation (think of the famous Milgram conformity experiment, in which the stooge was instructed to yell in pain when subjects turned up a knob that looked like it was delivering electrical shock, in order to test the subjects' obedience to authority figures).

In place of stooges, characters and avatars can be programmed to behave in any manner and take on any appearance that artists can render in programming. With avatars, we can, for example, conduct a Soldier-robot interaction experiment without the time and expense of building a real functioning robot. Artists could render a humanoid-looking metal entity that moves and speaks through a researcher's movements and speech. In the virtual environment, then, Soldiers are led to act as if they were interacting with robots. Researchers could learn about how

best to build robots so that Soldiers will work with them, through observing these virtual interactions and providing data to inform robot design requirements.

In a similar way, experimentation with weapons that do not exist is made possible by research in a simulator. Through software, programmers can create future weapons in the simulators, then operators use these devices within combat scenarios. For example, testing might examine the effect of increasing weapon range versus area covered for use in an urban environment, where distances are more limited than in open fields. Virtual experimentation with simulated weapons allows designers to gather lethality and other performance data and feedback from operators before bending metal. Human experimentation in the virtual environment allows materiel developers to verify and validate novel concepts of armaments such as swarms of drones or directed energy weapons, as well as to

identify performance requirements, especially lethality, in advance. In this way, researchers can chart the progress toward future weapons with more certainty.

A RADICAL DEPARTURE

A reading of any behavioral science journal article reveals quickly that typical psychological research is simply not configured to answer engineering questions. Research psychologists strive to reveal universal precepts of human behavior. Materiel developers yearn for characterization of a specific device. Tactical behavior experimentation must bend psychological science in service to engineering, and adopt the mindset and constructs of acquisition science, such as metrics of lethality, verification and validation, cost and capability trade-offs, analyses of alternatives, benchmarking and comparative testing of specific devices.

For example, one experiment planned by TBRL will research the relationships

A required precursor for engineering-focused human research is perhaps the most challenging aspect — joint experimentation efforts between engineers and psychologists.

SUBWAY SCIENCE
Researchers install cables for transmission of motion-capture and video recording throughout a section of a subway platform and on several train cars at a transit station in a major U.S. city. TBRL conducts "in vivo" testing in public locations such as theaters, religious buildings, schools, subways and sports stadiums. (U.S. Army photo by Charles Sheridan, RDECOM ARDEC)
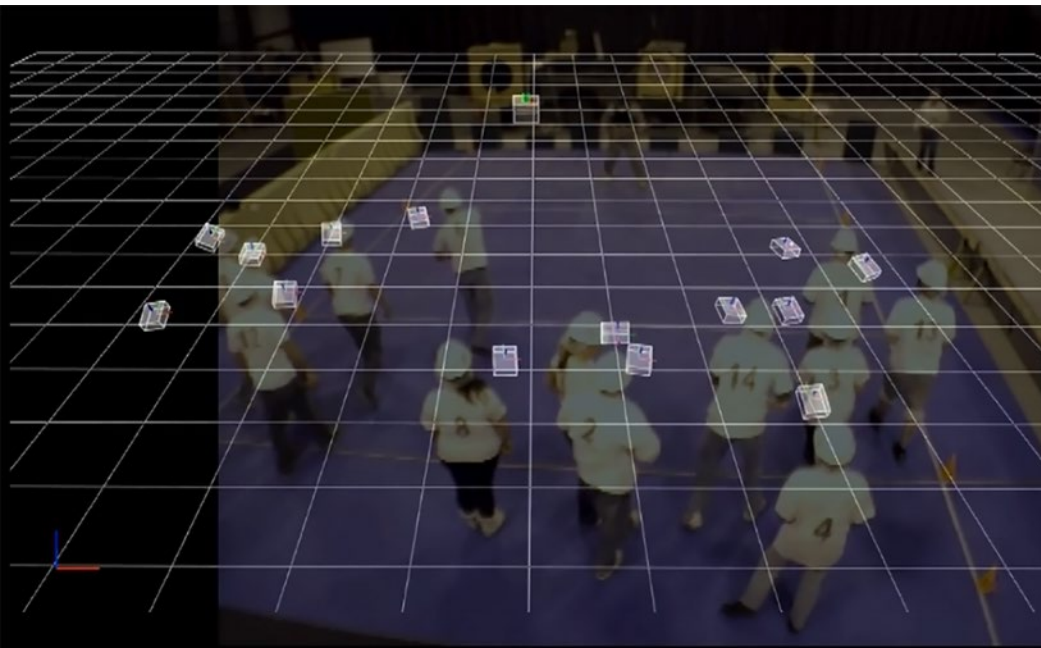
FACES IN THE CROWD
Crowd motion-capture data is overlaid on a video recording, with the boxes indicating the location and orientation of each of the crowd members and each member of the control force. The results are used to help Soldiers understand what nonlethal weapons might be used to react to aggressive behavior in such circumstances. (U.S. Army photo by Robert DeMarco, RDECOM ARDEC)

among Soldier cognitive fatigue, number of drones controlled and number of targets destroyed over a simulated mission to develop an algorithm that explains the connections among those variables. With this type of data, analysts can conduct trade-off analyses—for example, balancing the cost of building the optimal number of drones and Soldier-drone interfaces versus the lethality of the drone swarm versus the cognitive demands and stress on the operator.

Current regulations require that human-factors professionals—who primarily assess designs for ergonomic flaws and related Soldier performance concerns—be consulted at all developmental research and operational testing phases of the acquisition cycle. Based on our experience at TBRL, we propose a more radical solution—that each of the research engineering centers establish its own dedicated behavioral scientist laboratory to conduct the relevant engineering-focused human science experimentation. This early collaboration would then complement the

independent, third-party role of evaluation later provided by the human-factors specialist. By "embedding" behavioral science laboratories in all Army research, development and engineering centers, the right human research is done effectively to support the development of equipment for Soldiers. However, a required precursor for engineering-focused human research is perhaps the most challenging aspect—joint experimentation efforts between engineers and psychologists.

DIFFICULT QUESTIONS
In the last few years, TBRL's capabilities have come to the attention of the larger RDECOM ARDEC engineering community. Armament engineers have questions that require behavioral science methods and research designs and analysis. Behavioral scientists begin by working with materiel developers on articulating the knowledge gap, then translating the knowledge gap into a behavioral science research question. More discussions follow, resulting in designing the experiment and analyses to generate human

data that is needed to answer the question, describe the requirement or guide design. Engineers assist in the actual running of the study as well.

Materiel developers now come to the laboratory with questions that can be answered only through human-subject research, which requires experimentation that is approved and overseen by boards that ensure ethical conduct of research. Behavioral scientists are well-trained in the principles of the ethical conduct of human-subjects research, a topic possibly quite foreign to engineers. Therefore, in preparation for running human experimentation, engineers also take the required human-research ethics training.

There are many benefits to collaborations. Joint research between engineers and psychologists aligns with the cross-functional teaming principles outlined in the Army's modernization priorities. Moreover, the close collaboration of engineers and psychologists in tactical behavior research addresses transition problems identified

FOG OF WAR
Fog generators, together with ductwork and fans, produce obscuration at a simulated minefield test bed at the TBRL. Researchers were seeking to measure how long a person could be delayed from finding mines by obscuring the minefield, as well as how long a delay varying amounts of fog would produce. (U.S. Army photo by Robert DeMarco, RDECOM ARDEC)

A GOOD WALK SPOILED
A pyrotechnic device is detonated as a pedestrian walks through an outdoor test bed at the TBRL. Researchers were testing whether a blast would drive an unauthorized person away from a restricted area. (U.S. Army photo by Robert DeMarco, RDECOM ARDEC)

in the 2015 publication "Soldier Squad Performance Optimization." This report cited the challenges of bringing behavioral science data to customers—both to Soldiers and to engineers who build Soldier equipment. At least the second challenge can be resolved when materiel developers pose the engineering research questions and work with behavioral science on the experimentation to answer them. Joint research also mitigates the risk that promising technologies won't make it to Soldiers, a risk cited by the Army Science Board 2017 study "Improving Transition of Laboratory Programs into Warfighting Capabilities Through Experimentation."

CONCLUSION
How engineers and psychologists engage in joint research is demonstrated in the current laboratory efforts in the Armament Virtual Collaboratory Environment project. The work is a collaboration with the ARDEC Operational Analysis Branch to collect human performance and psychophysiological data in the virtual environment to support development of artificial intelligence that could aid the dismounted Soldier. That is, the experiment gathers detailed information on how someone is doing while performing a task, not only physically but also psychologically. In turn, those data are submitted to machine-learning analysis to inform the development of devices that are trained to "think" the way the gunner thinks.

Specifically, engineers approached the Gaming and Interactive Technology and Media group and TBRL to design and demonstrate a behavioral experiment to identify characteristics of potential targets that lead to Soldiers' decisions in the battle. The intended long-term outcome of the work will be a Soldier-armament interface with advanced fire
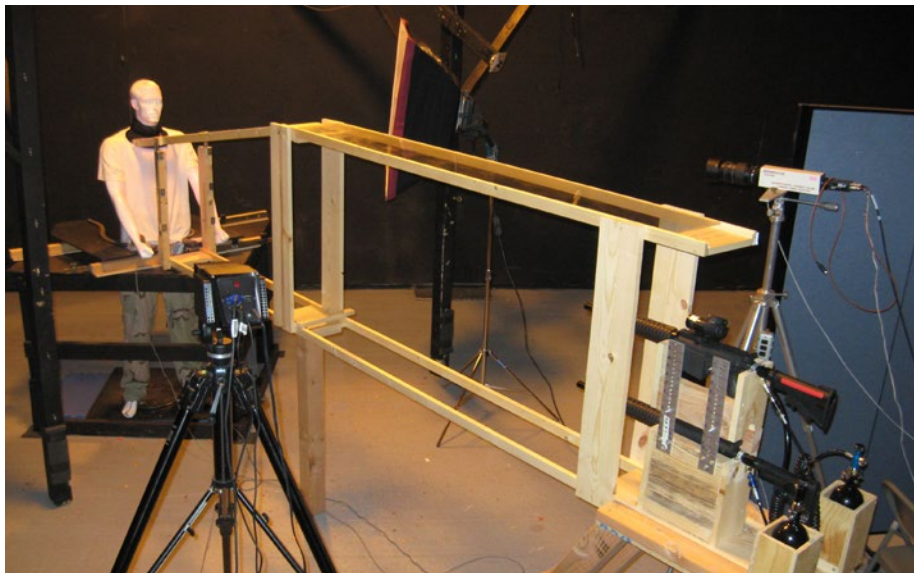
TAKE YOUR BEST SHOT
Test subjects in this test bed would stand in place of the dummy and shoot themselves with a paint gun. The research sought to address the possible associations among personality, pain tolerance, paintball velocity, injury severity and motivation. Researchers wanted to see how much pain was needed on the first shot to make a person decide not to take a second shot. Most subjects took the second shot, even though they got paid the same amount of money if they didn't. (U.S. Army photo by Kenneth Short, RDECOM ARDEC)
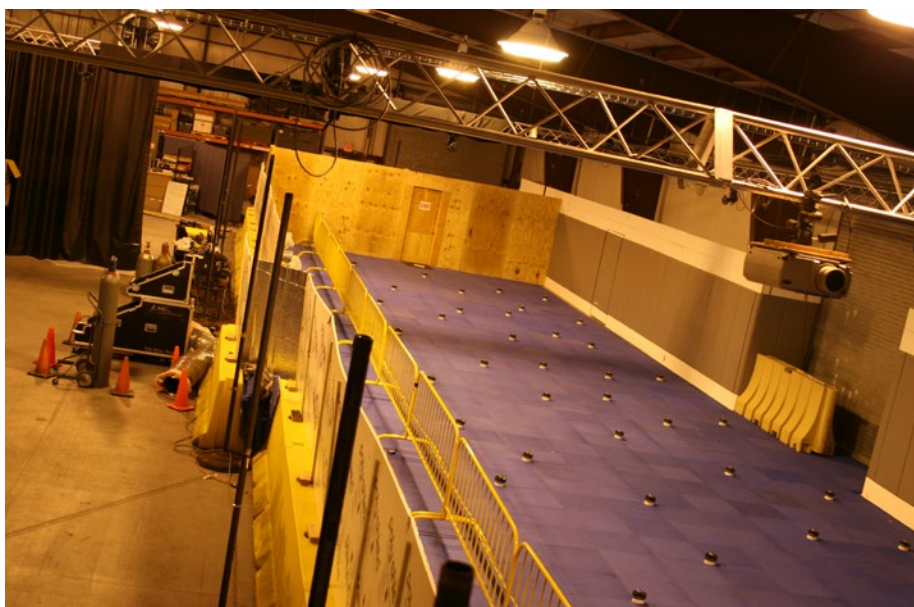
PSYCHOLOGICAL MINEFIELD
Simulated mines blink red and emit an acoustic signal to communicate a detonation. Researchers were studying the psychological factors determining a person's ability to cross a minefield. (U.S. Army photo by Gladstone Reid, RDECOM ARDEC)

controls, including optics and displays that enhance system lethality. This is the research we need to get to Jarvis, Tony Stark's machine assistant, and the target acquisition schematic he projects onto Iron Man's visor.

These data and other results must be gathered to answer fundamental questions for future warfare. What new structures of command and control must be configured between human and engineered entities? How should the labor be divided between them? Do we enhance the human brain and muscle or juice up the hard drive and armature? Or: Who (or what) pulls the trigger? Only research with both human behavioral and engineering considerations can answer these questions.

The successful blending of engineered entities and human entities is achievable only through collaborative science and experimentation between engineers and psychologists. Those robots won't build themselves. Not yet.

For more information, contact the author at **elizabeth.s.mezzacappa.civ@mail. mil**, *or go to* **https://www.milsuite.mil/ wiki/Target_Behavioral_Response_ Laboratory**.

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THE **FUTURE** *BATTLEFIELD*

Science fiction becomes science fact.

2023

A Soldier is on a foot patrol during an advise-and-assistance mission in a Middle Eastern nation. The trail ahead explodes in a brown blast of dirt and machine-gun fire opens up. He drops to the ground and looks through the S.M.A.R.T. sight on his rifle. Ahead is a wall of brown dust, but his sight overlays blue boxes showing the locations of the four allied soldiers in front of him on the trail. He doesn't need the red arrow on the left edge of the screen to tell him which side the machine-gun fire is coming from. On orders from his sergeant, the Soldier takes a position up the hill to lay down support fire. He counts five white boxes in his viewer, likely enemy locations, based on imagery analysis and acoustic signature of the enemy weapons. The boxes quickly turn yellow as the data confidence increases. He knows not to worry about all of the targets and focuses on the one flashing box. That's his priority target as his rifle coordinates with the rest of the squad to distribute targets in the most efficient way. Suddenly, Sparky, the squad's mechanical pack dog, runs over and drops a stack of fresh magazines on the ground. The Soldier looks at the counter on the side of his rifle; he hadn't noticed how low on ammo he was.

Image by Colin Anderson/ GettyImages

2034

A first lieutenant is on her first deployment as a cavalry platoon leader in a troubled North African nation. On the radio, her platoon sergeant calls, "Blue 6, this is Blue 7. Net sensors are detecting a lot of movement along the three-seven grid line." She launches a hawk, a small aerial drone, and can hear the tight whine of the motor as it takes off. The sound fades as the drone climbs higher and speeds forward. Soon the first lieutenant has a video feed as the hawk circles over the target area. Twenty or 30 Chinese-made enemy robotic tanks speed across the desert. Her platoon only has two Odierno manned battle tanks, one armored command vehicle and 12 semi-autonomous robotic battle tanks. They're outnumbered, but the American-built robots are faster and better armed. The first lieutenant taps the screen to direct her robots to initiate movement toward the approaching column and turns to the crew in the command vehicle. She orders her platoon sergeant to start entering targets from the hawk feed so that the computer can start analyzing and prioritizing indirect fires. As soon as the tanks make contact, they will require permission for lethal fires.

Image by Colin Anderson/ GettyImages

2056

The colonel entered the military way back when the "synths," or synthetic entities, required human permission to do anything of serious consequence. Especially in a military context. When he was a boy, his father would repair machines by trying to re-create a reported problem—back then, if a machine made an error and you gave it the same set of inputs, it would actually repeat the same error over again. All that's changed. The United Nations treaty banning fully autonomous military synths had to be scrapped after terrorists in Africa were able to mass-manufacture them by hacking civilian synths with custom code

Image by GettyImages and USAASC

and bolting on rifles. Fact was, training that kind of artificial intelligence software was so basic that any high school kid could have done it. Those first killer synths didn't care if they killed civilians and were so effective that human soldiers couldn't put them down. They were too fast. The only way to stop the genocide was to give military synths full autonomy. So here the colonel stands with his staff of coalition planners from the host nations in this region of Asia, ready to give a mission briefing to 800 synths. They've already got the battle plans loaded in memory, but his oral brief (the parts he includes in the brief and the inflection of his voice) will influence the synths' weighting of the instructions. It's their final programming to help them make sense of ambiguous situations they might encounter or to decide on changes to the plan once they deploy over the border. So the colonel spends about five paragraphs telling them the situation, his intent, the expected outcomes and the goals for each company. He makes sure to emphasize avoiding human deaths. These days, civilian casualties are extremely rare anyway, but best to emphasize the point. He wishes them luck and dismisses them to get on the trucks.

—DR. GORDON COOKE, ARDEC TACTICAL BEHAVIOR RESEARCH LABORATORY

TACTICAL-LEVEL
INNOVATION

Need a capability? The 3rd Brigade Combat Team of the 101st Airborne takes a DIY, every-Soldier-an-innovator approach.

by Maj. Tyrone Streifel and Mr. Michael Bold

The 101st Airborne Division (Air Assault) must be prepared to deploy anywhere in the world, ready to engage an enemy within 36 hours of being called. The command's vision is always to generate speed, agility and security during combat operations, which is a central ethos of the Screaming Eagle culture. There are uncertainties and risks involved in preparing to oppose an unknown peer or near-peer adversary, but counterbalancing those is the confidence that the 101st's Soldiers have in their equipment readiness and their competitive advantages over the enemy. So how does a highly specialized organization like the 101st Airborne Division stay at the cutting edge of warfare?

The commander of the 101st's 3rd Brigade Combat Team (3rd BCT) is attempting to answer this question. Col. John Cogbill has successfully integrated innovation into the entire BCT by inspiring subordinate leaders to embrace his vision of a "culture of innovation" and to create a force of "innovation insurgents."

Organizations that strive to maintain a "fight tonight" status don't have the luxury to wait for new equipment fielding through the Army's usual processes for acquisition and new equipment training. The reality is that in this era of globalization, our adversaries have access to technologically advanced capabilities. That's why Cogbill has encouraged a "do it yourself" approach in the 3rd BCT.

Cogbill was a senior military fellow at Stanford University in 2016 when Silicon Valley serial entrepreneur Steve Blank, former Army Rapid Equipping Force (REF) director Peter Newell and retired Army Special Forces Col. Joe Felter conducted their first "Hacking for Defense" class, in which teams of students innovate to find solutions to real-world national security problems. Cogbill served as an adviser and spent a lot of time interacting with innovators Newell and Felter. Hacking for Defense, commonly

NOTHING TO SEE HERE

A Satellite Transportable Terminal covered in camouflage netting is being tested for CERDEC, the result of two factors: the 3rd BCT's emphasis on embracing innovation and a partnership that developed when the 3rd BCT reached out to other organizations in an effort to develop a more agile expeditionary command post. (U.S. Army photo by Staff Sgt. Cody Harding, 3/101)

called H4D, has since spread to nearly a dozen universities nationwide. The Office of Naval Research has made H4D part of its Naval Innovation Process Adoption, and Defense Acquisition University has initiated a pilot class. Next year seven more colleges and universities will adopt H4D, including the U.S. Naval Academy and the Naval Postgraduate School.

Innovation within DOD, Cogbill said in an interview, is typically at the strategic level—inside the Pentagon, the program executive offices, the new Army Rapid Capabilities Office or the REF—where there's access to the acquisition process and dollars. But innovation at the tactical level—brigade or lower—must identify capability gaps and leverage the

experience of those closest to the problems: junior officers, noncommissioned officers, even privates.

Cogbill seeks to get people "who normally have nothing to do with acquisition" involved in the innovation process, noting that tip-of-the-spear outfits like the 3rd BCT can't wait five to seven years for a capability to come through the normal process.

FOCUSING THE EFFORT

In the nine months since Cogbill took command of the Rakkasans (a Japanese term meaning falling umbrella), his initiatives have led to the 3rd BCT holding multiple internal innovation conferences, starting numerous working groups to

solve complex problems using the Army Design Methodology, and hosting a mission-command innovation conference with over 30 commercial vendors offering cutting-edge technological products. The mission-command conference also provided the opportunity to focus discussion on a specific problem set: how the Army can effectively exercise command and control against peer or near-peer adversaries on a multidomain battlefield.

The 3rd BCT's communications team developed two solutions:

Brigade tactical actions center—Like most tactical operations centers in the Army, the 3rd BCT's has multiple tents, generators and vehicles that span an area

the size of a football field. The goal of the 3rd BCT communications team was to reduce this footprint and to develop a more agile and expeditionary command post. Searching the Army surplus system, the team found the Expeditionary Lightweight Air Mobile shelter. Weighing 10,000 pounds and with a payload capacity of 4,500 pounds, the shelter was quick to set up, could be used in air assault and was mobile once on the ground. The communications team installed racks mounted on shock absorbers to hold the BCT's communications gear, and mounted common operating picture screens to the front of the equipment rack, providing all the services currently offered in the tactical command post in a fraction of the space. Because the communications equipment is already in place, the expeditionary battlefield command post can be set up and working in a matter of minutes.

Mission Command Augmentation Support (MCAS)—The MCAS trims the current tactical operations center command post by placing the network operations suite, the battle command server suite, intelligence functions and other key enabling warfighter assets, both equipment (tents, computers, servers) and personnel, in a secure location, far from the battlefield. The MCAS site provides a cloud-based service architecture that is permanently accessible by any BCT node, increasing availability and reliability to the warfighter. MCAS has the added benefit of conducting uninterrupted cyberspace and intelligence operations, and in the future it may serve as a mission command continuity-of-operations site for the BCT. MCAS provides the commander with the flexibility to tailor the command post to each individual mission set. Moreover, regardless of whether the BCT's tactical operations center is jumping locations, experiences equipment

ALL SYSTEMS OPERATIONAL
Spc. Alejandro Ramos checks combat network radios while other Soldiers from the 3rd BCT check the internet connectivity inside the Expeditionary Lightweight Air Mobile Shelter developed by the 3rd BCT. The mobile shelter is lighter and faster to set up than previous tactical operations centers, and provides all of the services currently offered in the tactical command post in a fraction of the space. (U.S. Army photo by Staff Sgt. Cody Harding, 3/101)

failure or is destroyed by enemy action, these functions will remain available to the rest of the BCT.

FISHING FOR SOLUTIONS
The 3rd BCT's innovations didn't stop there. Among others are a $20 improvised high-frequency antenna, new applications for 3D printing and a smartphone app for motor pool inventory.

The current Army high-frequency antenna is the AS-2259/GR, weighing just under 15 pounds. It's bulky to carry, takes 20 to 30 minutes to erect, requires time-intensive training and costs $1,127. The 3rd BCT Dismounted Reconnaissance Troop used a telescoping fishing pole, a balun (an electrical device that converts between a balanced and unbalanced signal), a coaxial cable, a stabilizer and radio cable to produce an antenna that weighs less than 8 pounds, is over 10 feet shorter than the AS-2259/GR and can be used with multiple frequencies. It requires less training and costs about $20 per antenna.

"You can bet your bottom dollar that if we're deployed, we're taking fishing poles with us," Cogbill said.

To explore the military benefits of 3D printing, 2nd Lt. Andrew Shaughnessy of the 3rd BCT's Field Artillery Battalion approached Vanderbilt University's Design Studio—where students can build projects for both class and personal interests—to create a partnership. "With the robust equipment and sustainment

requirements inherent to a field artillery battalion such as ours, we believe that leveraging relatively inexpensive, highly flexible and immediately responsive 3D printers can greatly flatten our logistics tail at a very low cost," said Lt. Col. Joe Katz, the field artillery battalion commander.

Initial prototypes from Vanderbilt's studio include a basic firing pin wrench (produced for 80 cents, versus the normal $22.06 price tag) and communication parts, vehicle attachments and various applications for howitzers. According to Katz, 3D printing "is easily scalable and has a vast array of applications in either a garrison or field environment. Three-D printing is relatively new to the military, and it has yet to make its way down to lower-level tactical Army units. Our intent is to move this innovative process forward within our sphere

of influence and lead the way for other brigades to follow."

To improve motor pool inventory, one company executive officer created a smartphone app for tracking equipment that proved to be much more efficient than the Army's method. The app can track the maintenance status for unlimited amounts of unit equipment; overall mission capability status (non-mission capable or fully mission capable); date and time of reported use; and all types of specific faults (i.e., front-left tire flat, back-right taillight out, left-side fender severely bent, passenger seat belt does not retract).

EVERY SOLDIER AN INNOVATOR

"We encourage every Soldier to feel like you're part of the solution," Cogbill said. As the tactical action center was taking

> "You can bet your bottom dollar that if we're deployed, we're taking fishing poles with us."

shape, he held a "petting zoo" day where everyone could look at it and make suggestions. Another initiative was an "open mic night," where lieutenants and sergeants could tell 3rd BCT leadership what problems they thought needed attention. No one was forced to attend, said Cogbill, adding that he was seeking "a coalition of the willing." Soldiers should be thinking about solutions to problems every time they go into the field, he said. "We want you to identify the gaps."

As the tactical action center concept was coming together using the Expeditionary Lightweight Air Mobile shelter, the communications team was reaching out to other units and organizations for ideas on how to reduce the command post footprint. They discovered that a sister brigade had tested a light command post from the U.S. Army Communications-Electronic Research, Development and Engineering Center (CERDEC). The Lightweight Mobile Command Post, which had been returned to CERDEC, was soon on its way back to Fort Campbell, Kentucky, beginning a new partnership between CERDEC and the 3rd BCT.

"The government research and development community, as well as industry, look to partner with units, where they

MAINTAINING CONNECTION

Spc. Francisco Matos checks servers on the Network Operations Security Center installed on a Unit Hub SATCOM truck in preparation for testing the Mission Command Augmentation Support system developed by the 3rd BCT. The system provides connectivity to support network operations regardless of the location or condition of the BCT's tactical operations center. (U.S. Army photo by Staff Sgt. Cody Harding, 3/101)

are willing to assist in proofs of concepts and experimentation without negatively impacting existing unit training," said Brad McNeilly-Anta, a team lead with CERDEC's Command, Power and Integration Directorate. "Ideally, we are able to use an iterative process, with modifications and improvements made to the capability based on the unit feedback. There is a near-term benefit to the unit as they can refine their command post implementations, as well as the longer-term benefit to assist in the transition of capabilities from industry and the research and development community to the Army's program offices."

The partnership between the 3rd BCT and CERDEC has tested multiple systems, including:

- A Soldier-carried battlefield tracker called JCR (Joint Capabilities Release) Manpack.
- A biofuel generator that has reduced noise output and can run on a biosolution, potentially reducing the Soldier's total battery weight burden by half.
- A battle command common-services expeditionary platform in the form of a ruggedized Getac laptop, with the capacity to host the entire server infrastructure required to operate the tactical command post. This laptop also provides the ability to set up and tear down the server infrastructure in the time it takes for the laptop to boot up, versus the 45 minutes it takes to set up the contents of four four-man-carry containers of equipment.
- Radio-frequency transparent camouflage netting, used to conceal tactical communications equipment that traditionally has been left uncovered.

CONCLUSION
By unleashing his innovation insurgents, Cogbill has made innovation central to the 3rd BCT's ability to "fight tonight." While Army acquisition works on more permanent solutions to field needed capabilities, innovators in the 3rd BCT are finding solutions to those problems today.

"I believe Col. Cogbill has opened the doors for innovation simply by taking an active interest in its development," said Chief Warrant Officer 2 Ronnie Eriksson, a member of the BCT's communications team. "From a combat support perspective, it is rare to find a commander at the tactical level that places emphasis on innovation. It also feels good knowing that the work you are doing will be recognized and appreciated."

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GAME.

MISSION SET.
OVERMATCH.

War game introduces early synthetic proto-typing, which enables the Army to explore thousands more ideas than what is possible today before acquiring new capabilities.

by Dr. Robert E. Smith and Maj. J. Peter Barnhart

A group of cadets has some rare downtime, and they log into their favorite war-themed video game. The team has to capture a watch-list terrorist in a 40-story high-rise building in Mumbai, India. It's rainy season in the game, meaning that sometimes the streets flood en route from the edge of town.

After everyone logs in, the team receives a virtual budget and must first choose its base vehicle from three options:

- A tracked vehicle that can carry heavy armor and drive over obstacles.
- A light wheeled combat vehicle that's maneuverable but has limits on armor and weapons.
- A self-driving taxi appropriated by the cyberwar team that will blend in with the locals but has limited exportable power and can be only slightly up-armored.

This team opts for the hacked taxi. Next, players move to the virtual garage to kit out their vehicle using their remaining virtual cash. The cadets decide against adding armor to their already slow taxi and instead choose soft exo-skeletons to wear when they dismount. Soft exoskeletons use belts and small motors to augment the operators' own movements, and will let them ascend stairs effortlessly. They know from past attempts and from watching replays of the best games on the leaderboard that the full-up exoskeleton, which can knock down doors and provide lots of armor, runs out of power running up

a stairwell around the 14th floor. They've also learned that a small drone swarm can send back situational awareness floor by floor as they ascend. So they spend their last cash on the swarm launcher. Still, the enemy will create surprises, as the opposing force is played by another group of Soldiers.

Members of the team aren't in the same room or even the same physical location, but they feel like they are as they don their headsets and take friendly jabs at each other. The future video game the cadets are playing isn't "Call of Duty," but rather the Army acquisition-focused game "Operation Overmatch," which is the first product in a larger program called early synthetic prototyping (ESP). ESP is a collaborative effort of the U.S. Army Training and Doctrine Command's (TRADOC) Army Capabilities Integration Center and scientists from the U.S. Army Research, Engineering and Development Command (RDECOM). Operation Overmatch may provide a level of entertainment, but its main goal is to prove out technologies before the Army spends development dollars.

ESP enables the exploration of thousands more ideas than what is possible with physical experimentation done today. The scenario above isn't yet feasible, as Operation Overmatch is still developmental and in beta testing, but the initial release should go live in 2019. Developmental vignettes in 2018 will focus on the Squad Multipurpose Equipment Transport and Next Generation Combat Vehicle concepts.

KEEPING PACE WITH TECHNOLOGY

While the new Futures Command hopes to streamline bureaucracy, and legislative changes may unshackle program offices, the Army still will not be able to keep

ROADBLOCK
Enemy Czervenian Kodiak main battle tanks take up forward positions to stop a bridge crossing in a geographically typical complex urban environment. Operation Overmatch and the larger ESP effort will help enable the exploration of thousands more ideas than what is possible with physical experimentation today. (Image courtesy of Army Game Studio)

SMOKESCREEN
A Czervenian Timberwolf infantry fighting vehicle ducks into a construction channel and disperses smoke in an attempt to obscure the vehicle's location from a pending attack. Operation Overmatch, while entertaining, has a larger purpose: Prove out new technologies before the Army spends development dollars. (Image courtesy of Army Game Studio)

THE NEXT BIG CHALLENGES

The volume of telemetry data collected in Operation Overmatch creates a challenging big data and data mining problem to make it useful. Machine learning can help extract both optimal tactics and equipment performance specifications, which are interrelated. Learning to understand human tactics and goals solely from observing actions from thousands of game repetitions would be challenging for a human and is unequivocally challenging for a computer.

Discovering how equipment is used on the battlefield, together with requisite performance specifications, is a critical and often ignored aspect of acquisition—for example, learning the difference between how a heavy, slow tracked vehicle would be used to accomplish the same mission as a fast, lightly armored wheeled vehicle. Furthermore, each player tends to adopt a certain playing style: Some may be strategic, while others may be quick to act and fire off rounds. Players might also be new to the game or just "playing around." Data mining algorithms will attempt to sort all these different aspects to find the most robust tactics, force structures and equipment combinations.

Researchers at the U.S. Army Tank Automotive Research, Development and Engineering Center have sponsored two Phase II Small Business Innovation Research efforts on tactical behavior mining. This is also a very active research area for professional sports teams and electronic sports (e-sports), and the early synthetic prototyping team hopes to leverage that research. Early results show that it is effective to use machine learning to discover what actions and equipment specifications are optimal in a given scenario to accomplish a mission.

Operation Overmatch also stands to give a huge boost to developing autonomous systems that are key to the Army's future. The U.S. Army Research Laboratory (ARL) is working to implement artificial intelligence (AI) to control entities in the game for experimentation, creating what are known in game lingo as agents. Since many of the components of robotic systems are available commercially, the critical advantage for DOD lies in the AI that controls them. Training neural network-based AI requires a lot of data, which early synthetic prototyping can provide.

Initially, robotic vehicles in Operation Overmatch would be controlled by human players. With enough human player data, ARL could train agents that react to the context of the environment, similar to human players. Agents also could control adversarial entities. This might allow the game to drive high-level autonomous system tactics and behaviors. If all the entities in the game are entirely controlled by AI agents, then entire virtual battles may be fought faster than in real time. Fully autonomous force-on-force simulations could try different situations and learn to perform even better, possibly even suggesting new strategies to human players. Additionally, AI agents could learn threat-specific behaviors to optimize their responses to what they encounter.

The data architecture that Operation Overmatch matures will connect AI, data analytics tools and cloud-based services for distributed game play. The architecture could also enable other synthetic environments.

For example, a huge dilemma for many war games is the insertion of nonkinetic effects such as cyber, space and electronic warfare. For the most part, these types of effects remain largely estimates from subject matter experts; instead, they could be evaluated directly in a synthetic game environment.

A complementary investment to the process of ingesting and fielding technology might be in rapid manufacturing technology and architectures, allowing the Army to field tailored systems, as opposed to "exquisite" systems designed to do everything everywhere in the world. For example, maybe what the Army needs are different regional vehicles for megacities, desert warfare and mountain terrains. A single system is unlikely to excel across those three terrains without employing exotic and expensive materials and technology. Rapid manufacturing and early synthetic prototyping could combine to make fielding such tailored systems a reality.

—DR. ROBERT E. SMITH
AND MAJ. J. PETER BARNHART

FIGURE 1
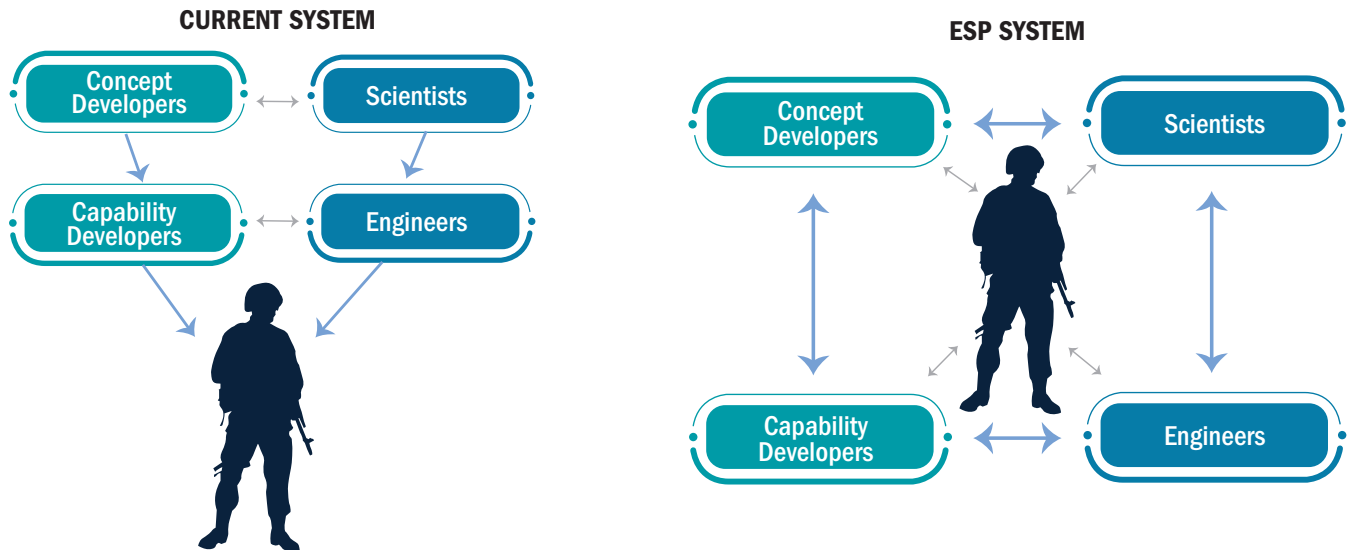
SOLDIERS MAKE IT HAPPEN
ESP puts Soldiers at the center of the development process, giving them the opportunity to work with concept developers, capability developers, scientists and engineers on solutions that will fit their needs effectively, including the associated requirements, training and implementation doctrine. (Graphic by Dr. Robert E. Smith, TARDEC)

pace with commercial technology development cycles. Our military has been driven by technological overmatch for 100-plus years, and suddenly commercial military-relevant technologies are available on the global market. In fact, commercial research budgets in robotics and artificial intelligence far exceed DOD's. That means the future Army must focus on time-domain overmatch—ingesting and fielding technology much faster while simultaneously learning to employ technologies on the battlefield more effectively than our adversaries.

The ingestion of new technologies requires a lot of experimentation, and ESP will allow the Army to tap into the creativity of thousands of Soldiers. As a persistent crowd-sourced game network focused on acquisition, ESP allows Soldiers to explore the trade space for performance requirements, force structure and tactics.

Pure technology "widgets" are easy for an adversary to duplicate. The hardest thing for adversaries to duplicate is the integration of advanced technologies with skilled Soldiers and well-trained teams.

ESP is not a simply a matter of writing a new video game, as nothing exists for the Army that Soldiers might play anywhere and that logs every event, communication and entity position in the game. There is also a lot of challenging research to do on how to rapidly insert new concepts into the game, integrate realistic physics and turn millions of hours of game play into data useful to decision-makers.

MISSION-MOTIVATED
Operation Overmatch, the first ESP product, is a first-person shooter game focused on small unit operations. The hope for ESP is to tap the fact that Soldiers already spend a lot of time playing video games and seem especially willing to play something that helps design the future of their Army. Survey data from an ESP pilot study at Fort Bliss, Texas, indicates a potential of a million hours of game play a month in off-duty time. The Fort Bliss test found that more than 87 percent of Soldiers played video games, and that 50 percent of Soldiers played more than 10 hours of video games per week.

Operation Overmatch is collecting all telemetry (player positions and events) and the players' technology selections. The

eventual 12 million hours of data per year will require machine learning and big data techniques to analyze and derive useful data on tactics and performance.

In the alpha version of ESP, Soldiers play eight versus eight against other Soldiers, fighting advanced enemies with emerging capabilities in realistic scenarios. Players will soon be able to experiment with weapons, vehicles, tactics and team organization.

Presently there are no dismounted Soldiers in the game; they will be added over the next year along with other new features. The game currently provides a discussion area so that innovative ideas might spawn even more ideas.

The way the early synthetic prototyping process might work within acquisition is as follows:

First, concept and capability developers, as well as scientists and engineers from across the Army, suggest various theses on force employment, force design and materiel capabilities. RDECOM engineers then model ideas in the game environment with an appropriate amount of physics rigor. The engineers, in turn, work with TRADOC to create scenarios that address what the Army wants to learn. For example, the Army may want to explore how best to equip and employ future platoons in an airfield seizure against a near-peer threat.

FIGURE 2
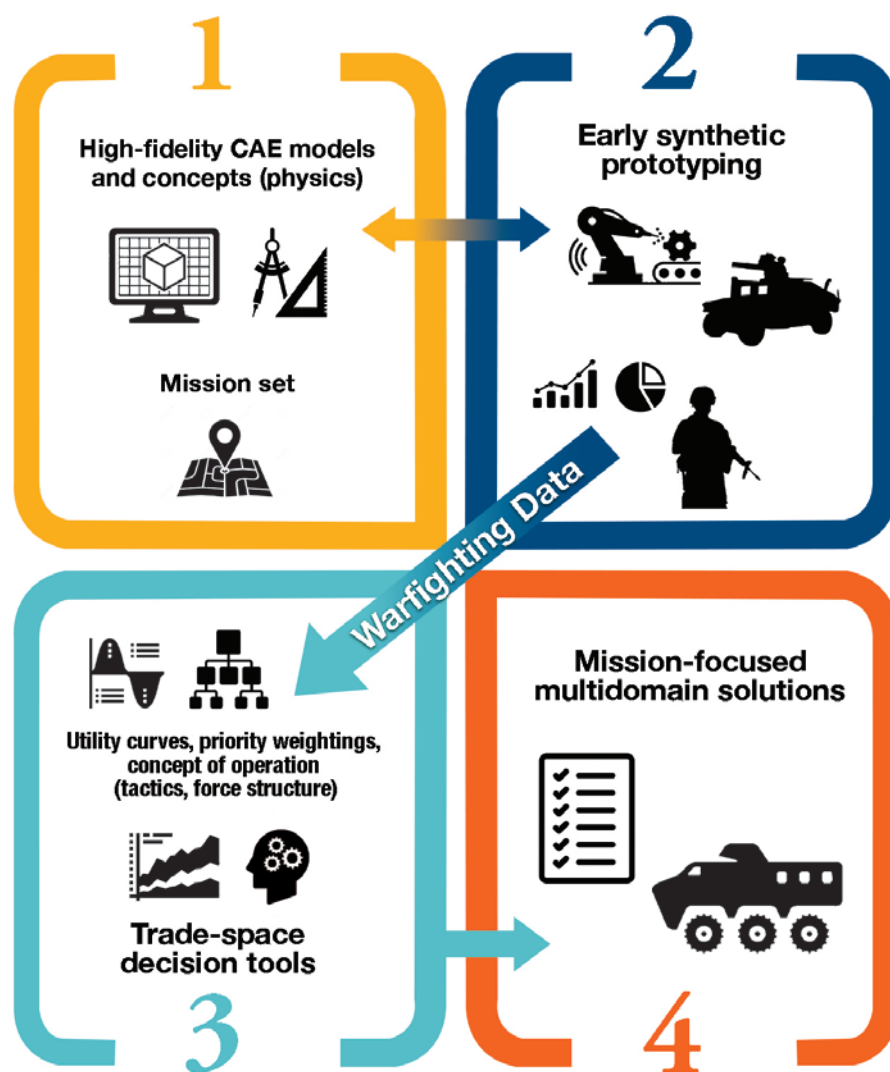
ACQUISITION IN THE LOOP
The digital loop that ESP applies to operational assessment is a tool to create prototype solutions that will provide effectiveness data to acquisition decision-makers. It features high-fidelity, computer-aided engineering (CAE) simulations that support realistic physics during game play, with virtual budget constraints so that Soldiers do not simply pick the most high-tech solution. The warfighting data generated through ESP will enable data-centric rank ordering of performance requirements. (Graphic by Dr. Robert E. Smith, TARDEC)

The hope for ESP is to tap the fact that Soldiers already spend a lot of time playing video games and seem especially willing to play something that helps design the future of their Army.

Next, the game is distributed to Soldiers across the Army via Steam, a widely used platform for the delivery of digital games. Steam handles digital rights management, installation and automatic updating of games. Players can learn how to use and modify the equipment in single-player missions before engaging in multiplayer scenarios. Some Soldiers will play as an opposing force using emerging threat platforms, and some will play as U.S. warfighters.

Following each scenario, the players can provide feedback about what they liked or disliked and make recommendations. Additionally, the game server collects game data for analysis. This process is intended to repeat continuously with changing equipment, scenarios, organization, goals, rules and objectives. (See Figure 1, Page 78.)

ACQUISITION SYSTEMS ENGINEERING
ESP provides an immersive, high-bandwidth communications tool for engineers and Soldiers to co-create solutions within a digital operational assessment loop. (See Figure 2, Page 79.) It will provide measured effectiveness data to decision-makers. To enforce realism, engineers create high-fidelity, computer-aided engineering (CAE) simulations that are turned into performance tables to allow realistic physics during game play.

Scenarios are simultaneously developed over a given mission set. Players use a design mode to construct a unit or platform (a vehicle, in this case) that they believe will best achieve the mission. Virtual budget constraints ensure that Soldiers do not simply pick the most high-tech solution.

ESP should help inform trade space tools such as the Army's Whole System Trades Analysis Tool and the Marine Corps' Framework for Assessing Cost and Technology. ESP warfighting data will enable data-centric rank ordering of performance requirements instead of relying on subject matter experts' opinions. The game data collected from teams trying various technology combinations over multiple missions can be used to measure the mission success of requirement X versus requirement Y. A mathematical tactical utility metric may be newly defined as probability of mission success ÷ total burden.

CONCLUSION
ESP is poised to help DOD achieve an enduring time-domain overmatch even if U.S. adversaries achieve technical parity in fighting technologies. ESP provides a rapid digital assessment framework to measure progress toward mission accomplishment through test and evaluation in an operational context. For future robotic systems, ESP will help train superior artificial intelligence behaviors and optimize their integration into the force.

ESP should greatly boost DOD's ability to ingest technologies from anywhere and figure out how to use them in the fight. The Army then can rapidly turn the technologies over to Soldiers who are readily able to employ them on an evolving battlefield. ESP is not a simple matter of writing another video game, however. There are many challenging research questions, many unfunded, that the Army is trying to address.

*For more information, go to **http://www.operationovermatch. com** or contact the authors at **robert.e.smith1699.civ@mail.mil** and **james.p.barnhart.mil@mail.mil**.*

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EXERCISE
THE OPTIONS

| RDECOM uses Pacific Pathways deployments to conduct operational tests on three new technologies.

by Ms. Argie Sarantinos-Perrin

ROBOT AS PARTNER
A Soldier from the 25th Infantry Division uses remote control to operate a Kobra 710 during the Pacific Manned Unmanned – Initiative held July 11-26, 2016. During the exercise, Soldiers conducted expeditionary combined arms maneuvers using manned air and ground robotics. (U.S. Army photo by Kimberly Bratic, U.S. Army Tank Automotive Research, Development and Engineering Center)

While the Army began Pacific Pathways in 2014 to build and sustain readiness in the Asia-Pacific region, the multinational exercises have acquired an additional mission: experimentation. The U.S. Army Research, Development and Engineering Command (RDECOM) recently experimented on three new technologies—Rapid Fabrication via Additive Manufacturing on the Battlefield (R-FAB), Fight Tonight Emergency Fuel Distribution System and Manned-Unmanned Teaming (MUM-T)—in Pacific Pathways exercises to see how they performed in operational settings.

"Putting equipment into exercises for experimentation allows the technology community to learn early lessons about how equipment performs in a realistic environment, how Soldiers will actually use the equipment and what capabilities should be included in the final product," said Andrew Wood, RDECOM – Pacific experimentation director for U.S. Army Pacific. "A formal operational test is too late in the life cycle to learn these lessons."

An annual series of exercises with various Pacific nations, Pathways involves three strategic deployments of Army units for three or four months at a time. Each Pacific Pathways deployment typically involves multiple individual exercises. Among the exercises are Orient Shield with Japan; Cobra Gold and Hanuman Guardian with Thailand; Foal Eagle with South Korea;

SUPPLY LINE
Soldiers from the 339th Quartermaster Company and 498th Combat Service Support Battalion laid 9,500 feet of lay-flat hose during the Combined Joint Logistics Over-the-Shore exercise at Pohang, South Korea, last spring. The hose is part of the Fight Tonight Emergency Fuel Distribution System, developed as a solution to the inadequacy of roads north of Seoul to support potential operational missions. (U.S. Army photo by Drew Downing, RDECOM)

Balikatan with the Philippines; Garuda Shield with Indonesia; and Keris Strike with Malaysia.

A PREPAID OPPORTUNITY

With the cost of the exercises already funded, they present a good opportunity to gather Soldier feedback. While RDECOM leverages both small- and large-scale exercises, the larger ones typically include a more diverse force, which generates more feedback. Large exercises also create more opportunities to insert technologies because a variety of units participate, while small exercises may be infantry only.

Research and development projects often do not include funding for exercises, so providing resources can be a challenge. Another challenge is getting equipment to the location, which includes securing travel, customs and access to foreign military bases.

Once RDECOM determines which technology needs to be inserted, the objectives of the experiment and the schedule, the team coordinates with exercise planners to ensure that the technology is inserted. Planning typically begins a year before the exercise.

TECHNOLOGY NO. 1: PRINT-A-SPARE

For Soldiers in the field, getting the necessary parts for broken equipment is essential. And faster is better.

Until now, Soldiers waited weeks or months for parts to be delivered. But with the R-FAB, essential parts can be created using 3D printing. The R-FAB, which consists of 3D printers in an expandable shelter, is one of many science and technology projects that RDECOM, a major subordinate command of the U.S. Army Materiel Command, is developing. RDECOM uses the lessons learned to improve future versions.

The R-FAB, which included two large and three small printers, was deployed to both Hanuman Guardian in August 2017 and Orient Shield in September 2017.

While the R-FAB technology can design and print new parts on the spot, it also features a database of pre-existing files known as the Repository of Additive Parts for Tactical & Operational Readiness, or RAPTOR. RAPTOR allows Soldiers to choose from a database of commonly used parts already designed and printed, such as a 55-gallon drum cap and wrench combination. To print new parts, Soldiers use the onboard database, which stores existing print files, and 3D computer-aided design software, which allows the operator to design a new part on a laptop and then make a 3D print file. If the physical part that needs to be replaced is available, a print file can be generated using the 3D scanning capability in the R-FAB.

Before they conducted the Hanuman Guardian and Orient Shield exercises, Soldiers from the 1st Stryker Brigade Combat Team, 25th Infantry Division completed a week of classroom training at Picatinny Arsenal in New Jersey. The Soldiers were able to operate the equipment skillfully within a couple of days.

Thus training time should decrease to one or two days, particularly with the development of system design and training packages. The system design can influence training by simplifying the process; incorporating updated capabilities that are easier to use, including training reference materials; and adding a help desk capability to the reachback system that connects forward-deployed operators with technical experts at the home base.

Soldiers set up the system in about two hours during the exercises, including expanding the container, leveling it, installing the environmental control unit, putting the components in place, hooking up the generator for power and allowing the 3D printers to warm up.

During Orient Shield, Soldiers used the R-FAB to print camera lens covers for a Stryker vehicle in four hours. Rapidly fabricating the parts was especially important since Typhoon Talim made landfall on the Japanese island of Kyushu during the exercise.

"A camera lens cover may seem like a trivial part, but it actually deadlines the vehicle because driving without a lens cover will damage the camera lens, degrading the capability and damaging a costly item," Wood said. (If a part is "deadlined," then the vehicle cannot be used until it is repaired or the commander agrees to assume the risk that deploying the system could result in additional damage.) "Making a quick replacement part using the R-FAB enabled those vehicles to continue to conduct their missions until the supply system could provide standard replacement parts."

RDECOM uses Soldier feedback from the hands-on exercises to develop tactics, techniques and procedures for future

FAST PRINTING
Soldiers used R-FAB during a Pacific Pathways exercise in September 2017 to print camera lens covers for a Stryker vehicle in four hours. Rapidly manufacturing the part enabled Soldiers to continue the mission even when Typhoon Talim made landfall during the exercise. (U.S. Army photo)

TEMPORARY FIX
Using R-FAB during a Pacific Pathways exercise in September 2017, Soldiers printed a cover for the Common Remotely Operated Weapon System night vision camera, left. The cover on the right is the original part from the manufacturer. With R-FAB, Soldiers print commonly used and new parts in the field. (U.S. Army photo)

FAST IN, FASTER OUT
Soldiers from the 339th Quartermaster Company and 498th Combat Service Support Battalion used existing culverts to thread the lay-flat hose through pipes during the Combined Joint Logistics Over-the-Shore exercise. The Soldiers laid the hose in 4½ hours and removed it in 2½ hours; in a combat scenario, Soldiers could set up the fuel distribution system even faster by breaking road surfaces to bury the hose. (U.S. Army photo by Drew Downing, RDECOM)

deployments. There were several lessons learned about the R-FAB from the two exercises, including the following:

- The environmental control unit was not large enough for the hot climates.
- Soldiers made little use of the R-FAB system during Hanuman Guardian because they were not aware of its capabilities.
- Improvements are needed for the reachback capability.
- 24-hour-a-day operations require military-grade generators.

"Part of the intent of the exercises was to see how well the system stood up to multiple deployments as part of the same operation," Wood said. "One area where the system will be improved is in ruggedness for multiple moves during operations."

RDECOM plans to continue experimenting with the R-FAB to fine-tune it. The R-FAB will also be used to evaluate other additive manufacturing technologies, including cold spray, metals and electronics. As these mature, RDECOM will look for opportunities to integrate them and evaluate the result.

For the near term, an updated R-FAB is being built at Rock Island Arsenal, Illinois, and will be tested in a 12-month operational assessment in Korea starting this summer; feedback from this exercise will help refine the tactics, techniques and procedures for its use. Another R-FAB was tested at Joint Warfighter Assessment 18, which took place April 20 – May 9 in Grafenwoehr and Hohenfels, Germany.

2. STAYING FUELED

In large-scale military operations, fuel is transported over long distances and on main supply routes, which leads to traffic congestion and disruption in supply. As a result, commanders keep exceedingly large amounts of fuel on hand, which affects the agility and flexibility of operations. A medium petroleum truck company, for example, is equipped with a combination of 60 tractors and either 60 M967 5,000-gallon semitrailers or 60 M1062 7,500-gallon tankers, which enable the company to deliver 300,000 or 450,000 gallons per day, respectively.

In Iraq and Kuwait, the Inland Petroleum Distribution System, developed in the 1980s, is the tactical pipeline system that is currently in use and that supported

Operation Iraqi Freedom. More than 60 million gallons of fuel were transported from refineries in Kuwait to tactical fuel farms in Iraq.

However, the system has a very large footprint, encompassing more than 1,000, 20-foot ISO (International Organization for Standardization) containers and requiring lots of people, equipment and time to deploy and install. The Fight Tonight Emergency Fuel Distribution System was developed in response to a capability gap identified by U.S. forces in Korea, where the road network north of Seoul is inadequate to support potential operational missions. The Fight Tonight system can be deployed at a rate of 25 miles per day with minimal support and deliver 720,000 gallons of fuel per day.

Ten Soldiers from the 339th Quartermaster Company and 498th Combat Service Support Battalion conducted an operational demonstration of the Fight Tonight Emergency Fuel Distribution System during the Combined Joint Logistics Over-the-Shore exercise March 22 – April 16, 2017, at Pohang, South Korea. Using repurposed components

from the Tactical Water Distribution System along with commercial off-the-shelf components, Soldiers deployed 9,500 feet of hose in 4½ hours, pushed more than 140,000 gallons of water (a surrogate for fuel) from the beach to the storage area, and recovered that hose in 2½ hours.

"The Soldiers could have deployed and retrieved the system much faster; however, given that we conducted this experiment during an exercise, we were not allowed to execute many of the field-expedient measures we might normally consider," said Drew Downing, RDECOM science adviser to U.S. Army Pacific. "For instance, road crossings: In a conflict operation, we would break through the road surface to bury the hose line using a culvert kit. However, during the exercise we were forced to find existing culverts in the road network and thread the hose through the pipe, which is extremely time-consuming."

The Fight Tonight Emergency Fuel Distribution System was assessed in five functional areas: fuel distribution, deployability, reliability, transportability and

remote system control. Overall, the system demonstrated its capability to deliver fuel. However, reliability and remote system control could not be measured because of the short duration of the exercise and issues with the original pumps. The success of the Fight Tonight concept demonstration during Combined Joint Logistics Over-the-Shore led the 8th Army to develop and submit an operational needs statement, which documents a critical need for the technology from an operational unit. HQDA validated the statement in December 2017, allowing U.S. Army Pacific to seek funding.

The Fight Tonight Emergency Fuel Distribution System will be fielded to the 339th Quartermaster Company. Since it is not in the formal acquisition process, however, it will be competed as a high priority in the next round of funding established to address capability gaps in Korea. If funding is approved, U.S. Army Pacific plans to refurbish the existing Fight Tonight equipment and procure new pumps and additional hose to integrate with it.

3. TEAMING WITH ROBOTS

To support combat readiness, the Army is developing MUM-T, which was highlighted during the Pacific Manned-Unmanned – Initiative I held July 11-26, 2016. Engineers and Soldiers from the 25th Infantry Division tested and provided feedback for more than 20 capabilities in a system of systems that included communication networks, mission command systems and MUM-T.

The latter consisted of small, man-portable unmanned ground vehicles with cameras that collected information and transmitted it via video to Soldiers through the Nett Warrior system, featuring a chest-mounted screen that works with a smartphone to display fellow Soldiers' locations and video feeds and to send text messages. Unmanned ground sensor systems collected chemical, biological, radiological and nuclear information, as well as video, including one system that recorded video onboard an aircraft. Unmanned Squad Multipurpose Equipment Transport systems transported small unit equipment, supplies, eapons and ammunition, and an unmanned

FUELING UP

Soldiers from the 339th Quartermaster Company and the 498th Combat Service Support Battalion used existing culverts to thread nearly 1.8 miles of hose during last spring's exercise at Pohang, South Korea. The Fight Tonight Emergency Fuel Distribution System can deliver 720,000 gallons of fuel per day. (U.S. Army photo by Drew Downing, RDECOM)

ground system transported heavy equipment (weighing more than 330 pounds), supplies, weapons and ammunition.

During the exercise, small units conducted expeditionary combined arms maneuvers, using unmanned air and ground robotics. The units used a mobile 4G LTE network for communications to support intelligence, fires and mission command tasks.

"The MUM-T concept is a unique capability that links Soldiers to future unmanned air, ground and sensor domains. The MUM-T capability extends the Soldiers' reach by enhancing situational awareness and providing better protection and lethality options," said Lonnie Freiburger, Emerging Capabilities Office project manager at RDECOM's Tank

"Part of the intent of the exercises was to see how well the system stood up to multiple deployments as part of the same operation. One area where the system will be improved is in ruggedness for multiple moves during operations."

Automotive Research, Development and Engineering Center.

Until the Pacific Manned Unmanned – Initiative I, the MUM-T had never been assessed in a jungle environment. The thick foliage, hills and ravines on the southeastern shore of Oahu, Hawaii, posed line-of-sight, communications and mobility challenges. Another challenge arose when Tropical Storm Darby made landfall during the exercise, forcing the team to cancel the assessment for one day.

While the MUM-T was less usable during dismounted tasks because of the extreme jungle terrain, Soldiers successfully used unmanned aircraft systems to acquire threats and employ indirect fires. The engineer platoon completed dismounted route reconnaissance, small obstacle breaching, and chemical, biological, radiological and nuclear detection. Feedback from the assessment informed an initial capabilities document, which includes details about the technology and recommendations to enhance it.

A mounted version of the MUM-T, known as the Robotic Capability Breach Concept, has additional capabilities, including minefield detection; support for fires and intelligence, surveillance and reconnaissance; and deployment of a mine-clearing line charge to clear a path for tanks, other vehicles and personnel. The concept was tested at Joint War-fighter Assessment 18 and will be tested at Joint Warfighter Assessments 19 and 20.

CONCLUSION

RDECOM teams with Soldiers to experiment during exercises such as Pacific Pathways as a way to get the best technology to Soldiers as quickly as possible. Inserting technologies into exercises

leverages already funded events to gather a large and diverse volume of Soldier feedback.

RDECOM is now researching the possibility of testing counter-unmanned aircraft system capabilities during Tiger Balm in Singapore in 2019 and possibly inserting tactical bridging (a bridging system that is rapidly installed to support Soldiers and small vehicles) into Exercise Balikatan in the Philippines in 2019. RDECOM is also working with U.S. Army Pacific and U.S. Army Training and Doctrine Command to design the Multi-Domain Task Force, which was established to determine the requirements for a new military formation that will address warfighting capabilities required in an anti-access and area denial environment. U.S. Army Pacific is planning a two-year effort to experiment with capabilities and determine which are suitable for the task force.

Continuous experimentation and delivering technology to Soldiers faster are central to the Army's modernization strategy. RDECOM supports the Army's mission by using the feedback and lessons learned from operational exercises to improve future versions of technology.

*For more information, go to **www.army. mil/rdecom** or call the RDECOM Public Affairs Office at 443-395-3922.*

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NO TIME
to WASTE

Experiments to test incremental solutions that will give joint forces more warning of chemical, biological, radiological and nuclear weapons on an accelerated timeline.

by Mr. Richard Newton

HARNESSING RADAR

The AN/TPQ-50 counterbattery radar plays a key part in a JPEO-CBRND experiment at Yuma Proving Ground, providing radar data in which the experiment will look for information on CBRN threats. The experiment's aim is to determine whether radar systems like the AN/TPQ-50 and AN/TPQ-53 can detect ordnance filled with chemical or biological weapons or materiel, either in flight or upon detonation. (U.S. Army photo)

In an unpredictable location, which could be an urban center in Syria or a semirural suburb like Salisbury, England, a chemical, biological, radiological or nuclear (CBRN) event will happen, again. Such an event could mean devastating losses for U.S. forces if they have no warning or protection from weapons of mass destruction.

That is why the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense (JPEO-CBRND) established an Experimentation Directorate in 2017—to improve the acquisition cycle and free DOD to counter threats, quickly. Advances in technology have made it easier for state actors to develop and employ weapons of mass destruction (WMD) and other CBRN threats. Now DOD is reforming bureaucratic policies that have impeded the United States' own technological advances to prevent and protect against such threats.

JPEO-CBRND's Experimentation Directorate seeks to improve joint force capabilities to defend against WMD threats, using incremental or evolutionary solutions. Experimentation—whether in the laboratory or field-testing new equipment with joint forces—is a faster way to establish how best to use technologies to counter WMD threats than the traditional cycle of development, testing and, ultimately, deployment. Experimentation will help DOD get ahead of the threat rather than reacting after a WMD event by managing the consequences.

For JPEO-CBRND, it is a vital step toward providing early warning, situational awareness and understanding of asymmetric and unpredictable threats to the nation's security. Experimentation offers a structured approach to improve tools, adopt new processes, and assess and deliver available technologies to joint forces on the multidomain battlefield.

In remarks Oct. 10 at the annual meeting of the Association of the United States Army, Gen. Mark A. Milley, Army chief of staff, described this "significant streamlining of processes" as a "shift to a U.S. Special Operations Command-like model of buy, try, decide and acquire." Both the National Defense Strategy and the JPEO-CBRND's strategic guidance on acquisition call for streamlining rapid iterative approaches to reduce risk and cost. This includes championing prototyping and experimentation before refining requirements. That is the Experimentation Directorate's mission.

JOINT, INTEGRATED PICTURE

The new directorate is managing an enhanced capability demonstration as part of the JPEO's larger integrated situational-understanding campaign. The objective of the campaign is to develop an integrated chemical and biological early warning capability using mostly nonmateriel and a few materiel solutions. These solutions combine existing sensor technologies, information threads and advanced algorithms from multiple battlefield domains into a novel decision management framework for operational use. Never before have disparate information threads come together to provide courses of action to joint forces confronting WMD threats.

The intent is to give joint forces more warning time and more options in the event of a chemical or biological attack. Increased warning time allows them to don their protective masks and consider options such as moving upwind or around the attack, thus maintaining their freedom to act, move and maneuver while accomplishing the mission.

A successful integrated situational-understanding campaign requires three improvements to the existing decision-making infrastructure, and the development and fielding of a fourth piece:

- More timely delivery of CBRN information to the joint forces. Seconds count in warning of an attack; it takes at least 10 seconds to put on a protective mask, for example.
- A more robust information network drawing from a wider variety of sources, such as non-CBRN counterbattery radar sensors, to warn commanders of incoming rounds before they explode and disseminate chemical agents.

Another element of the experiment is to determine the feasibility of incorporating a CBRN logistics management system into the integrated situational-understanding campaign.

- A more robust way to disseminate information to and from commanders.
- Development of an automated decision tree that provides actionable outputs for commanders.

The integrated situational-understanding campaign will collect CBRN-related information threads, distribute the threads in a common operating environment among the joint forces and develop an analytical engine to weave the threads into an informative fabric, offering commanders choices of action and informing logistical considerations. The actions could include changing the joint forces' Mission Oriented Protective Posture levels, altering battlefield routes of ingress and egress, and suggesting decontamination options.

OBJECTIVE: EARLIER DETECTION

The enhanced capability demonstration, led by Experimentation Director George "Ed" Lawson, includes two experiments in FY18, with the objective to reduce risk and enable commanders to survive an event involving WMD. One experiment, which is exclusive to the demonstration, will analyze the value of real-time, radar-based information threads. In the other, the demonstration will enlist the Defense Threat Reduction Agency to study the connectivity and continuity of the common operating environment and its interfaces.

The experiment examining real-time information threads will look for CBRN information of value in existing radar-based data, such as that gathered using the fielded AN/TPQ-50 and AN/TPQ-53 counterbattery radar systems. This experiment is designed to determine if the systems can detect ordnance filled with chemical or biological weapons or material in flight or upon detonation. For joint forces, this capability could mean more warning time.

Additionally, chemical sensors deployed right of boom—just after detonation of the chemical-biological round—could be directed by radar data to stare at the point of impact to detect chemical-biological threats, rather than scanning the entire battlefield. This could also yield additional warning time.

This experiment, to be performed at the U.S. Army Yuma Proving Ground in Arizona, will use 155 mm rounds, some with conventional solid fills and some with liquid fills. (Liquid fills are characteristic of chemical-biological munitions.) The fills include triethyl phosphate (liquid), polyethylene glycol (liquid), conventional high explosives (solid) and blanks. The 155 mm rounds will be detonated in ground and air bursts to replicate possible scenarios. Among the differences to be captured from the variously filled rounds are their trajectory, wobble and post-detonation fragmentation patterns.

Contrasting the rounds' radar signatures could identify the fill as chemical-biological (liquid) or non-chemical-biological (solid). An analysis of differences in the data should illuminate the possibilities of using radar-based information threads for early warning of a chemical-biological attack.

In the other FY18 experiment, the JPEO will join the Defense Threat Reduction Agency in Perceptive Dragon II. This exercise evolved from the even more obscurely named experiments called the

Advances in technology have made it easier for state actors to develop and employ weapons of mass destruction and other CBRN threats.

THE FACE OF READINESS
The Joint Service General Purpose Mask is one element of Soldiers' training for integrated CBRN readiness. Experimentation will provide the early warning that Soldiers need to don personal protective equipment. (U.S. Army Reserve photo by Spc. Torrance Saunders, 982nd Combat Camera Company Airborne)

Sophos Kydoimos Challenge. Blithely translated from Greek, it generated the oblique phrase, "Wisdom over the din of battle." As that is hardly a fear-inducing battle cry, it became known colloquially as the SK Challenge. That, in turn, quickly became the Esskay or Bacon Challenge, after the meat processing company in Baltimore.

Perceptive Dragon II will take place at Marine Corps Base Quantico, Virginia, and will examine the connectivity and continuity of interfaces in the common operating environments of the Army and Marine Corps. The field demonstration, using Army and Marine personnel and equipment, will assess the feasibility and utility of passing CBRN tactical voice and data communications between the two services for common battlefield awareness and understanding.

The connectivity and continuity of existing interfaces control the flow of data between the Army and Marines. In the Perceptive Dragon II experiment, the two services will exchange simulated radar data such as point of origin, point of impact and in-flight characteristics of suspected CBRN rounds. Knowing the point of impact allows CBRN detectors to stop scanning a wide area and focus on a single point, thus reducing the time it takes to identify a CBRN threat.

Successful interservice exchange of CBRN data will demonstrate the capability to enhance awareness and understanding, thus shortening a commander's decision cycle—the time from awareness to understanding to decision to action. Using the Army and Marines is just a start; ultimately, the development of a truly joint common operating environment will require additional experimentation involving the Navy and Air Force as well.

Another element of the experiment is to determine the feasibility of incorporating a CBRN logistics management system into the integrated situational-understanding campaign. There is no current system to record and track the

amounts of contaminated classes of supply that need to be reconstituted beyond local standard operating procedures. Improved management of CBRN logistics information could improve the management of equipment by quickly answering the question: Do we have the CBRN equipment that joint forces need when they need it? The benefit to the joint forces would be to more reliably identify areas needing resupply and better understand the mission impacts.

The Perceptive Dragon II experiment also will examine a radiological and nuclear sensor interface in the legacy integrated sensor architecture, to gauge the feasibility of harvesting and distributing radiological and nuclear data between services. This will increase awareness, understanding and options for commanders' actions.

CONCLUSION

This fall, the Experimentation Directorate will analyze the data inputs, outputs and joint force evaluations. If the experiments prove successful in harvesting real-time CBRN-related information threads and distributing them among the joint forces' common operating environment, then the enhanced capability demonstration will have contributed substantially toward early warning. A successful demonstration will bring about the combination of awareness, understanding and confidence that facilitates effective, timely decision-making so the joint force can continue military operations in a CBRN environment.

Conducting experiments to establish information threads and connectivity to and from the joint forces' operating environments is a start. Additional experiments are planned for each year in FY19-21 on the decision-support tool that produces courses of action for joint forces commanders. Once the experiments have established the utility of data from counterbattery radar and radiological detectors, along with connectivity among commanders, those information threads can feed into the decision-support tool.

Future experiments will incorporate additional threads, and the decision-support tool will continue weaving the threads into an informative fabric to increase awareness and understanding and provide commanders with courses of action. Other future experiments will examine the operational relevance of these courses of action to the joint forces.

For more information, contact George "Ed" Lawson at **George.e.lawson.civ@mail. mil** *or 410-436-8476.*

MR. RICHARD NEWTON is a chemist in JPEO-CBRND's Experimentation Directorate at Aberdeen Proving Ground, Maryland. He has an M.S. in systems management from the Florida Institute of Technology and a B.A. in chemistry from McDaniel College. He is Level III certified in engineering and in science and technology management.

SPEEDIER DECISION-MAKING
Integrated with other elements of CBRN defense, detectors such as the Joint Chemical Agent Detector enable commanders to make decisions in advance of an actual strike. Experimentation will modernize and further integrate capabilities to allow for faster situational understanding and earlier decision-making. (U.S. Marine Corps photo by Lance Cpl. Clare J. McIntire, Marine Corps Air Station Miramar/3rd Marine Aircraft Wing)

Overseas assignment gives AMRDEC researcher the chance to explore

Strength Under
PRESSURE

This column is the second in a series of articles profiling the work of defense science and technology personnel participating in the Engineer and Scientist Exchange Program, managed by the deputy assistant secretary of the Army for defense exports and cooperation. The program's mission is to increase international collaboration in military research, development and acquisition, as well as to provide career-broadening work assignments for U.S. military and government defense personnel in foreign defense establishments.

by Mr. Adam Genest

We've all seen photos and videos of rocket and missile launches—hot, white flames emerging from a rocket pod, a launch stand or a missile tube as the rocket accelerates toward its target. While we focus a great deal of attention on what happens when that missile reaches its final destination, Army scientists are also concerned with the condition of the materials that are exposed to the forces and heat of the initial launch, especially since those materials are often used to launch additional rockets and missiles soon after their initial use.

Brittany Griffin, a mechanical engineer with the U.S. Army Aviation and Missile Research, Development and Engineering Center (AMRDEC), recently traveled to Germany through the Engineer and Scientist Exchange Program (ESEP) to study the effects of thermal degradation—the breakdown of materials caused by exposure to heat, such as from the thrust of a rocket—on composite materials.

Assigned to the Bundeswehr Research Institute for Materials, Fuels and Lubricants in Erding, Germany, Griffin put to work her bachelor's and master's degrees in mechanical engineering from Auburn University, as well as her experience with AMRDEC as a missile platform integration specialist. She sought to understand how compression and heat exposure damaged various composite materials.

directly applicable to the work I do at my home organization. Therefore, I had the opportunity to tailor my ESEP position into work that would be immediately beneficial to my programs and position at AMRDEC." She normally studies system dynamics, vibration, shock and environmental effects on nonconventional materials (primarily as they apply to aviation components exposed to extreme stress).

Griffin, who was awarded a letter of commendation from the director of the German research facility for her work, experienced more than just the professional exposure of working in a foreign lab. "The benefits of ESEP are immeasurable," she said. "Professionally, I had time to focus solely on research and gain experience that I could not have gotten at home. I made contacts that will be invaluable in the future. Personally, my husband and I got to experience living and traveling abroad; being able to travel easily in Europe was amazing."

While most of the people in the lab spoke English, Griffin got to hone her German language skills away from work. "There are not many opportunities to actively practice German in Alabama," she noted. "Personally, there were some difficulties, but for the most part there were funny misunderstandings. I accidently ordered the wrong pastry in bakeries more times than I can count. But it always worked out really well and was a great way to try new things."

Now that Griffin is back in Alabama, she hopes to continue the collaborative work between AMRDEC and her German counterparts, as well as to maintain the friendships she made while staying in Erding.

The deputy assistant secretary of the Army for defense exports and cooperation (DASA(DE&C)), which manages ESEP, released the call for applicants in May, and there is still time to apply by contacting Allison Barry, ESEP program manager. Selected applicants will deploy overseas in October 2019.

For more information, contact Allison Barry at **allison.j.barry.ctr@mail.mil** *or 703-614-3175.*

MR. ADAM GENEST is a strategic communications contractor for Booz Allen Hamilton, providing contract support to the DASA(DE&C). He is a Master of Liberal Arts candidate at Harvard University, and he holds a Master of Forensic Science from George Washington University and a B.A. in homeland security and emergency preparedness from Virginia Commonwealth University.

AN ALPINE BREAK
During her year working in a German engineering lab as part of the Engineer and Scientist Exchange Program, Griffin and her husband, Massey, visited the highest point in the country, in the Alps. (Photo courtesy of Brittany Griffin)

Using infrared spectroscopy, a technique for studying the molecular structure of materials, Griffin assessed the damage to materials at the microscopic level after exposure to heat. She then compressed and twisted the materials to the point of failure. In this way, she could model how materials would respond to the rigors of supporting multiple missile and rocket launches in the field, enabling missile and rocket system developers to design hardware that could handle multiple launches without failing.

"My ESEP assignment was a great fit for me. I really enjoyed the work and the atmosphere," said Griffin, who was in Germany from October 2016 through September 2017. "The project was

FACES *of the* FORCE

MS. NATASHA M. OWENS

COMMAND/ORGANIZATION: Project Director for Joint Services, Program Executive Office for Ammunition

TITLE: Project management officer

YEARS OF SERVICE IN WORKFORCE: 18

DAWIA CERTIFICATIONS: Level III in program management and engineering

EDUCATION: M.S. in engineering management and B.S. in mechanical engineering, New Jersey Institute of Technology

AWARDS: Commander's Award for Civilian Service (2015 and 2017); Achievement Medal for Civilian Service

Planning for success? Prepare for change.

Natasha Owens is a planner: "If it is a trip, a dinner or a surprise party, I want to plan out all the details, develop the budget and list all the tasks needed for completion." Fortunately, that dovetails perfectly with her work as a project management (PM) officer for the Project Director for Joint Services within the Program Executive Office (PEO) for Ammunition at Picatinny Arsenal, New Jersey. "In PM shops, we manage program cost, schedule and performance. Planning things is what I enjoy doing. It's a strange and challenging puzzle to me, because just when you think you have all the pieces in order, something happens—budget cuts shift program activities or unforeseen issues [arise] during testing that may require additional testing—and the puzzle is never as easy as it seems."

The Project Director for Joint Services oversees the industrial base facilities and installations that develop, produce, store, distribute and demilitarize munitions for DOD. "When I describe my work to others, they are always amazed at the opportunity I have to work with and provide weapon systems, weapon accessories or ammunition to our Soldiers," Owens said. "They are also equally amazed at some of the opportunities for career development that I have been given."

It's a long list. In 2011, she was accepted into the Excellence in Government Fellows Program, a yearlong leadership development opportunity provided to

"What better opportunity for someone who desires to be a member of the Senior Executive Service than to be a fly on the wall in a room of strategic leaders?"

federal government employees by the Partnership for Public Service. The following year, she served as a DA system coordinator in support of the Product Manager for Crew Served Weapons, working on a full-rate production decision for the Common Remotely Operated Weapon Station. The product office comes under the PM for Soldier Weapons, assigned to the PEO for Soldier and co-located with PEO Ammunition at Picatinny Arsenal.

In 2014, Owens was selected for a six-month developmental assignment as the staff action officer for the Executive Operations Group in the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology (OASA(ALT)). As staff action officer, Owens attended meetings for ASA(ALT) leadership, which at the time was the Hon. Heidi Shyu, ASA(ALT); Lt. Gen. Michael E. Williamson, principal military deputy to the ASA(ALT); and Gabriel Camarillo, principal deputy to the ASA(ALT). "We were tasked with taking notes and identifying action items, and then tracking action items to completion," Owens said. "We also handled special projects: I worked with Mr. Camarillo on an arsenal workload realignment project and with Ms. Shyu on coordinating and planning the senior leader discussion on the Joint Acquisition and Sustainment Review and Force 2025 and Beyond," she said.

"A lot of folks thought I was crazy when they heard I applied to the [Executive Operations Group] program because they considered it grunt work," Owens said. "But I saw it as an opportunity to see strategic-level leadership firsthand. What better opportunity for someone who desires to be a member of the Senior Executive Service than to be a fly on the wall in a room of strategic leaders?" The Executive Operations Group assignment also broadened her understanding of the acquisition process. "Sometimes at the PM level, we do not understand what is going on at the ASA(ALT) level. But my time in [the Executive Operations Group] helped to open my eyes and change my perspective."

Owens' acquisition career started at the U.S. Army Armament Research, Development and Engineering Center in June 2000, just two weeks after she graduated from college. She was hired as a mechanical engineer for the Light Armored Vehicle – Assault Gun program and supported engineering development of fire control systems. She moved to PM Soldier Weapons in 2003 and worked on several weapon system programs through 2015.

That year, she joined the ranks of PEO Ammunition, working for its PM for Maneuver Ammunition Systems as an assistant

product manager for lightweight ammunition, overseeing the early-stage development of 7.62 mm and 5.56 mm ammunition and working with the U.S. Marine Corps on its .50-caliber ammunition development. In 2017, she began working as the DA systems coordinator for the Gator Landmine Replacement Program under the PM for Close Combat Systems, then completed a brief assignment as the special assistant to the PEO for Ammunition before his retirement. "Each assignment brought a different level of challenge and excitement and further helped to build my skill set."

For the past three years, she also took part in the Competitive Development Group, a three-year developmental program that provides members of the Army Acquisition Workforce with expanded training through a series of educational, leader development and broadening assignments. "I came into the program expecting so many things but quickly realized the program expected so many things from me," Owens said. "It's not that the people leading the program don't help—they definitely do. But the expectation is for you to have ownership of your career and your goals, and to know the things you need to do in order to accomplish those goals."

She has passed on that lesson to nearly a dozen co-workers at Picatinny Arsenal who are interested in the program. "The very first thing I explain to them is that this program is not for the weary. You really have to be focused and determined to do the work necessary to move toward your goals." She also suggests thinking big and taking risks. "If I could do it again, I would take more of a 'it doesn't hurt to ask' approach. My mentor was from Fort Belvoir, [Virginia,] and I probably should have asked for some assignments at PM shops there. I didn't, figuring it would be hard to find an organization that would fund my travel. Looking back, I should have at least asked the question: You really never know until you ask."

The Competitive Development Group "was a catalyst for taking me out of my comfort zone," she added. "Before I started, I worked in PM Soldier Weapons for over 12 years, and I admit I became comfortable; I neglected pursuing my career goals, and the work became somewhat routine. But routine is not something I want. Instead, I want to ensure that whatever the assignment, I am giving 100 percent toward providing the best product or service to our Soldiers."

—*MS. SUSAN L. FOLLETT*

DELIVERING NOW

PEO IEW&S contract planning tool literally shows the way to successful execution of myriad actions at once.

by Mr. John Higgins

"Deliver now" has become an unofficial motto of the Program Executive Office for Intelligence, Electronic Warfare and Sensors (PEO IEW&S). So what does that mean?

If you've heard the phrase "live in the now," you have an idea. But PEO IEW&S deals with a very specific part of "now"—the now where our warfighters are at risk. In order to keep pace with threats from the intensely detail-oriented vantage point of contracting, the PEO headquarters' Contract Planning Division has implemented several tools to help program managers (PMs) understand and plan for their current and future contract needs. The most far-reaching of these tools—one that informs all the others—is the Contract Management Review Board, which brings a more proactive focus on procurement action lead time and allows for timely contract awards to prevent gaps in delivering essential requirements to the warfighter.

To a great extent, this approach bears the influence of Maj. Gen. Kirk F. Vollmecke, program executive officer since April 2016, who has held a variety of leadership positions in theater and stateside in which he was responsible for ensuring that contracts delivered as promised. Before coming to PEO IEW&S,

Vollmecke was deputy commanding general for the Combined Security Transition Command – Afghanistan, overseeing the security assistance program for the Afghan National Security Forces. He has also served as the commanding general of the U.S. Army Mission and Installation Contracting Command and deputy to the deputy assistant secretary of the Army for procurement, so he appreciates timely and accurate contracting.

"Vollmecke knows it is important, as he has seen death in wartime efforts because PWSs [performance work statements] weren't written correctly," said Mardel Wojciechowski, chief of the Contract Planning Division. "He takes that to heart. He lived it. That is why we take the time to technically write our PWSs to be cogent and succinct and hold the contractors accountable."

MAPPING THE PATH

To that end, under Vollmecke's guidance, the team created the Contract Management Review Board. It's a kind of virtual whiteboard, where all the stakeholders have access to a living document on a network. "It's very visual, so even if someone doesn't know contracting, they can look at that flowchart and understand where the PM is with that program and that contract

action," said Wojciechowski. "Users can see when it's due to award, when the follow-on is due, if there's an option to be exercised, and determine if they're going to need any type of extension."

The board facilitates interaction among the various offices involved in a contract. It allows the requiring activity, such as a PM, a PEO or the U.S. Army Contracting Command, along with legal staff and the competition advocate, to get involved early and buy in to a timeline, said Kim Nugent, an acquisition management specialist on the contract planning team. "Bad news does not get better with time," Nugent noted. That oft-heard saying is one reason the board exists; it brings any issues to the surface so that all parties can facilitate a solution, she said.

The Contract Management Review Board is updated quarterly. The charts are prepared by the PMs and presented in person to the deputy PEO at least twice a year, sometimes more. Who puts the board together is handled on a case-by-case basis at each PM. Typically the O-5 staff will complete the charts for their products, and the O-6 staff will consolidate them into one submission for each PM.

The board "also shows the progress of the documents that comprise an [acquisition requirements package] and can be the first indicator that a contract award will slip if not prepared in a timely manner," said Nugent.

TRIMMING THE FAT

The success of this new tool is clearly measurable. "One thing that we've noticed is a reduction in bridge contracts," that is, contracts that extend lead or funding time for a certain product's development, said Jesse LeFever, a procurement coordinator on Wojciechowski's team. "That's helpful not only to us but also to the PMs,

A JOB WELL DONE

Kim Nugent, left, an acquisition management specialist with the PEO IEW&S Contract Planning Division, receives a coin in recognition of her achievements from Dr. Bruce D. Jette, assistant secretary of the Army for acquisition, logistics and technology and the Army acquisition executive, as Mardel Wojciechowski, Contract Planning Division chief, looks on. Nugent, honored at Aberdeen Proving Ground, Maryland, on Jan. 31, and Wojciechowski were instrumental in implementing tools to help PMs more effectively plan for their current and future contract needs. (U.S. Army photo by John Higgins, PEO IEW&S)

because we're all doing less duplication of work." The number of bridge contracts decreased from 37 in FY15 to only four in FY18. Additionally, reducing time spent on the bridge actions gives PMs more time to focus on high-quality follow-on acquisition requirements packages.

In preparing charts for the board, the PM must pay special attention to procurement action lead time, which is a general outline of the required time to award a contract from start to finish, including three major milestones along the way. Phase I is the period between establishment of contract by the integrated product team and draft acquisition requirements package approval. Phase II is the period between draft acquisition requirements package approval and request for proposal (RFP) release; Phase III is the number of days from RFP release to contract award.

Further, the team has seen value in making five-year contracts the standard as much as possible.

"It's very important because the [procurement action lead time] to put a new contract package together is a two-year period," said LeFever. "So if the PM awards a three-year contract, there is only a one-year gap before you are starting over. By doing five- to 10-year contracts, you're not just doing the churn constantly.

"Before, if you had a current contract that's going to end in, let's say, March, and your new contract isn't going to be awarded in time, not only are you creating all the documentation for the new contract, you would also have to create additional, separate documentation to extend the current efforts in order to be able to meet your requirements," LeFever said.

PdM/PD XX – [Product & Effort]
CONTRACT / TASK ORDER EXAMPLE
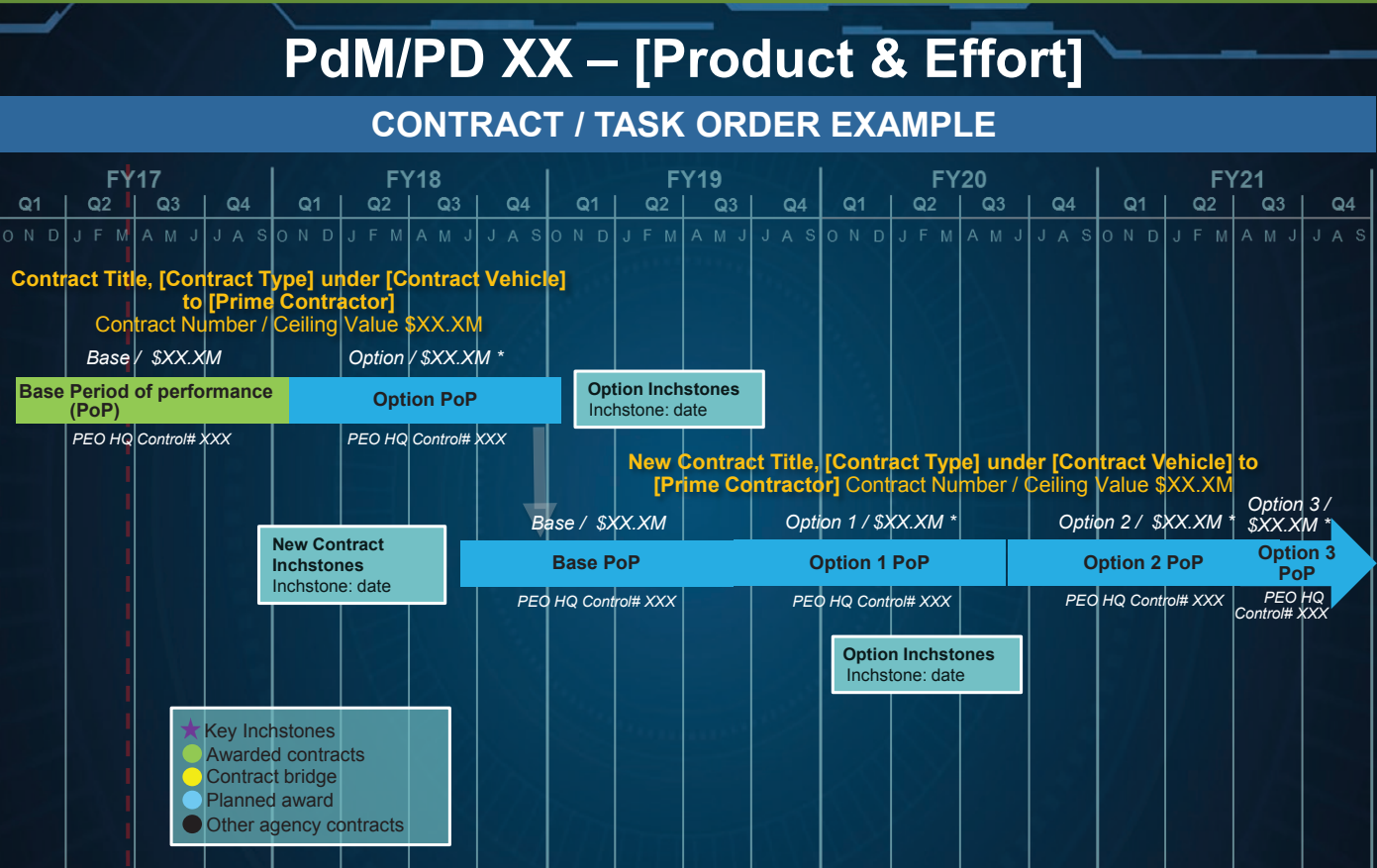
PUTTING THE PIECES TOGETHER

This screenshot from the Contract Management Review Board, with contract specifics removed, represents a product or project manager's current and projected contracts for a five-year period. The five-year period was chosen to allow users to ensure proper transitions between periods of performance by tracking when contracts are due to expire and planning for follow-on acquisition requirement packages. The system is updated in real time so that users track the most accurate information. The dotted red line on the left marks the current date, and the key in the bottom left corner identifies which contracts have been awarded and which are in the planning stages. The down arrow at the beginning of FY19 indicates the date that the first effort is scheduled to transition to the next project award below. (Image by Justin Rakowski, PEO IEW&S)

CONCLUSION

The board "allows the PM to see a pictorial view of contract coverage over a five-year period." said Nugent. "In addition, it shows major inch-stones, which act as leading indicators to timely contract award." Those inch-stones—so named because they are necessary steps between milestones—bring clarity to a highly complex process, allowing even nonexperts to see the bigger picture. Everyone's "piece" of a contract process is more clearly laid out before them, making it easy to see where they fit in the bigger picture. And the bigger picture is how a PEO must plan.

"The PEO has tried to instill and empower the PMs to think long-term, plan far ahead," said Wojciechowski. "He said, 'I know that you don't think you should plan today because you don't have the money. That's not the concept. The concept is to plan before you have the money, so that you're prepared and postured to execute those dollars on a contract vehicle to support that mission when it's time and keep pace with the threat.' "

This means focusing contract planning not only on current needs but also future needs and requirements, so that they deliver "now" even when the "now" changes.

For more information, go to the PEO IEW&S website at **https:// peoiews.army.mil**.

MR. JOHN HIGGINS is a public affairs writer for PEO IEW&S. He is an Iraq War veteran and former public affairs Soldier. He holds a B.A. in film production from Towson University.

SPEEDING UP
ACQUISITION AWARENESS

Defense Acquisition University (DAU) regularly develops case studies for educational purposes to emphasize acquisition in action. In DAU's case-study-based curriculum, students spend weeks reviewing case studies that include the Army combat glove, the Navy's advanced medium-range air-to-air missile, the Air Force F-18 software acquisition and dozens of others. While it often takes months to research and develop these case studies, DAU is also looking at ways to make the process go faster. With support from Ellen M. Lord, undersecretary of defense for acquisition and sustainment, DAU personnel are speeding up the release cycle by collecting acquisition stories and developing micro-case studies in defense innovation as videos and podcasts for immediate use. Turning around the media in a matter of days instead of weeks means members of the defense acquisition workforce can learn what is being used in the field right now instead of last year.

With that in mind, it is fitting that the first of these innovation stories was about Defense Innovation Unit Experimental. Then-Secretary of Defense Ash Carter stood up the unit, commonly referred to as DIUX, in 2015 to quickly provide funding for innovative private-sector technology and get it into the hands of Soldiers in days instead of months and years. One of their recent successes was with the Shield AI mapping drone, a handheld quadcopter that will give troops eyes inside buildings before they rush in.

DIUX Leads the Way with Other Transaction Authority
Lauren Schmidt, pathways director for the program, explained that when contracting this quadcopter with Shield AI, DIUX chose other transaction (OT) authority over a traditional Federal Acquisition Regulation (FAR) route not to circumvent any regulations, but instead to better tailor—and therefore speed up—development of the drone.

"DIUX chose to use OTs because it allows us to work with and reach out to a nontraditional [government contractor] on a fast, flexible and collaborative basis ... we can solicit for, negotiate and award these OTs in a very short period of time, often as quickly as 60 to 75 days," Schmidt said.

OTs are used to support research and development for prototype acquisition from companies that do not usually do business with DOD. Because much of this includes proprietary, cutting-edge technology, other transaction authority prototypes are not awarded through standard contracts and agreements. This provides a legal framework outside FAR with more flexibility to speed up the procurement timeline, particularly when making immediate adjustments to a prototype.

"Because all of the terms and conditions of the OT are negotiable, we can negotiate directly with those companies and design an OT that works best for both parties," she said. "We can actually sit across from the company and design projects collaboratively together in a much more agile fashion than you can do under a FAR-based contract."

Other transaction authority may have been the contracting vehicle for the Shield AI quadcopter prototype, but DIUX also reframed the contract to focus on solving the problem instead of generating a list of requirements that would have to be fulfilled.

"The acquisition process is complex," Schmidt said. "It's not just contracting, but it's your overall acquisition model and your requirements. We try and focus not just on better speed to market and better outcomes from contracting through OTs, but also on the re-quirement side by focusing on problems rather than prescriptive requirements."

This approach to problem-solving sped up development time by creating a flexible contracting environment that enabled the government to sit down with the developer and make adjustments to prototypes based on warfighter feedback.

"Because of the flexibilities that OTs and their competitive process provide, we were able to modify the OT quickly in response to that direct warfighter feedback," Schmidt said. "That gave us a much faster iterative loop of design and allowed us to get a better product that better met the needs of our warfighters on the ground."

OTs provide a lot of flexibility to tailor contracts outside of traditional FAR regulations, which can make some people hesitant to employ them. However, Schmidt said that this flexibility is more a feature than a risk.

"There's very little regulation or guidance on how you have to use them, and sometimes that can scare people off," she said. "You can use the OT statute to design a process that works best for your team, for your mission, for your customers, so use this flexibility to the maximum extent practical. ... OTs allow for a lot more flexibility throughout the life of the performance of the OT, not just in the solicitation or award for it. So it allows you to really respond to the needs of the project on the ground and respond to that engineering."

—ABEL TREVINO, DAU PUBLIC AFFAIRS

*The full interview with Lauren Schmidt can be found on DAU's website. Do you have a success story to share? For more information, contact DAU Public Affairs at **communications@dau.mil**.*

Defense Acquisition University

Richard K. Bernstein, M.D.

PATIENT, TEST *THYSELF*

Army materiel developers could learn a lot from the perspicacity and grit of one old man. The adage has it that the doctor who treats himself has a fool for a patient, but there's a long tradition of self-experimentation in science. Perhaps nowhere has it been so successful, if only after decades of effort, as it has been for engineer-turned-doctor Richard K. Bernstein, M.D., a Type 1 diabetic who has arguably broken more ground than anyone in history to help diabetics live normal lives, all because he used himself as a guinea pig.

by Ms. Margaret C. Roth

The evidence could not have been more clear: After years experimenting with his diet and insulin regimen to level out his blood sugar, engineer Richard K. Bernstein saw the answer he was seeking to his ever-more damaging Type 1 diabetes. It included monitoring blood sugar closely, and minimizing carbohydrates.

Diabetes had affected his health for so long, since age 11, that Bernstein, at age 35, set out to control the diabetes, which was making life miserable in so many ways. He looked and felt like an old man at what would seem to be the prime of his life, to be enjoyed with his wife, Anne, a psychiatrist and psychoanalyst, and their children—three at the time, all under the age of 9. His moods fluctuated dramatically with his blood sugar levels, making him often irritable, prone to lashing out at work and at home. Fatigue was his norm. His kidneys had been damaged by high blood sugar. His vision had deteriorated. And there

was the relentless uncertainty that comes with any chronic, life-threatening disorder. "You know, it's very frightening to not know your blood sugar and know you could die of a low blood sugar [episode] any time," he said.

By happenstance, he saw an ad in a medical laboratory trade journal he had been receiving, for a three-pound meter designed for hospital emergency rooms. The device gave ER staff a way to determine, when laboratories were closed at night, whether someone who appeared drunk was in fact having a diabetic crisis. It cost $650, more than $4,400 in today's dollars—a major investment compared with today's finger-stick blood glucose meters for daily use, which generally range from $15 to $30.

The only problem was that the meter was available at the time only to medical professionals. So Bernstein ordered it through his wife and set out to solve the most important problem he'd

ever faced. "I said, well, I'm an engineer. If I knew what my blood sugars were, I could do something about them."

That was 1969, and Bernstein was, in effect, his own doctor in his quest to master his diabetes. For the first time, looking at seven or more blood sugar measurements a day, he could see his body at work, and it wasn't a pretty sight. Over the next four years, through experimentation, he developed a way to achieve normal, steady blood sugar levels, and it made all the difference, reversing most of the damage his elevated blood sugars had done.

DEFINING A NEW FRONTIER

His own physician said there was no reason for a diabetic to maintain normal blood sugars. But Bernstein saw, and felt, the results of his experimentation, felt the immensity of the weight lifted from him, and understood the potential power of his results for uncounted other diabetics struggling to survive, much less thrive.

He had no idea how hard it would be to persuade the medical community of this potential, the professionals who supposedly were dedicated to improving diabetics' lives. It would take a medical degree, a 560-page book and many more years beyond those for Bernstein to persuade even a minority of the diabetes specialists in this country that a carefully structured low-carbohydrate diet, in conjunction with multiple carefully timed insulin shots, can normalize blood sugar in Type 1 and many Type 2 diabetics. Perhaps just as important, it would also take thousands of diabetics essentially experimenting on themselves with Bernstein's guidance—and living markedly healthier lives as a result.

Now 84 and a practicing physician in Mamaroneck, New York, Bernstein has surpassed, by 43 years, what the average

life expectancy was for a person with Type 1 diabetes at the time he was diagnosed. He is not disabled. Far from it. He sees patients four days a week, works out three times a week and maintains a passion for opera. "Vecchio e saggio," or "old and wise," was his response in Italian to the less colorful "How are you?" that opened Army AL&T magazine's conversation with him on May 24.

"Vecchio" because Bernstein figured out how to keep diabetes from cutting his life short. "Saggio" because he has learned so much about the modern practice of medicine: its institutional prejudices, professional self-interest and perverse economic incentives, Bernstein said—themes that cross over into the fields of science and engineering, not to mention government. And it's hard to miss the parallels with Army acquisition: bureaucratic intransigence, risk aversion, self-protection.

THE PHYSICS OF LIFE

Bernstein did not set out to be a doctor, or even an engineer. As a teenager, he wanted to study physics, not diabetes. An insatiable learner, he asked his high school science teacher for some summer reading, plunged into two books—one on quantum physics and the other on relativity—and was hooked right away. It was the "strange things that were involved that hook most people who go into physics," he said. "There were things that seemed to contradict everyday experience. And I wanted to study that."

He was on the right path for a while, a student at Columbia College, admitted two years below the minimum age. He loved physics and the company of physicists. His lab partner at one point was Gerald Feinberg, later the head of Columbia's physics department and the person who introduced the word

"tachyon." A tachyon—from "tachys," the Greek word for swift—is a theoretical quasi-particle that moves faster than the speed of light and can travel backward in time.

Such mystery and complexity were precisely what Bernstein thrived on at Columbia—if only he could retain what he was learning from day to day. "I couldn't remember what I was taught in any of my courses. By the time I started the second year in college, I was taking graduate math courses. But again, I couldn't remember things." His thyroid gland, the engine of the human body, was not producing enough thyroid hormone.

Thyroid disorders are second only to diabetes in the United States among conditions affecting the endocrine system, the group of glands from which the body gets hormones that regulate growth, function and nutrient use by cells. An estimated 20 million Americans have a

> *A central principle of Bernstein's solution for diabetics is that they have "the right to normal blood sugars like a nondiabetic," such that even when they eat, their blood sugar remains constant at a healthy level.*
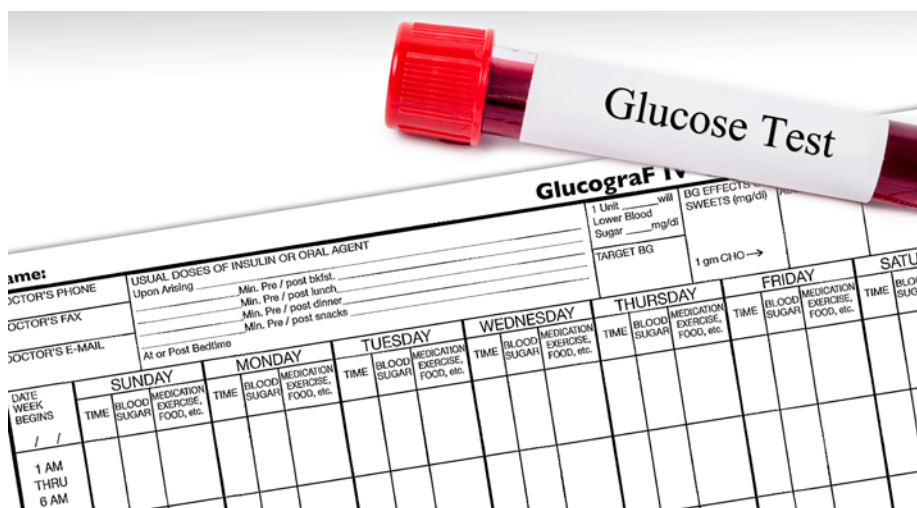
thyroid disorder, although as many as 60 percent of them don't know it, according to the American Thyroid Association. It is common for someone to have both thyroid disease and diabetes.

With classmates like Feinberg, Bernstein thought, "I can't compete with these people. Here I was, sleeping through classes. I was missing exams because I'd sleep until 10 o'clock in the morning. So I switched to engineering, figuring it would be less demanding." Bernstein was in Columbia's "professional option program," whereby he could finish his last year of college while taking his first year of engineering school.

By a stroke of luck, a doctor suspected that his thyroid was at the root of his problem. "So they put me on thyroid replacement, and I suddenly woke up. I got all A-pluses for the rest of my engineering education." He received a Bachelor of Arts degree from Columbia College and a Bachelor of Science from Columbia Engineering, and set out to make a living.

EARLY GLIMMERS

With his training in math and engineering, Bernstein's first jobs were in what is now known as systems engineering. He worked for a housewares company that had a warehouse in Massachusetts and a showroom in New York City, taking orders mailed to the New York office by salesmen across the country. The New York staff would type up the orders and mail them to Massachusetts, where warehouse personnel would ship the products and then mark on the forms mailed to Massachusetts how much they'd shipped, how much was back-ordered and so on. The completed forms were mailed back to New York.

Photocopiers as we know them today did not exist, so if some of those forms got lost in the mail, they were gone. Bernstein had an idea to modernize this process.

As a computer maker, "IBM was brand new. Punch cards were brand new. Paper-tape teletype was old; that was how they sent telegrams," he said. "What I set up was a system where people in New York would type up punch cards and put them in a machine that converted them to paper tape, [then] run the paper tape through the teleprinter." That would simultaneously transmit the information to Massachusetts and print it in New York

on the teleprinter, providing hard copies of the information to both locations.

"Plus, the tape up in Massachusetts could be converted to IBM cards and they could then, when they made a shipment, type into the cards the shipment information, convert them back to tape and send the tape to New York. It was sort of very early automation … the only company in the country that had bidirectional, long-distance information transfer."

The company did not have the progressive management Bernstein was looking for, however, so he looked elsewhere, hoping to get back into science. He took a job in the medical equipment field, where he was responsible for product development, among other areas, and applied his training and expertise to a number of products, some of which are still on the market 60 years later. For example, one was a stain to pick up microscopic abnormalities in urine, another a centrifuge for blood testing in doctors' offices. Bernstein was doing what he enjoyed, and he had a lot to show for it—none of which would keep him from "dying of the complications of diabetes."

A HANGRY MAN

His main problem was frequent dips in blood sugar, "causing me to get into all kinds of trouble because your behavior gets distorted. You get easily frustrated. You can get angry at people. You could lose your temper. It's like being drunk. So, if my blood sugar were low and if my boss was wrong about something, I'd yell at him. If my blood sugar were normal or high, I'd tolerate his mistakes."

Bernstein's wife and children suffered the same volatility. "The problem was terrifying my family at home," he said. So in 1969, when he saw that ad in the trade journal for laboratory equipment for a three-pound meter designed for hospitals to distinguish the intoxicated from the diabetics, he went for it. The blood-testing process was far from elegant—"you had to rinse off the blood after a minute and then blot the [test] strip, so I had to

carry a little squeeze bottle of water with me, but it was easy enough to get accurate results."

Over the next three years, Bernstein took careful notes on how his blood sugars varied with exercise and insulin intake, on a cheap, pocket-sized notebook with perforated pages. He increased his daily insulin shots from one to two. The sharp highs and lows smoothed out somewhat, but his health was no better, although his physician saw nothing remarkable and said he was doing well.

Over the next year of his experimentation, measuring his blood sugar five to eight times a day, he changed one aspect of his routine every few days—what he ate, when he took insulin shots, his dosages—and maintained the changes that resulted in normal blood sugar, discarding those that didn't. He found, for example, that

one gram of carbohydrate raised his blood sugar by 8 milligrams per deciliter (mg/dL), and that one-half unit of the beef-pork insulin he was taking lowered it by 15 mg/dL. (For more on diabetes and blood sugar levels, see "Getting to 'normal,' " Page 110.) He was on his way to the breakthrough he was looking for.

"It was about two years after I got my blood sugar straightened out and started to see my complications getting better. I was actually sitting on the toilet, and was thinking that I felt like I had escaped from a concentration camp and that there were millions of people still prisoners, whose lives were on the line every day. That's the case with Type 1 and many Type 2 diabetics, because they could drop dead of very low blood sugar or even go very high" and develop life-threatening diabetic ketoacidosis.

"So I had to get doctors interested in this better mousetrap. I decided that I was going to try to convince the physicians who attended the [medical] conventions that they should have their patients measuring their blood sugars and do the other things that I had worked out."

As convinced as Bernstein was of the benefits of self-monitoring, he was astonished to find not a single physician who wanted to be convinced. Having patients check their own blood sugar was an unwelcome concept to the established experts in endocrinology, as his very low-carbohydrate dietary solution would later prove to be.

His first target of persuasion was his own doctor, who was president of the American Diabetes Association (ADA). Founded in 1940 by 26 physicians as a professional medical organization, the ADA had only recently, in 1970, opened its membership to the general public.

WEIGHT OF ACHIEVEMENT
Bernstein, 84, lives an active life for an octogenarian, in part because of his willingness to use himself as a guinea pig in the search for better diabetes treatment, providing well-documented evidence that a very low-carb diet is effective in smoothing out blood sugar levels. (Photo courtesy of Richard K. Bernstein, M.D.)

Bernstein saw, and felt, the results of his experimentation, felt the immensity of the weight lifted from him, and understood the potential power of his results for uncounted other diabetics struggling to survive, much less thrive.

Now the organization describes itself as "a network of more than one million volunteers, a membership of more than 500,000 people with diabetes, their families and caregivers, a professional society of nearly 14,000 health care professionals, as well as more than 800 staff members." Its stated mission is to "lead the fight against the deadly consequences of diabetes and fight for those affected by diabetes," by funding research, delivering services, providing "objective and credible information" and being a voice for "those denied their rights because of diabetes."

Bernstein tried to get across three points. "One, I was taking a shot before every meal and also a shot of long-acting insulin twice a day, five shots a day," to which he said his doctor responded, "It's enough trouble to try to get a patient to take one shot a day. No way am I going to waste my time trying to get someone to take five shots a day."

Point No. 2: "I said, 'Well, you know, the literature on animals shows that you reverse the diabetic complications if you normalize their blood sugars.' He says, 'Yeah, but you're not an animal.' And I remember saying to him that Einstein said that the laws of nature remain the same throughout the universe."

Point 3 was the urgent need for patients to measure their own blood sugars. His doctor's objection, Bernstein said, was purely one of self-interest. "He said, 'I certainly am not going to let them measure their own blood sugars because they come to see me once a month to get a blood sugar. If they can do it themselves, I'd never see a patient.' " Not until 1980 would finger-stick glucose meters be available to the general public for accurate self-testing of blood sugar.

Bernstein knew that he'd have to communicate with the medical establishment the way they communicated with one another, by getting published. "I didn't know how to write a medical article, but the people who made the blood sugar meter had a medical writer on their staff, and he guided me. We put together an article that was about 20 pages long and was scientific-looking. It used medical terminology and so on." As this was before computers made it easy to type something and

print it in multiple copies, Bernstein paid $1,000 to have it typeset by hand for reproduction.

He still has the rejection letters. "I submitted it to a number of journals, a couple of journals published by the American Diabetes Association and also the Journal of the American Medical Association and the New England Journal of Medicine."

"I wrote this really as a step-by-step to what patients should do. I didn't put it together, as 'Here's the evidence,' but it was my assumption that doctors would jump to normalize blood sugars."

THE RIGHT TO BE NORMAL

A central principle of Bernstein's solution for diabetics is that they have "the right to normal blood sugars like a nondiabetic," such that even when they eat, their blood sugar remains constant at a healthy level.

Professional self-interest is the only reason that Bernstein can see for major medical organizations like the ADA to set a standard for blood sugar in diabetics that is higher than what the same organizations know is normal. The ADA's desirable blood sugar level for diabetics is 70 to 130 mg/dL before meals, and less than 180 mg/dL after meals, versus Bernstein's target constant blood sugar of 83 mg/dL for adults, in the 70s for children before puberty and 65 for pregnant women.

The likely reason for the ADA standards is that doctors want to hedge their bets and avoid the risk that a diabetic patient could die from hypoglycemia, or too-low blood sugar, Bernstein said. "If they go too low, the doctor is afraid of getting sued, so he doesn't want any part of it." Whereas, he said, if the patient suffers diabetic complications with blood sugars in the ADA's target ranges, there are long-term expected consequences of their disease that would never justify a lawsuit. If a patient with chronically high blood sugar gets a foot amputated because of a nonhealing ulcer, insurance will pay for it and the doctor won't get sued. If, however, in trying to keep a patient's blood sugar normal, a diabetic dies from a prolonged very low blood sugar level, the doctor can be sued.

The issue of carbohydrate reduction as a means to prevent wild blood sugar swings is equally important to Bernstein, and one on which he continues to assail the much larger forces of the ADA and the food industry.

Whereas Bernstein, based on his experimentation, has arrived at maximum limits on carbohydrates that diabetics should observe in order to maintain normal blood sugar, the ADA is nonspecific in its dietary guidance. Rather, it offers a generic statement on the many choices diabetics face in deciding what to eat and defers to the diabetic to make the right choices in consultation with their health care providers.

"Carb counting may give you more choices and flexibility when planning meals," the association states on its website. "It involves counting the number of carbohydrate grams in a meal and matching that to your dose of insulin. With the right balance of physical activity and insulin, carb counting can help you manage your blood glucose. It sounds complex, but with time you and your diabetes care team can figure out the right balance for you," the website states.

The ADA's bottom-line position on the right diet for diabetics? "There isn't one. At least not one exact diet that will meet the nutrition needs of everyone living with diabetes. Which, in some ways, is unfortunate. Just think how simple it would be to plan meals if there were a one-size-fits-all plan that worked for everyone living with diabetes, prediabetes, or at risk for diabetes. Boring, yes, but simple!

"As we all know, it's much harder than that. In the long run, an eating plan that *you can follow and sustain* and that meets your own diabetes goals will be the best one for you."

ONE BRIGHT LIGHT IN THE DARK
By 1975, the only encouragement Bernstein had received for his efforts to promote normalizing blood sugar was from Charles Suther, in charge of marketing diabetes products for Ames Division of Miles Laboratories, the company that made the blood glucose meter he had bought. Suther also hand-distributed Bernstein's rejected article to diabetes researchers and physicians around the United States.

Suther arranged for free testing supplies to support the first of two university-sponsored studies in this country, which demonstrated that normalizing blood sugar levels could reverse early complications in diabetic patients. Those studies led, in turn, to the universities sponsoring the world's first two symposia on blood glucose self-monitoring. Bernstein was becoming better-known and received invitations to speak at international conferences on diabetes, though not in the United States. The ADA nevertheless continued to block blood sugar self-monitoring.
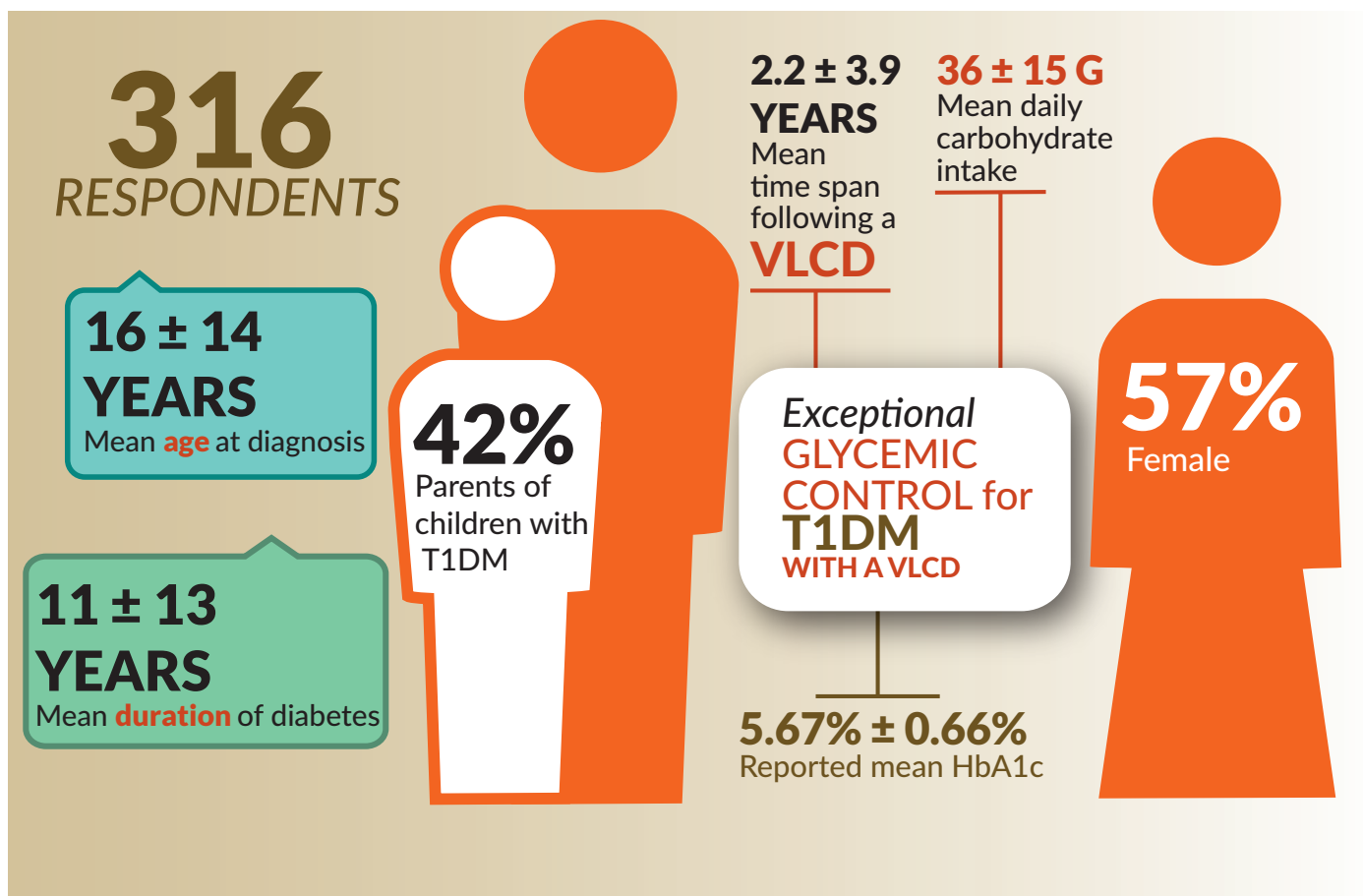
Frustrated that self-monitoring was still not accepted and that he could not get published, Bernstein reluctantly pursued another path. He hoped that an M.D. degree would enable him to publish. So, in 1977, he quit his job, took premed college courses, got high grades on the Medical College Admission Test and entered medical school.

Six years later, he opened his practice in Mamaroneck, a suburb of New York City, determined to do things differently. Instead of spending an hour or less with a new patient, Bernstein's initial evaluation and training spans three days. Nowadays, he makes himself available to patients not only at his office, but through free monthly teleseminars and videos in which he answers questions sent to him from around the world.

Spending those three days with new patients enables Bernstein to address other issues that may affect their blood sugars. "They may have eating disorders. They may have a neuropathy of the digestive system, which is very common in diabetics, called gastroparesis. They could have other things that screw up the diabetes, like infections or the need for steroids and so on. Almost every patient presents with new variations, new problems. I'm trying to keep their blood sugars in a very narrow, normal range."

Now the author of nine books, Bernstein is best-known for the 560-page "Dr. Bernstein's Diabetes Solution: The Complete Guide to Achieving Normal Blood Sugars," originally published in 1997 and updated in 2011. His book has become a lightning rod for patients and families who are desperate, as he once was, to not be at the mercy of diabetes. As the title indicates, it goes into great detail on how diabetes affects the body; how diet, exercise and insulin of various types, for example fast-acting versus slow-acting, affect blood sugar; and the optimal times to measure blood sugar and take insulin (a minimum of five shots a day for Type 1 diabetics; for Type 2, anywhere from none to five a day depending on the severity of their diabetes).

The book also goes into candid detail about the many medications for treating Type 2 diabetes, describing the appropriate circumstances for their use as well as their values and shortcomings and modes of use.

316
RESPONDENTS

16 ± 14 YEARS
Mean **age** at diagnosis

11 ± 13 YEARS
Mean **duration** of diabetes

42%
Parents of children with T1DM

2.2 ± 3.9 YEARS
Mean time span following a **VLCD**

36 ± 15 G
Mean daily carbohydrate intake

Exceptional GLYCEMIC CONTROL for **T1DM** **WITH A VLCD**

5.67% ± 0.66%
Reported mean HbA1c

57%
Female

KEY
±: Represents standard deviation
G: Grams
HbA1c: Glycated hemoglobin
T1DM: Type 1 diabetes mellitus
VLCD: Very low-carbohydrate diet

PROOF OF CONCEPT
Nearly 50 years after Bernstein began experimenting on his own blood sugars, the medical journal Pediatrics released research results in May indicating that the very low-carbohydrate diet that Bernstein developed can significantly improve blood sugar control in Type 1 diabetics. It's not vindication, though, Bernstein said. "It'll be vindication when the doctors start changing." (Graphic by U.S. Army Acquisition Support Center)

Bernstein's strict emphasis on maintaining a very low-carbohydrate diet—an average of 30 grams a day for a 140-pound person—is central to keeping blood sugar at normal levels. He has found, from his own experience and that of his patients, that higher amounts of carbohydrates rapidly raise blood sugar above what is normal and healthy. That means, for example, avoiding all foods with added sugar or honey; all foods made from grains and grain flours such as breads, cereals, pasta and rice; all starchy and high-carbohydrate vegetables such as potatoes, corn, carrots, peas, tomatoes and most beans (as opposed to zucchini, cucumbers, broccoli, cauliflower and other vegetables that contain mostly complex carbohydrate that's harder for the body to break down); and, with very few exceptions, all fresh or preserved fruits and fruit juices. It also means avoiding dairy products except for butter, cream, cheeses and full-fat yogurt; the higher the fat content of dairy products, the lower the carbohydrate content.

THE LAWS OF SMALL NUMBERS
Key to Bernstein's approach to managing blood sugar, and a reflection of his systems engineering perspective, is what he calls "the laws of small numbers," which basically look at the management of blood sugar as an imperfect system because there are variables in it such as what you eat and how much insulin you

> "I would much rather be a physicist, and I'm 84 years old. I'd rather not be working so hard. I like sailing; I'd rather be sailing. But I'm stuck. I have to continue. I have an obligation to the patients who didn't know what I know."

inject or produce. The laws of small numbers can be seen as a corollary of the "fail early" principle in Army experiments with warfighting technologies.

The point is, Bernstein said, "If inputs are imprecise, the outputs will be imprecise, and the errors in the outputs will be greater for large inputs." In other words, he said, "Big inputs, big mistakes. Small inputs, small mistakes. I'm sure it applies to any system where there's any degree of uncertainty of your inputs, where you can't be precisely on the nose."

Say, for example, that a diabetic who takes insulin is trying to estimate the amounts of carbohydrates to eat. The diabetic is having 100 grams of carbohydrate, each gram of which will raise blood sugar by 10 mg/dL. One unit of insulin will lower blood sugar by, say, 50 mg/dL. Thus, if the diabetic is going to eat 100 grams of carbohydrates, that will raise blood sugar by 1,000 mg/dL, requiring 20 units of insulin.

But the carbohydrate estimate could be way off from the actual amount, Bernstein said. "Let's say that you take a medium-sized apple. Depending upon how old it is, how long it's been sitting on the counter, what brand, what kind of apple it is, what form, what the weather conditions were for its growth, you can probably be off by, let's say, 40 percent on the amount of carbohydrate in that apple. And you're looking at other things that you're eating in that meal to get that 100 grams."

If the estimate is off by 40 percent, that translates to 400 mg/dL on the blood sugar measurement. "But you're treating it with insulin as if it were 1,000. It could be 1,400, and it could be 600. So, what you're going to do is possibly be 400 mg/dL off on your blood sugar after that meal."

In addition to which, the insulin introduces its own variability, he said. "If you're using ultra-rapid insulin, which is what the doctors like nowadays, you have a very sharp peak of insulin activity. If you're using rapid-acting carbohydrate … you get a sharp peak in blood sugar rise, and you're trying to match in time the sharp peak from the insulin with the sharp peak from the rise.

"Whereas if you're using small amounts of slow-acting carbohydrate and small amounts of slower-acting insulin, you end up with a shallow peak and a shallow peak, and you have to match those.

And they're not peaks, they're just shallow bumps. It's much easier to match two shallow bumps in time than two sharp peaks."

The laws of small numbers apply to any number of situations involving the day-to-day, hour-to-hour management of blood sugar, Bernstein said, and should guide the diabetic patient's calculations of "if x, then y."

This is yet another area in which Bernstein's approach to diabetes differs sharply from the established advice, he noted. "What do you do if your blood sugar gets too low? The medical profession may tell people, eat a peanut butter and jelly sandwich, which will have an unpredictable effect on blood sugar, [the ingredients] being both rapid and slow acting. It'll start maybe in 10 minutes, 15 minutes, but it'll keep working for hours." Bernstein advocates the use of measured amounts of pure glucose—glucose solution, if possible—to rapidly raise blood sugar by a predictable amount if it's too low.

EXPANDING THE DATA
The letters following "M.D." after Bernstein's name—F.A.C.N. (Fellow, American College of Nutrition), F.A.C.E. (Fellow, American College of Endocrinology) and FCCWS (Fellow, College of Certified Wound Specialists)—attest to his advanced work.

"I've experimented on myself, but I've learned all kinds of new tricks from working with patients," he said. "I'd look at their blood sugars for one or more weeks, look at their insulin doses and when they took it, how much they took, when they ate, etc. I ask the patient to eat the same meals every day while I'm experimenting with them so that I can get consistent results."

Disposable pocket notebooks wouldn't work for this level of data collection and comparison, so, ever the engineer, Bernstein designed a chart he calls the Glucograf for patients to enter data that he could readily interpret. The chart records time, blood sugar, food, medication and exercise for each day of the week. "I needed a format that would enable me to rapidly figure out what's happening to a patient." He uses it for himself, too.

The data from patients has taken on a life of its own with the formation a few years ago of TypeOneGrit, a Facebook group of about 3,000 Type 1 diabetics, or parents of Type 1s, who have read "Dr. Bernstein's Diabetes Solution" and are currently following his very low-carbohydrate protocol to normalize blood sugars. The discussion and advocacy group formed around a shared conviction that the protocol works, and the impassioned belief that it can work for other diabetics to relieve the havoc and dismay that uncontrolled blood sugar can wreak in their lives.

"We believe that type 1 children (as well as adults) are entitled to the same normal blood sugars as non-diabetics," TypeOneGrit's Facebook page states.

Most of the diabetics represented in TypeOneGrit use continuous glucose monitors, which employ fine sensor fibers placed in the skin to measure blood sugar. The data can go to a cellphone and be uploaded to a computer.

The data that TypeOneGrit members have generated are now national news. Nearly 50 years after Bernstein began experimenting on his own blood sugars, the journal Pediatrics on May 7 released an article, "Management of Type 1 Diabetes With a Very Low-Carbohydrate Diet."

The finding was "Exceptional glycemic control of type 1 diabetes without high rates of acute complications may be achievable among children and adults with a very low-carbohydrate diet," according to an online patient survey. The researchers, led by Belinda Lennerz, M.D., Ph.D., and David Ludwig, M.D., Ph.D., of Boston Children's Hospital, reviewed data provided by the physicians of 316 TypeOneGrit diabetics, 42 percent of them children. All of the survey respondents had followed Bernstein's diet for at least 90 days, consuming an average 36 grams of carbohydrates per day (ranging from 30 to 50 grams), or less than 5 percent of total calories.

Carbohydrate intake was the only predictor of their A1C blood sugar levels. The survey group had an average blood sugar of 103 mg/dL and an average A1C (a longer-term measure of blood sugar) of 5.67 percent. Nearly all, 97 percent, bettered the ADA's targets for blood sugar. Significantly, the very low intake of carbohydrates had no adverse effects on the children's growth, as measured by normal height for their ages.

"It's hard for me as a single person, unfunded, to do a study," Bernstein said. "If it weren't for this group that materialized on Facebook—a mother finding my book and a father who's a physicist used it to treat their newly diagnosed son, who had previously been put into big trouble because of conventional medical treatment; he turned around and started growing and having normal blood sugars—if they weren't so excited about this and organized this group, this paper wouldn't have come out."

VINDICATION? NOT YET.

The researchers who conducted the study are now calling for controlled clinical trials of the very low-carbohydrate protocol to normalize blood sugar levels, which would seem to vindicate Bernstein's hard-fought convictions. The study is unquestionably a big boost to his work, but hardly the last word.

This one published article does not mean, Bernstein said, that it's time to sit back and say he's done what he set out to do. "I say it'll be vindication when the doctors start changing. I know of a number of Type 1 diabetic doctors who are using my book to treat themselves, but not to treat their patients because they don't have the time to spend with the patients.

"I'm waiting to see what happens as a result of this article. We might get more attention. I'm anxious to find a large medical practice that has a lot of patients, where paramedical people can be used to teach them and train them, because doctors can't

The laws of small numbers can be seen as a corollary of the "fail early" principle in Army experiments with warfighting technologies.

afford to do this."

The U.S. may not be the best test bed for broader experimentation of Bernstein's approach, he said. "Here it's very hard—[there's] a lot of prejudice against doing anything significant. The doctors are so interested in protecting themselves that it might be smart to look to another country, like China, where there's a huge epidemic of diabetes due to overeating. They don't know how to treat it, but their health care system is well-funded."

Nor is Bernstein inclined to retire and write the autobiography of a determined insurgent who challenged long-established institutional health care practices on behalf of some 30 million Americans—422 million worldwide—living with a potentially fatal disease.

Diabetes is the field he knows the best. "I would much rather be a physicist, and I'm 84 years old. I'd rather not be working so hard. I like sailing; I'd rather be sailing. But I'm stuck. I have to continue. I have an obligation to the patients who didn't know what I know."

He has "absolutely not a doubt" in the science of what he's doing "because I see the results. I see it every day. Patients are getting better."

MS. MARGARET C. ROTH is an editor of Army AL&T magazine. She has more than a decade of experience in writing about the Army and more than three decades' experience in journalism and public relations. Roth is a MG Keith L. Ware Public Affairs Award winner and a co-author of the book "Operation Just Cause: The Storming of Panama." She holds a B.A. in Russian language and linguistics from the University of Virginia.

GETTING TO 'NORMAL'

Just as "normal" is no absolute in any context, it varies somewhat among medical professionals providing guidance to diabetics on target blood sugar levels. And that's where Dr. Richard K. Bernstein differs vehemently with the U.S. medical establishment.

Bernstein's persistent insurgency against conventional thinking in diabetes treatment, grounded in a difference of numbers representing desirable blood sugar levels that in turn mean the difference between good health and life-threatening illness, is akin to Army leaders now doing their insurgent best to fight the standard approaches to acquiring and fielding the best equipment and materiel for warfighters in a timely manner while it can still save lives. Disciplined experimentation is a key to success in both cases.
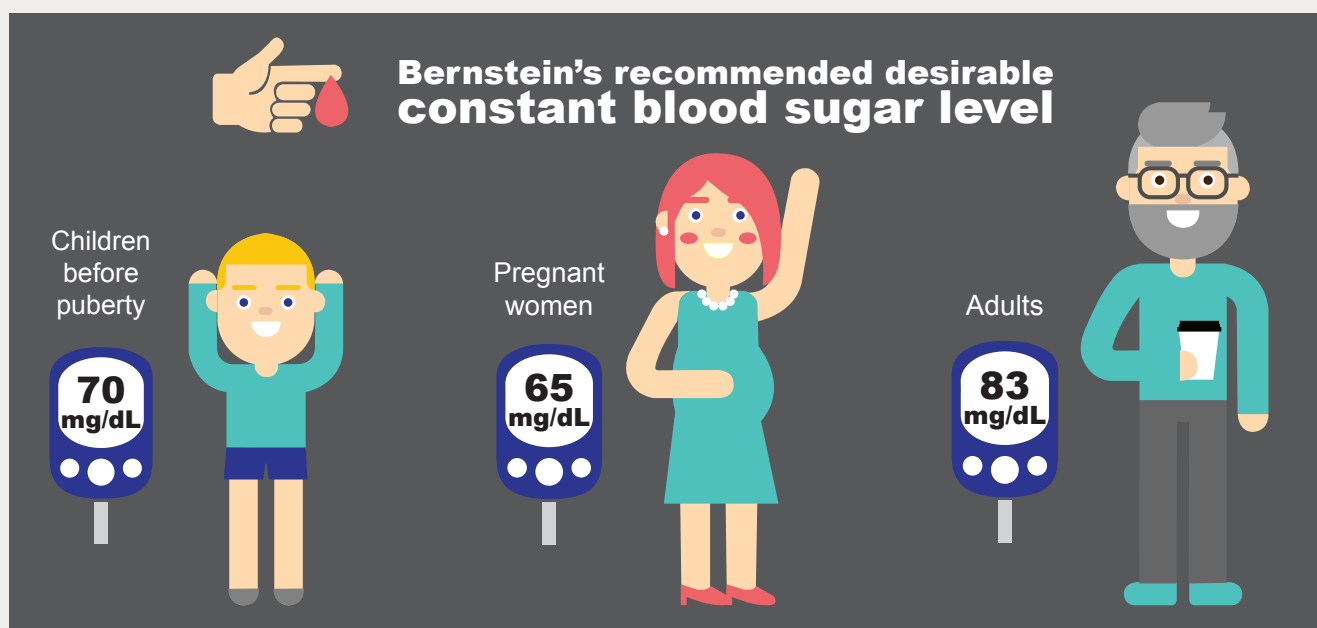
At high levels, blood glucose can be essentially a slow-acting poison for virtually every part of the body, including the cells of the pancreas that make insulin. High levels of blood sugar can stunt growth and impede brain development in children. They can also cause changes that lead to atherosclerosis, a hardening of the blood vessels, as well as a host of other complications.

"Normal" blood sugar is the holy grail of diabetics, especially Type 1 diabetics, whose bodies make very little or no insulin at all because their immune systems attack and destroy the cells in the pancreas that produce the hormone. They cannot survive without taking insulin every day, and their blood sugar levels can fluctuate wildly with the food they eat and their bodies' responses to the insulin they take.

For those with Type 2 diabetes, the most common type, these fluctuations are less likely to be as intense; their bodies do not make or use insulin well, but they are not as dependent on supplemental shots, if they take them at all. In all, 9.4 percent of the U.S. population, or 30.3 million people, have diabetes, according to 2015 figures, of whom the vast majority of the adults—more than 90 percent—have Type 2 diabetes, according to the National Institute of Diabetes and Digestive and Kidney Diseases.

Type 1 diabetics need to test their blood sugar as many as 10 times a day—before meals and snacks, before and after exercise, before bed and sometimes during the night—or even continuously using a sensor worn under the skin. Type 2 diabetics who take insulin are likely to test just two or three times a day, depending on the type and amount of insulin they use.

There are two primary measures of blood sugar for diabetics monitoring themselves. One calculates the milligrams of blood glucose per deciliter

Bernstein's recommended desirable constant blood sugar level

Children before puberty

70 mg/dL

Pregnant women

65 mg/dL

Adults

83 mg/dL

LOW AND STEADY

The standard approach to diabetes management suggests a range of blood sugar levels at various times of day. Bernstein's approach sets a goal of dramatically lower blood sugar levels—exactly how low depends on the age and condition of the patient—that stay stable throughout the day. (Graphic by U.S. Army Acquisition Support Center)

of blood (mg/dL) at a particular point in the day, while the other, called the A1C or glycated hemoglobin test, measures the average blood sugar level over the past two to three months. The A1C blood test looks at what percentage of the body's hemoglobin—a protein in red blood cells that carries oxygen—is coated with sugar (glycated). The A1C percentage is convertible to average mg/dL. Doctors treating diabetics typically do the A1C test every three to six months, but A1C test kits are also available for home use.

For someone who doesn't have diabetes, a normal A1C level is below 5.7 percent, according to the Mayo Clinic. As the standard for diagnosing diabetes, an A1C level of 6.5 percent or higher on two separate occasions indicates diabetes. A result between 5.7 and 6.4 percent is considered prediabetes, which indicates a high risk of developing diabetes. For most people who have previously diagnosed diabetes, Mayo's website says, an A1C level of 7 percent or less is a common treatment target, while higher targets of up

to 8 percent may be appropriate for some individuals. Someone who has had uncontrolled diabetes for a long time might have an A1C level above 8 percent.

According to the American Diabetes Association, a desirable blood sugar level for diabetics to achieve is 70 to 130 mg/dL before meals, and less than 180 mg/dL after meals, with an A1C of less than 7 percent, the "common treatment target" cited by the Mayo Clinic.

In sharp contrast is Bernstein's vision for a healthy life of normal, steady blood sugars, day in and day out: 83 mg/dL for adults (equating to an A1C of less than 5 percent), in the 70s for children before puberty and 65 mg/dL for pregnant women.

On at least one point, diabetes specialists agree: Any sugar levels higher than normal are unhealthy.

—MS. MARGARET C. ROTH

CLEARING THE AREA
U.S. Army Special Operations Soldiers assigned to 10th Special Forces Group (Airborne) conduct urban operations training in November near Stuttgart, Germany. The SOF operational community is generally more experienced than similar Army units and trains extensively, both of which allow SOF AT&L to consider greater risk in fielding materiel. (U.S. Army photo by Visual Information Specialist Jason Johnston, Training Support Activity Europe)

AGGRESSIVE.
INNOVATIVE.
FAST.

By understanding what the SOCOM acquisition model is and what it isn't, the Army can leverage its strengths appropriately for more efficient and effective modernization.

by Col. Joe Capobianco and Col. David Phillips

"We've been fortunate to have an amazingly consistent leadership philosophy for the last 20 years: Clearly communicate your expectations for risk management and empower the team to make decisions at the appropriate level."

—James H. Smith, U.S. Special Operations Command acquisition executive, February 2018

When reading about or interacting with the forces assigned to the U.S. Special Operations Command we think of speed, global reach and, most important, operational success. Special operations forces (SOF) routinely conduct critical missions with highly trained operators using world-class equipment that is peculiar to them. After more than 15 years working closely with SOF on the battlefield, the Army has a well-established respect not only for their formations but also for the streamlined SOF acquisition processes that result in rapid delivery of modern capabilities.

The command, commonly referred to as SOCOM, bases its acquisition model on several simple, straightforward tenets. In counterpoint to those tenets are several myths that reinforce the Army's and DOD's fascination with SOF equipment development, procurement and fielding.

Several Army acquisition processes mirror the tenets of SOCOM acquisition success, as Lt. Gen. Paul A. Ostrowski, principal military deputy to the assistant secretary of the Army for acquisition, logistics and technology (ASA(ALT)), reinforced recently in his Acquisition Streamlining and Cultural Initiatives road show and memo.

TARGET ACQUIRED
A Green Beret from the 1st Special Forces Group (Airborne) (1st SFG (A)) sniper team takes aim in the U.S. Army Special Operations Command International Sniper Competition at Fort Bragg, North Carolina, in March. Over time, SOF AT&L's perceived ability to rapidly deliver capability to support its operational missions has grown to epic proportions and spawned several myths. (U.S. Army photo by Sgt. 1st Class Jacob Braman, 1st SFG (A))

The five tenets of the SOCOM acquisition model are speed, risk tolerance, scale, inclusivity and relationships. They emphasize an aggressive, operator-focused and innovative acquisition culture with an emphasis on agility and speed of delivery to the customer.

GUIDING PRINCIPLES IN ACTION

"Velocity is my combat advantage. Iteration speed is what I'm after, because if I can go five times faster than you, I can fail four times and still beat you to the target. … That's really what we're going after here."

—James Geurts, former SOCOM acquisition executive, January 2016

To put its streamlined processes into practice, SOCOM translates these guiding principles into specific program management actions. Reviewing each tenet illustrates aspects of the SOCOM approach that the Army might adopt.

Speed. There is a clear focus on expeditious delivery of capability to the SOF operator. SOCOM accomplishes this by exploiting proven techniques, methods and technologies. While the SOF acquisition, technology and logistics (AT&L) enterprise constantly scouts for emerging and disruptive technologies, its program executive offices (PEOs) focus on leveraging proven

technologies to hasten delivery and mitigate risk. Another key attribute of this tenet is the command's relatively flat organizational construct. It maintains milestone decision authority at the very lowest levels appropriate to keep pace with SOF operations, and program managers have easy access to milestone decision authorities to enable agile decision-making.

Risk tolerance. SOF AT&L accepts more risk in program execution than is typical of the larger services. Beyond recognizing cost, schedule and performance risk in program management, aggressive risk management permeates the command culture. Managing risk, coupled with exploiting opportunity, ties directly to the commander's priorities while fulfilling operator requirements. Emphasizing risk acceptance and mitigation early in program cycles allows SOCOM to stabilize the long-term, more costly efforts in time for execution. In contrast, the Army has considerable oversight and visibility on its acquisition portfolio, specifically at the Acquisition Category (ACAT) I and II levels, leading to a generally risk-averse approach. SOF AT&L mitigates oversight and high visibility by keeping programs small. SOCOM leaders create an environment where tailored acquisition strategies thrive and senior leaders know the difference in associated risks between the rapid and deliberate processes.

Scale. Reviewing the SOCOM and Army acquisition portfolios, almost all SOF programs of record, 92 percent, are ACAT III, as defined by dollar value. With these smaller efforts, the statutory and regulatory requirements are considerably less, allowing greater flexibility and speed of execution. By keeping the majority of its efforts at the ACAT III level, the SOF AT&L approach places the milestone decision authority at the O-6 (colonel) level. The highest-level efforts, ACAT II, place the milestone decision authority at the SOCOM acquisition executive level.

This delegated management and approval contributes significantly to velocity. Recent Army acquisition streamlining efforts mirror this approach, with ACAT IV efforts delegated to the level of colonel or the civilian equivalent for management and milestone decision authority. To date, the Army has 97 ACAT IV efforts, most of which are in the portfolio of the PEO for Soldier.

Inclusivity. SOCOM typically achieves inclusivity and collaboration using SOF acquisition integrated product teams (IPTs). At the foundation of the IPT are SOF operators, acting as combat developers: highly skilled and educated combat veterans who understand their mission sets, current equipment and new capability requirements. In addition to operators and program managers, the IPT has participation from SOCOM staff, members of the requirements, testing, contracting and legal departments; business financial managers; product support managers; the Science and Technology Directorate; and service component commands. The inclusivity of the IPTs enables them to manage expectations and program trade-offs effectively. As a result, there are few surprises in cost, schedule and performance.

The Army acquisition community also uses the IPT structure, but on a much larger scale. The Army recently established a pilot program with eight cross-functional teams aligned with its six modernization priorities. They are focused on combat development (e.g., requirements generation) in much the same role as the SOF operator and component command staffs.

Relationships. Acquisition is all about relationships and building trust. The shared culture, co-location and smaller size of SOF AT&L within the SOCOM command and staff structure help build strong relationships. There is a real trust that the SOCOM acquisition community will rapidly deliver to the SOF operator effective and suitable materiel and non-materiel capabilities. SOF teams work to deliver capabilities as promised, which not only builds credibility but also leads to greater freedom of maneuver in requirements, resourcing and acquisition.

Beyond SOCOM, SOF AT&L has developed solid relationships with the Office of the Secretary of Defense, the military services, Congress, industry, academia, government laboratories and foreign SOF organizations. The construct of the new Army Futures Command, with an overarching headquarters synchronizing all aspects of combat and materiel development, will also enhance relationships among the diverse organizations of warfighters and stakeholders that contribute to delivering capability.

DEBUNKING THE MYTHS

Over time, SOF AT&L's perceived ability to rapidly deliver capability to support a small but diverse set of operational missions has grown to epic proportions. This perception, in turn, has given rise to several myths. The overarching myth is that SOF AT&L simply does not follow the rules, cuts corners, operates under waivers and uses significantly different authorities than DOD and the services' acquisition constructs.

The current SOCOM acquisition executive, James H. Smith, addressed this myth in one of his earliest interviews, stating: "We are absolutely subject to all of the same oversight and policy as the rest of DOD. Our workforce operates professionally within the same DOD 5000 directives, the same Federal Acquisition Regulation and the same Financial Management Regulation. I think it's important to understand that. … Give credit to our acquisition workforce for the results they achieve, and you might dismiss using SOCOM as a benchmark for how to do acquisition under the assumption that we're somehow 'different.' "

> *Emphasizing risk acceptance and mitigation early in program cycles allows SOCOM to stabilize the long-term, more costly efforts in time for execution.*

FULLY LOADED
This MH-47 Chinook is an Army helicopter that has been modified for SOF missions. SOCOM's programs are predominately ACAT III, thereby minimizing statutory requirements and layered oversight. ACAT I platforms such as the Chinook, as well as gunships and maritime vessels, are provided by the services, then modified by SOF AT&L for specific mission requirements. (Photo courtesy of SOF AT&L)

The most notable SOCOM acquisition myths are that it has big programs, doesn't use requirements, uses a different funding model, doesn't test, and is always successful. What is interesting is that several of the myths counter the command's tenets of success. A close look at how SOF AT&L conducts business can address each of these myths:

Big programs. In the tenets of success, smaller scale is critically important. By having predominately ACAT III programs, SOCOM minimizes statutory requirements and layered oversight, within the bounds of regulation and law. For example, SOF operators use mission-modified helicopters, AC-130 gunships and maritime vessels. The services provide these ACAT I platforms, which SOF AT&L then modifies for its specific mission requirements.

No requirements. SOCOM uses several methods to document, validate and approve its requirements. Similar to the services,

SOCOM uses both urgent and deliberate requirements processes. Urgent requirements include operational needs statements and joint urgent operational needs statements. Combat evaluations—in which SOF operators use a small amount of new equipment in an operational setting—also can rapidly assess a potential solution. SOF Capabilities Integration and Development System documents also align with the Joint Capabilities Integration and Development System initial capability, capability development and capability production documents. Validated requirements documents define capability performance for SOCOM acquisition efforts.

Different funding. SOF AT&L annually executes active appropriations, submits a budget estimate submission for the next year and plans its program objective memorandum just like the rest of DOD. SOCOM follows the same OSD "burn rates" (goals for obligating procurement and expending research and development funding); is subject to midyear reviews; and uses similar procedures for below- and above-threshold reprogramming. It gains some efficiencies by having fewer funding lines and maintaining a strong relationship with Congress to ensure that lawmakers are aware of acquisition funding and programmatic efforts. Additionally, SOF AT&L has tailored its process for reprogramming actions in the year of execution so the practice is not seen as exceptional, but rather as a normal part of doing business. SOCOM PEOs carefully consider funding risks inside and between program portfolios. In addition, SOCOM routinely involves senior acquisition, service component and resourcing leaders in reprogramming decisions.

No testing. SOF AT&L coordinates and funds considerable testing events with dedicated test organizations. These test events are commensurate with the ACAT level and intended operator mission sets. (For a detailed look at a SOCOM technical experimentation event, see "On the Ground Floor," Page 20.) The SOF operational community is also generally more experienced than similar Army units, with personnel entering at the E-6 (staff sergeant) and O-3 (captain) levels, and trains extensively, both of which allow SOF AT&L to consider greater risk in fielding materiel. When the operational leadership accepts rapidly fielded equipment, they accept a certain risk that nonetheless is based on operationally focused, streamlined testing.

Always successful. The biggest myth is that all SOCOM acquisition efforts are a success. By accepting more risk early in the program's life cycle, program managers knowingly risk "infant mortality," or early termination. Failure in these circumstances, with comparatively low dollar amounts and little time invested,

is acceptable in the SOF culture, which explains why you don't hear of large, costly program failures. In fact, neither the successes nor the failures of the "quiet professionals" who make up the SOF AT&L workforce are likely to be front-page news. Tailored, rapid acquisition processes are not always applicable for every SOF situation, either. While rapid is suitable for urgent or incremental acquisition, building a major defense ACAT I system using a rapid process could result in unforeseen cost, schedule, performance or sustainability issues.

USING ARMY KNOWLEDGE IN SOCOM

The SOF AT&L enterprise has acquisition professionals from all the services, 191 of them being active-duty military. Interestingly, the greatest percentage of the acquisition officers are from the Army. Not only does the Army contribute 43 percent of the officers to SOCOM, it fills three of the eight O-6 PEO leadership positions and multiple program manager positions at the O-5 (lieutenant colonel) level.

Serving in both Army ACAT I and ACAT II programs, as well as with SOCOM ACAT III programmatic organizations, provided many opportunities to compare and contrast the standard acquisition approaches against SOF streamlined methods. The opportunity to work multiple, small and risk-tolerant efforts helps to develop well-rounded and knowledgeable acquisition professionals.

As these officers gain experience serving in SOF AT&L, it is critical to leverage their knowledge and experience through collaboration with Army cross-functional teams, Army PEOs and the larger Army when they return for their next assignment.

SOF BY THE NUMBERS

The SOF AT&L enterprise provides rapid and focused support to the SOF operator. In any given year, the SOF AT&L team of roughly 450 professionals delivers and sustains more than 100 aircraft, 700 tactical vehicles, 4,000 weapon systems, 20 million munitions, 3,000 radios, 2,000 items related to command, control, communications, computers and intelligence and 600 intelligence, surveillance and reconnaissance kits to support SOF units.

To accomplish this mission, SOF AT&L has eight program executive offices (PEOs):

- Command, Control, Communications and Computers.
- Fixed Wing.
- Maritime.
- Rotary Wing.
- SOF Support Activity.
- SOF Warrior.
- Services.
- Special Reconnaissance, Surveillance and Exploitation.

Along with five directorates—Comptroller, Logistics, Procurement, Acquisition Agility and Science and Technology—the PEOs manage and support the development, acquisition and fielding of the critical items that make it possible for SOF operators to carry out their no-fail mission sets.

U.S. Code Title 10, Section 167 authorizes the command to conduct development and acquisition of SOF-peculiar equipment, material, supplies and services. SOCOM Directive 70-1, which lays out the command's acquisition policy, tailors the policies and procedures. At the same time, it adheres to DOD Directive 5000.01, which describes the Defense Acquisition System, and follows the supporting DOD Instructions 5000.02 and 5000.74.

SOF AT&L maintains close relationships with the Army, collaborating with U.S. Army Materiel Command, Army labs and PEOs under the assistant secretary of the Army for acquisition, logistics and technology at locations including Redstone Arsenal, Alabama; Natick Soldier Systems Center, Massachusetts; Picatinny Arsenal, New Jersey; Aberdeen Proving Ground, Maryland; and Fort Belvoir and Joint Base Langley-Eustis, Virginia.

CONCLUSION

For large, diverse and complex organizations like the Army, adopting new models can be difficult, and the barriers to change are often steep. Today, the nation faces complex external threats including a resurgent Russia, an assertive China, violent extremist organizations, Iran and North Korea. Additionally, by necessity, the Army has prioritized personnel and readiness over modernization for some time. With today's realities, neither SOCOM nor the Army can afford the luxury of long acquisition timelines.

Core cultural changes will take time to spread across Army acquisition, requirements and resourcing communities. However, Army and SOCOM leaders should continue to diligently invest in people and be determined to build a culture that adapts its assumptions and norms. Army culture should close the gaps between operational users, the acquisition workforce and resourcers, bringing them closer together to think about and solve problems in new ways.

Current efforts to stand up the Army Futures Command, and early steps by the new cross-functional teams that are aligned with the Army's six modernization priorities, are aligned to the SOCOM way of acquisition in this aspect. This collaboration, combined with the vision set outlined by Ostrowski—focused on streamlining acquisition with a greater degree of customization, including prototyping and a "fly before you buy" mentality—is also reforming traditional processes.

Continued collaboration between the Army and SOCOM has great potential to accelerate and embed many of these positive cultural traits, leveraging the SOCOM model to support the missions

LITTLE YET FIERCE
The MH-6 Little Bird is a SOF-unique helicopter developed in close collaboration with SOF operators and combat developers. SOCOM bases its acquisition model on five tenets—speed, risk tolerance, scale, inclusivity and relationships—that reinforce an aggressive, operator-focused acquisition culture in which agility and speed of delivery are key. (Photo courtesy of SOF AT&L)

of the Army Futures Command and the Army acquisition system.

*For more information, go to **http://www.socom.mil/SOF-ATL** or **http://rapidcapabilitiesoffice.army.mil/**.*

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COL. DAVID PHILLIPS is the PEO for Rotary Wing and the former product manager for Special Operations Aviation Mission Equipment. He holds an M.S. in aerospace engineering from North Carolina State University, a master of strategic studies from the U.S. Army War College and a B.S. in engineering physics from the United States Military Academy at West Point. He also completed DAU's Executive Program Managers' Course and is a designated experimental test pilot by the U.S. Navy Test Pilot School. He is Level III certified in program management and a member of the Army Acquisition Corps.

PM PERSPECTIVE
COL. MICHAEL J. THURSTON

WANT *FASTER* ACQUISITION?

Reforming the process isn't the answer, says a seasoned PM, who recommends instead a greater emphasis and more education on tailoring and risk management.

by Ms. Bridget Lynch

This column is the second in an Army AL&T series, PM Perspective, which looks at acquisition from the viewpoint of the program, project or product manager. These are big programs— generally Acquisition Category I and II— not only in terms of their importance to the Soldier, but also in terms of sheer dollars. How do PMs deal with the complexity of these programs? What do they wish they'd known then that they know now? What lessons can other PMs take from their experiences?

Col. Michael J. Thurston's Army career began in 1988, when he was commissioned as a Signal Corps platoon leader and executive officer. He became part of the Army Acquisition Workforce in 2003 with his assignment to the Project Manager for Tactical Radio Communications Systems at Fort Monmouth, New Jersey. Since then, he's held several positions with the Program Executive Office for Command, Control and Communications – Tactical (PEO C3T) at Aberdeen Proving Ground, Maryland, and with the Army G-6, the U.S. Army Communications-Electronics Command and the U.S. Army Signal Center. He's now PEO C3T's chief of staff, a position he has held since September 2017. PEO C3T develops, acquires, fields and supports the Army's

mission command network to ensure force readiness, delivering tactical communications so commanders and Soldiers can stay connected and informed at all times. Its work to deliver the network to regions around the globe enables high-speed, high-capacity voice, data and video communications to a user base that includes the Army's joint, coalition and other mission partners.

Thurston holds an M.S. and a B.S. in electrical engineering from Worcester Polytechnic Institute, as well as an M.S. in national resource strategy from the Industrial College of the Armed Forces of National Defense University. His awards include the Legion of Merit, Bronze Star Medal, Defense Meritorious Service Medal (one oak leaf cluster (OLC)), Meritorious Service Medal (two OLCs), Army Commendation (three OLCs), Army Achievement Medal, National Defense Service Medal with Bronze Star, Armed Forces Expeditionary Medal, Iraq Campaign Medal, Global War on Terrorism Expeditionary Medal, Global War on Terrorism Service Medal, Humanitarian Service Medal, Armed Forces Reserve Medal and the Parachute Badge.

As modernization plans take shape, much attention has been paid to revamping the myriad processes that guide Army acquisition. Not so fast, says Col. Michael J. Thurston, chief of staff for PEO C3T. The acquisition process isn't the problem, he said. "My recommendation would be to stop spending so much effort reforming the process and start teaching and emphasizing acquisition tailoring and risk management." Sure, tweaks can be made to statutes, regulations, organizations and procedures, he conceded, "but there is already substantial flexibility and a significant number of tailoring tools available to the 'big A' acquisition community."

In Thurston's experience, "the paralysis experienced in many developmental efforts is not caused by process, but by our collective inability to assume, manage and mitigate risk," he said. "Time and time again, I have seen instances where the acquisition system is so risk-averse that we fail to make a decision on a better, cheaper product for fear of perceived cost, performance or perception issues, while we continue to spend significant national treasure on buying and sustaining less capable and more costly systems."

Based on a 30-year Army career and an extensive acquisition background—having worked in the requirements community as a systems engineer and in all levels of program management, and having executed numerous operational tests and been part of dozens of decisions on the Army staff—he noted that no one in the acquisition process is immune from this way of thinking. "It is rather ironic that an organization that is exceptionally competent at operational risk management has not transferred those same leadership and management skills to the major acquisition processes of requirements generation, programming and program management," he said.

> "I discovered over time that you don't have to be the smartest person in the room on your product. You should instead surround yourself with others who are smarter than you."

LAYERS OF LEARNING

As PEO C3T's chief of staff, Thurston manages more than 1,600 people who acquire, field and support the communication networks, radios, satellite systems and other hardware and software that Soldiers require for information dominance on the battlefield. He has three main roles: manage PEO staff, advise PEO leadership and assist project managers (PMs) in preparing for programmatic and milestone decisions.

It's a role for which he's well-suited, given his previous assignments. "I have had the pleasure of working in every project management level in the PEO, so I am very familiar with the portfolio of products and the resources the PEO has available," he said. "My time on the Army staff exposed me to the information needs of Army senior leaders and decision-makers and the importance of timely, concise, accurate and consistent reporting. I understand the many demands placed on PMs and how every task or action has a cost and value associated with it. As the chief, it is my goal to minimize impact on the PMs, ensure that engagements with decision-makers are productive and gain the most value out of every action."

Before moving to chief of staff, Thurston was PM for Mission Command, managing a dozen Acquisition Category (ACAT) I, II and III programs, along with several pre-ACAT and non-program-of-record efforts. His budget of about $1.4 billion included a mix of development, production and operations funds, and his accomplishments during the four years he served as PM are noteworthy, including fielding the Joint Capabilities Release software and the Blue Force Tracking 2 network; developing, testing and fielding the Joint Battle Command – Platform system; developing the tactical server infrastructure for command posts; developing the Precision Fires – Mounted and Precision Fires – Dismounted systems; establishing the acquisition strategy for Advanced Field Artillery Tactical Data System 7.0; and fielding thousands of mission command systems in support of the Army's capability set and unit set fielding strategies. Additionally, he and his team established the architecture, system design and acquisition strategy for the Command Post Computing Environment and the Mounted Computing Environment.

"We had programs in every acquisition phase, from science and technology transition to divestment," Thurston said. "We supported stakeholders from the mission command, maneuver center, fires, cyber and intel communities; we were in the process of merging cultures from two project offices; and we supported a mix of products, some that were highly sought-after and others that were highly criticized." The best way to

ON THE TACTICAL EDGE
PEO C3T's PM for Tactical Network equipped the first unit—the 3rd Brigade Combat Team, 82nd Airborne Division—in February with the new inflatable satellite communications system known as Transportable Tactical Command Communications. The system, which makes possible expeditionary mission command and situational awareness in the heart of evolving fights, is one of dozens of communication networks, radios, satellite systems and other hardware and software that Thurston helps to oversee as PEO C3T's chief of staff. (U.S. Army photo by Amy Walker, PEO C3T)

summarize those experiences into a single lesson learned? "Take a moment to identify which tasks are urgent and what is important," he said. "Most often, the urgent things aren't what is most important. Resist the urge to chase the urgent but unimportant. Instead, establish a vision and communicate it well. Create a plan with your team and keep them focused on it. Nurture the team, feed the vision, regularly check progress and beat down the distractions."

Before his PM assignment, Thurston was the deputy to the deputy for acquisition and systems management in the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA(ALT)). That role and his PM assignment taught him the importance of early engagement and building trust with stakeholders, including PEOs,

ASA(ALT) and the Office of the Secretary of Defense. "It's critical to truly understand the information needs of the staff and the decision-makers, and to recognize that those needs are different. You must gain the trust of the staff by answering their questions thoroughly, transparently and consistently. Most importantly, meet your commitments."

NEVER TOO EARLY FOR INPUT
Incorporating all stakeholders, particularly end users, early in the process is something PEO C3T stresses, and something it's hoping to improve upon by incorporating DevOps—a mashup of development and operations—into its program constructs. "A system acquisition starts with user representatives establishing requirements, and these representatives are typically involved throughout the acquisition process," Thurston explained.

enough to ferret out weaknesses in the system. That's where the DevOps approach comes in. Although DevOps technically is a software development approach that allows continuous collaboration across all functions in the software development and delivery process, the Army uses the term more broadly to describe frequent interaction with end users during the development process for any system or capability.

"DevOps allows for more robust feedback earlier in the acquisition process," Thurston explained, "and truly successful DevOps in the Army requires an established relationship not only between the PM and a tactical unit or group of units that will exercise prototypes of its system, but also with the Network Cross-Functional Team." For example, the Network Cross-Functional Team, working closely with the PEOs for Soldier and C3T, is conducting experimentation with light infantry units to assess a package of network capabilities. This early DevOps approach will help inform how operations at company and below can use information technology capabilities originally designed for special operations forces' and commercial use.

PLATFORM FOR LEADERSHIP
Capt. Doug Williams, right, and Capt. Jake Singleton review the Joint Battle Command – Platform's new interactive multimedia instruction software in January at Aberdeen Proving Ground, Maryland. The software will allow Soldiers to train on the system from a CD, the Army's online training tool LandWarNet or embedded on-vehicle hardware. Developing, testing and fielding the Joint Battle Command – Platform system was one of Thurston's many responsibilities as the PM for Mission Command. (U.S. Army photo by Dan Lafontaine, PEO C3T)

CONCLUSION
Having achieved a great deal over the past 30 years, Thurston says there are a few things he wishes he had done differently. "When I first became a product manager as a lieutenant colonel, my first actions were to dive in and become an expert on the system I was charged to

"Although beneficial to the acquisition process, these user representatives don't always fully embody the voice of the end user." For example, PEO C3T end users include not just signal Soldiers, but all functional branches and all tactical warfighting echelons in the Army.

To address that, programs frequently incorporate user juries, demonstrations and exercises to gather feedback from a variety of end users. However, Thurston noted, this step often comes too late in the process to make substantial changes to the system design, and it is not robust

"The paralysis experienced in many developmental efforts is not caused by process, but by our collective inability to assume, manage and mitigate risk."

THE ULTIMATE TEST OF SUCCESS

A Soldier tests the Precision Fires – Dismounted application on the Nett Warrior End User Device during fielding at Fort Drum, New York, in April. Thurston was in charge of developing the app as PM for Mission Command. (U.S. Army photo by Dan Lafontaine, PEO C3T)

SEE THE BIG PICTURE

Soldiers demonstrate the Command Post Computing Environment prototype at Aberdeen Proving Ground in May. With a new single tactical server infrastructure plus a common software baseline, it will provide Soldiers an underlying core command post system that will accommodate additional warfighting functionality. Thurston and his Mission Command team established the architecture, system design and acquisition strategy for the Command Post Computing Environment and the Mounted Computing Environment. (U.S. Army photo by Dan Lafontaine, PEO C3T)

manage," he said. "However, I discovered over time that you don't have to be the smartest person in the room on your product. You should instead surround yourself with others who are smarter than you."

As a PM, his first actions were to focus on and understand the acquisition strategies, program fundamentals—cost, schedule and performance—and resources available for the products in his portfolio. That approach made him a better PM, he said, but didn't always produce the best results for his programs. "If I had the opportunity to do it again, I would have taken a page from the late Maj. Gen. Harry Greene's philosophy and focus my first and recurring actions on understanding your stakeholders: what they want, what the end users really need, what they think of your products and how stakeholders perceive your organization."

At its core, he said, acquisition is two things. First, acquisition is business—it's not personal. "Be committed, be competent, be collaborative, but do not take it personally." Second, acquisition is hard. "Every worthy challenge is. If it was easy, everyone would do it."

*For more information, go to the PEO C3T website at **http://peoc3t.army.mil/c3t/**.*

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CULTURE *as an* *OFF*SET

Innovation in the Army needs to come from the top down and the ground up, and Soldiers at all levels need freedom, time and equipment to make it happen.

by Col. John P. Cogbill

Maintaining overmatch against any and all potential adversaries—known as an offset strategy—places a premium on new, potentially disruptive technologies. However, technology alone will not maintain the offset. An effective and enduring offset will require a culture of innovation that enables critical thinking and the application of the myriad emerging military and commercial technologies to address the full spectrum of national security challenges in an increasingly hostile and complex world.

In these times, the Army has an opportunity to look to Silicon Valley—where startups vie for position in a do-or-die environment—not just for emerging technologies, but for the organizational culture of innovation that allows entrepreneurs to flourish and ideas to become realities.

WHAT IS INNOVATION?

Innovation is a critical component of the offset strategy, but the word is used so often today that it risks losing meaning. The U.S. Army Operating Concept, published by the U.S. Army Training and Doctrine Command (TRADOC), defines innovation as "the result of critical and creative thinking" and "the conversion of new ideas into valued outcomes." Innovation can be incremental and continuous, as an adaptation of an existing idea or technology; or it can be, as serial entrepreneur Steve Blank labeled it, disruptive in a way that turns the status quo on its head and creates a new paradigm in a market or field of study.

> **Google** implemented a policy that encourages employees to spend **20 percent** of their time at work on a **personal project** about which they feel passionate. This protected time has led the company toward new technologies and new markets that the senior managers would have never anticipated. **The Army should adopt a similar approach.**

RECOGNIZING INNOVATORS
The author pins an Air Assault Badge on Capt. John Bergman, 1st Battalion, 187th Infantry Regiment, on April 10. Bergman was the Honor Graduate and Ruck March Champion of his Air Assault School class at Fort Campbell, Kentucky. The author contends that public recognition of a Soldier's contributions is an important component of fostering innovation.

WHY INNOVATION MATTERS

Historically, the culture inside the Army was the antithesis of the creative, collaborative, meritocratic and risk-taking culture of Silicon Valley startups. Creativity is essential to achieving a culture of innovation. In the past, the Army has not placed a premium on creativity, nor has it created an environment for it to thrive. According to Milan Vego, a professor of operations at the U.S. Naval War College, the main impediments to military creativity are the "military's inherent hierarchical command structure—and authoritarian and bureaucratized system—and its thinking, which is exemplified by conformity, group-think, parochialism, dogmatism, intolerance, and anti-intellectualism."

Although the Army previously had creative leaders or episodic moments of tactical, operational or strategic brilliance, it will not be able to bring those discrete moments of creative genius to scale in a way that will allow the Army to guarantee U.S. competitive advantage on future battlefields unless it can address the obstacles that inhibit a culture of innovation.

CORPORATE ENTREPRENEURSHIP MODELS

Just as the Army Operating Concept addresses strategic, operational and tactical levels of war, so, too, must the models for creating a culture of innovation in the Army. The Army is not a monolithic institution, and a standardized solution to organizational culture challenges will not work. Different models for cultural change exist for organizations of varying size, specialization and scope.

STRATEGIC LEVEL

In many organizations, change starts at the top. It most certainly cannot survive without the promotion, and protection, of top management. At the strategic level, the Army can set the tone and create conditions to inspire innovation throughout the rest of the organization. That said, senior Army leaders must avoid efforts to control the pace or direction of innovation within this complex and uncertain operating environment. Just as governments have learned the power of Adam Smith's "invisible hand" in coordinating economic activity in free markets and the perils of command-and-control economies, the Army should take a

similar approach in creating conditions for innovation by allowing individuals to maximize their utility, or that of their teams, by having the freedom to make decisions in a market that is both informed and unrestrained.

To successfully use this enabler model, senior management must clearly state the corporate entrepreneurial objective. As stated in the Army Operating Concept, the objective for the Army is to create a culture of innovation that "drives the development of new tools or methods that permit Army forces to anticipate future demands, stay ahead of determined enemies, and accomplish the mission." With that objective in mind, the Army must capitalize on innovative initiatives within subordinate units and

reinforce success until innovative excellence becomes a hallmark throughout the Army at all levels.

Strategic Action Plan:

Incentivize. During the past decade, there has been a modest increase in the number of thought-provoking and creativity-inspiring broadening opportunities within institutional (non-U.S. Army Forces Command (FORSCOM)) Army organizations. However, these opportunities are often not pursued by the Army's top performers because of the high opportunity costs associated with time away from "muddy boots" assignments. According to the "Fashion Tips for the Field Grade" study by Dr. Leonard Wong of the U.S. Army

War College Strategic Studies Institute, the percentage of officers selected for brigadier general who had also attended full-time graduate school dropped from 31 percent in 1995 to 8 percent in 2005. Until education and broadening assignments demonstrate real and visible advantages for career progression, and are valued as reinforcing or supplementing time spent in tactical units, the Army will have a hard time attracting the most talented service members to these programs.

Educate. TRADOC can advance an entrepreneurial culture by adding Lean Startup techniques and Army Design Methodology—focused on improving the critical and creative thinking abilities of leaders and teams to understand and solve problems—to the current professional military education curriculum for all ranks. Internalizing these techniques helps minimize the need for bureaucratic controls, destroy barriers between compartmented hierarchies, and connect senior managers with consumers and customers to accurately identify problems and rapidly develop innovative solutions through an iterative process of experimentation and validated learning. This education should be coupled with a purposeful increase in opportunities for Advanced Civil Schooling and Training with Industry for officers and noncommissioned officers (NCOs), to maximize the military's exposure to a diversity of ideas while simultaneously increasing opportunities to better connect society to an all-volunteer Army that's increasingly isolated from it. To permanently affect the Army culture, the same educational opportunities and training events must be afforded to the Army civilian workforce, those long-term civil servants who provide continuity, institutional memory—and sometimes inertia—within the institutional Army.

ADAPTIVE THINKING IN THE FIELD
The author, right, and Brig. Gen. K. Todd Royar, 101st Airborne Division deputy commanding general (Support), discuss 3rd BCT training inside the brigade tactical operations center in May. Hands-on training like this helps reinforce classroom instruction and encourages adaptive thinking, the author argues.

AHEAD OF THE PACK
The author, second from left, conducts physical training with Royar, left, and officers of the 3rd BCT.
All types of training, education and creative challenges encourage an innovation culture that will help
the Army in the future.

Proliferate. TRADOC must create a digital forum to share ideas among communities of interest, to create synergistic effects between Soldiers, units and installations and to eliminate redundancy of effort. TRADOC has created military "wiki-like" websites to increase shared consciousness through online Army Warfighting Challenges discussion groups. However, most Soldiers outside TRADOC do not know these sites exist and will never access these forums. Idea-sharing portals must become marketplaces for ideas, reinforced with senior leader participation, that showcase innovative solutions to capability shortfalls.

OPERATIONAL LEVEL

Creating cultural change at the operational level requires a slightly different approach. Brigades, divisions and corps serve as the hierarchical connection between strategic guidance and the day-to-day business of manning, equipping and training tactical units. As the name implies, leaders at this level are intensely focused on operational matters and do not have the luxury of focusing exclusively on innovation, nor can they create new organizations or funding sources to pursue internal innovation initiatives.

In his book "Accelerate: Building Strategic Agility for a Faster-Moving World," author John P. Kotter advocates for a dual-operating system comprising diffuse networks working in a symbiotic relationship with the traditional management hierarchies. These networks are staffed with volunteers from existing business divisions (the Army equivalents to battalions, brigades and divisions), and are charged with finding innovative solutions to the organization's most challenging problems. This approach allows traditional hierarchy elements to remain unencumbered in managing routine operations in the most efficient manner.

These ad hoc, agile networks are grass-roots movements, manned with true believers rallying around a guiding coalition that has articulated a sense of urgency, actively seeking innovative opportunities—even while circumventing institutional barriers—to achieve quick wins. The deliberate accumulation of these victories eventually builds momentum toward the long-term innovation objective and leads to the desired institutional change without undermining or threatening management hierarchies.

Operational Action Plan:

Resource. A common complaint among Soldiers and leaders is the tyranny of the training schedule. Acknowledging the importance of setting aside time to think, Google implemented a policy that encourages employees to spend 20 percent of their time at work on a personal project about which they feel passionate. This protected time has led the company toward new technologies and new markets that the senior managers would have never anticipated.

The Army should adopt a similar approach. "Thinking Thursdays" would be the new take on "Sergeant's Time," providing small unit leaders the flexibility to work on their most important problems or develop solutions to battalion, brigade or division priorities. The opportunity to prototype and experiment should be further developed by setting aside resources for this purpose. Brigades might establish collaboration spaces, complete with dry erase boards, post-it notes, movable furniture, computer workstations and basic prototyping materials, to encourage teams to experiment and display ideas and innovations. Installations could build fabrication laboratories, including 3D printers and basic machining equipment, where Soldiers might build more advanced prototypes to take to the field to test.

Challenge. Division commanders should challenge units to enter their most innovative ideas in installation-level competitions (or hackathons) to crowdsource ideas and develop rapid prototypes to solve challenging problems. Winners of corps-level innovation challenges could present their ideas during quarterly competitive symposiums involving entrepreneurs and academics from surrounding communities. This would give credibility to the process, raise industry awareness of important DOD problems, and give Soldiers valuable experience communicating their ideas and skill to civilians who might later be their employers.

Experiment. The Army can increase its capacity for testing and experimentation by welcoming (or directing) new experiments by FORSCOM units at the battalion or brigade level. TRADOC should leverage the agility of brigade combat teams and divisions, incorporating them into the experimentation enterprise. This expansion would drastically increase the Army's experimentation capacity and have the added benefit of making operational headquarters the champions of the new capabilities instead of program managers and requirements writers. Using FORSCOM units to experiment, instead of

TRADOC units whose sole purpose is conducting testing and experimentation, will result in better user feedback because the interests of the unit are more aligned with the programs or concepts being tested.

Reward. Innovation is primarily a human endeavor. Leaders, especially at the operational level, must reward innovation in their formations. Commanders can offer coins, certificates, time off based on performance, or public recognition in formations to Soldiers who make meaningful contributions during "Thinking Thursdays" and competitive innovation challenges. Soldiers who see the fruits of their labor will recognize the importance of contributing to the innovation process and be more likely to proactively participate in the process.

TACTICAL LEVEL

Creating a culture of innovation must also happen at the tactical level. Innovation is not the exclusive purview of general staffs or the Army's officer corps. Too often, the Army isolates creativity and deep thinking exclusively to senior officers. To harness the entirety of its corporate intellect, the Army must exploit the inherent creativity and ingenuity inside tactical formations. The small teams within the Army (squads, platoons and companies) most closely resemble, in size and demographics, many early-stage ventures in Silicon Valley—startups that are raising billions of dollars in venture capital every day because of their disruptively innovative solutions to some of society's most pressing problems. Empowering squads, platoons and companies with Lean Startup methodologies for prototyping new

> *Creativity is essential to achieving a culture of innovation. In the past, the Army has not placed a premium on creativity, nor has it created an environment for it to thrive.*

equipment or reimagining small unit training will vastly increase the number of ideas generated and concepts validated, or dismissed, at the lowest echelons, with successful approaches gradually making their way through the Army's middle management and up to senior decision-makers and resources.

Tactical action plan:

Identify. To identify appropriate talent to support innovation, the Army must be more scientific in its approach. Commanders could administer simple personality tests to see which Soldiers, NCOs and officers most strongly demonstrate characteristics of creativity and collaboration. These Soldiers might volunteer or be handpicked to compete in unit hackathons or work on specific projects as a special duty assignment or additional duty. These innovative Soldiers are likely the best candidates for advanced educational opportunities.

Focus. While the future of warfare is unknowable, creative leaders can use multiple media sources, such as forward-looking movies or books like "Starship Troopers," "Ender's Game" and "Ghost Fleet" to help Soldiers visualize the nature of, and their potential roles in, future warfare. Military professionals have consistently advocated the study of military history as essential to building learning organizations. Looking to the future is equally important to help Soldiers conceptualize future threats and potential problems that can be addressed with innovative solutions.

Train. Education and inspiration alone will not win wars. The Army must continually train Soldiers so that the ability to solve complex problems and take necessary action in combat becomes second

> *According to the 'Fashion Tips for the Field Grade' study by Dr. Leonard Wong of the Army's Strategic Studies Institute, the percentage of officers selected for brigadier general who had also attended full-time graduate school dropped from 31 percent in 1995 to 8 percent in 2005.*

nature. Broader implementation of the Asymmetric Warfare Group's Adaptive Soldier Leader Training Education at the tactical level can reinforce classroom instruction with hands-on training and practical examples of adaptive thinking and problem-solving from academia and industry.

CONCLUSION
The character of warfare has never been more complex, more unpredictable or more influenced by the exponentially increasing velocity of technological change or the diffusion of dual-use technologies and asymmetric adaptations to U.S. military superiority.

While the stakes are too high for DOD to outsource innovation to the dreamers and engineers in Silicon Valley, it can import the Silicon Valley culture of innovation. To create a culture of innovation and ensure success on future battlefields, the Army must change from within at every echelon to remain agile, forward-thinking and prepared to overwhelm the capabilities of peer and near-pear competitors in the future. By teaching Lean Startup techniques and identifying and rewarding innovative thinkers and actors across the force, the Army can exploit their efforts in creative ways to visualize

and participate in innovation initiatives. Agile and adaptive leaders have shouldered the responsibility of maintaining the U.S. Army as the most powerful and capable land force in modern times, but it will require a culture of innovation guided by an invisible hand—a hand that is creative, meritocratic, tolerant of risk and inclusive—to guarantee success in future wars.

This article is condensed from a paper written by the author in 2016, while he was a U.S. Army War College Fellow at Stanford University's Freeman Spogli Institute in the Center for International Security and Cooperation. To read the full paper, and to access multiple online extras, go to the online version of this magazine at http:// usaasc.armyalt.com/#folio=1.

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BEEN THERE,
DONE THAT

HOW MUCH TESTING
IS ENOUGH?

Skimping on test and evaluation in defense acquisition is not a recipe for effective reform, it's a recipe for disaster.

by Robert F. Mortlock, Ph.D., Col., USA (Ret.)

From 2009 to 2015, the Army conducted the most comprehensive testing of combat uniform camouflage in history, leading up to its selection of the Operational Camouflage Pattern on the Army combat uniform. The testing included a combination of controlled testing—relying on photo-simulation techniques (Soldiers viewing photos of camouflage uniforms on computer screens) that used modeling and simulation—and Soldier field testing. The testing measured the performance of camouflage patterns based on probability of detection and blending, with performance scores depending primarily on distance, environmental background, movement, lighting and the actual camouflage pattern.

The goal of the program was to select the best-performing camouflage pattern. The testing included a combination of developmental test and evaluation—highly controlled testing in an environment that typically is not combat-realistic, in this case the testing that relied on photo-simulation techniques—and operational test and evaluation, in this case the Soldier field testing, which takes place in a combat-realistic environment. (See Figure 1, Page 134.) The test and evaluation (T&E) strategy was considered a major shift in approach because it weighted developmental test and evaluation results more heavily than operational test and evaluation results, the reverse of a typical acquisition program. The developmental test and evaluation was statistically

UNDER COVER
Gunners from the 173rd Airborne Brigade Support Battalion position themselves behind branches for concealment during base defense training in March in Slovenia. Though the search for a new camouflage pattern was not a major defense acquisition program, it attracted a lot of high-profile interest from Army leadership and Congress, as well as from the Soldiers who would be wearing the new uniform. (Photo by Lt. Col. John Hall, 173rd Airborne Brigade)

robust and tightly controlled the distance, background, lighting and movement variables, such that changes to detection and blending scores were attributed primarily to differences in the camouflage patterns. (See Figure 1, Page 134.)

Yet senior Army leaders consistently placed more credibility on the field testing than the photo-simulation results. Each time the program came forward for a decision, leadership demanded more expensive and time-consuming field testing, unnecessarily driving up program costs and delaying schedules. The scope of the T&E effort grew not because it was necessary but because senior leaders remained risk-averse and unwilling to make a

decision. The bottom line is that they never fully appreciated the T&E paradigm shift and never really trusted the project manager.

That project manager was me, and the experience highlighted the importance of clearly understanding and synchronizing test objectives within the acquisition strategy, especially as T&E is a target for savings and efficiencies in current efforts to reform acquisition. It is a fool's errand to try to chase the "right" amount of T&E cost for a particular acquisition effort. In each case, the T&E strategy must be optimal to provide the knowledge that decision-makers need for the most informed decision possible.

An extensive, comprehensive T&E program is a big part of building trust with warfighters, and acquisition professionals cannot afford to sacrifice that trust. The last thing the defense acquisition profession wants is for a Soldier, Airman, Marine or Sailor in combat to question whether their equipment works as required. Warfighters must be focused on their mission and must know implicitly that their equipment works.

Rigorous T&E in defense acquisition projects provides information and knowledge to decision-makers and warfighters about how the equipment will work in a combat environment, and provides confidence that the equipment is safe to operate and works as intended. Efforts to marginalize the importance of T&E within acquisition, along with the perception that acquisition programs have bloated, wasteful and redundant T&E activities, erode the integrity of defense acquisition as an institution—further compromising legitimate reform initiatives focused on process improvements.

PUTTING COSTS INTO PERSPECTIVE

A comprehensive and rigorous T&E program comes at a significant cost for any category of acquisition. A meaningful measure of the appropriate scope, value and return on investment of a T&E effort might be the T&E costs as a percentage of total life cycle costs—the sum of a program's research, development, test and evaluation (RDT&E), procurement, and operations and support costs. The following are two examples of using total life cycle costs to measure the value of T&E:

The **Joint Common Missile** (JCM) program—the predecessor to today's Joint Air to Ground Missile program—was a major defense acquisition program

TEST AND EVALUATION ESSENTIALS

In acquisition program management, T&E refers to activities conducted throughout the project life cycle to assess an item's performance, reduce risk and provide information for decision-makers. Testing is the process to obtain, verify and provide data to determine whether an item meets, exceeds or falls short of measurable objectives. Testing is usually labor- and time-intensive. Evaluation is the process to assess the progress of the design, performance, supportability or other attribute in meeting the objectives of the customer—the user or warfighter. Evaluation is intellectually intensive and answers the key question, "So what?"

The developmental test effort focuses on the critical technical parameters established by the program, while the operational test effort addresses whether the system is operationally effective and suitable. T&E is an integral step in the systems engineering process because it verifies performance, detects deficiencies and validates requirements. Along with other activities such as inspections, demonstrations, certifications, and modeling and simulation, T&E accomplishes the verification and validation functions of the systems engineering process.

T&E is an essential element in acquisition decision-making, as it provides information to support trade-offs, refine requirements and manage risk. Although the systems engineering process makes up the technical aspect of the project life cycle, decision-makers must consider other aspects, such as the project's business case and the available budget. Throughout the system's life cycle, but particularly at each milestone review, T&E activities provide decision authorities with critical information concerning the project's technical progress, which obviously affects its cost and schedule.

A T&E assessment by the responsible test organization provides information to the decision-maker about whether the program is ready to move to the next phase in the acquisition management process. This is a critical element in the application of industry best practices for knowledge-based development and the acquisition of capabilities.

T&E is also required by law. The most significant T&E-related legislation concerns operational and live-fire T&E. In many cases, T&E legislation reflects both Congress's dissatisfaction with DOD's and contractors' past testing and its corresponding desire to exercise more control and oversight to ensure adequate testing in the future.

DOD has taken many positive actions as a result of congressional interest in improving T&E activities. For example, the Office of the Director, Operational Test and Evaluation was created with responsibilities to monitor, review and oversee operational and live-fire T&E within DOD.

FIGURE 1

DEVELOPMENTAL TEST AND EVALUATION:
PHOTO SIMULATION

- **Detection scores and blending scores in 46 different backgrounds, day and night.**
- **Statistically robust with nearly 100,000 data points.**
- **Several hundred Soldier participants.**

OPERATIONAL TEST AND EVALUATION:
FIELD TESTING

- **Detection scores and Soldier observations in three locations, day and night.**
- **Fewer than a thousand data points.**
- **Soldiers participating on the order of squads.**

TEST PURPOSE

- **Pattern selection and performance verification.**

- **Operational insights and performance validation.**

TEST PARADIGM SHIFT (RELEVANCE TO PATTERN SELECTION)

- **More objective.**

- **More subjective.**

LAB VS. FIELD
Pattern selection using photo simulation—whereby a camouflage pattern is viewed and manipulated on a computer—can generate statistically significant data and control distance, movement, background and brightness. That's why it's a good way to select a camouflage pattern that will protect Soldiers. In the author's experience, however, senior leadership did not trust the lab tests, which highlights the importance of following a robust, well-designed test plan from the very beginning of an acquisition. (SOURCE: The author)

under development in the mid-2000s. It sought to develop a missile that could be fired from Apaches, Cobras and Super Hornets, replacing HELLFIRE, Maverick and aviation tube-launched, optically tracked, wire-guided missiles. From the JCM joint cost position, the JCM total life cycle cost estimate was $7.275 billion ($970 million in RDT&E, $6.023 billion in procurement, $267 million in operations and support) with a T&E effort costing $293 million, or 4 percent of the total life cycle costs. (See Figure 2, Page 136.)

The **Ground Combat Vehicle** (GCV) program sprang from the ashes of the Future Combat Systems Manned Ground Vehicle program and was meant to replace the Bradley Fighting Vehicle. From the GCV program office estimate, the GCV's total life cycle cost estimate

was $83.982 billion ($8.195 billion in RDT&E, $38.952 billion in procurement, $36.835 billion in operations and support) with a T&E effort costing $417 million, or 0.5 percent of the total life cycle cost estimate. (See Figure 2, Page 136.)

Did the T&E effort for JCM provide a better value than that for GCV? One might conclude that the GCV program's T&E was a better investment, at less than 1 percent of program costs compared with 4 percent for the JCM. However, the numbers alone don't provide a complete picture of whether either T&E effort was appropriate in scope or a good return on investment.

The T&E program for a missile inherently involves more expensive, destructive testing—the object being tested is generally destroyed during the test—and requires a great number of missile firings for statistical confidence. Additionally, the total life cycle cost profiles for a missile program and a vehicle acquisition are drastically different because the missile program requires far less in operations and support costs—the missiles are simply stored until fired and then destroyed.

Returning to the camouflage T&E effort, which represented 0.167 percent of total program life cycle costs, did the Army get its money's worth for $10 million spent over six years of testing camouflage patterns? The cost numbers don't account for the other benefits of improving camouflage, including reduced casualties, increased mission effectiveness, greater force protection and safety and improved Soldier confidence.

This program was not a major defense acquisition program, but it did have considerable interest from Soldiers, senior Army leaders and Congress. The

INTO THE WOODS

Soldiers assigned to 2nd Armored Brigade Combat Team, 1st Infantry Division conduct a platoon combined arms live-fire exercise at Presidenski Range in Trzebian, Poland, in March. The author, who was the project manager in charge of the search for a new camouflage pattern, describes two ways that T&E can go wrong: Cutting back on testing too aggressively, in pursuit of cost savings, puts the program at risk, while demanding more expensive field testing in the mistaken belief that it's more accurate drives up program costs. (U.S. Army photo by Spc. Dustin D. Biven, 22nd Mobile Public Affairs Detachment)

proliferation of camouflage patterns on uniforms had garnered a lot of attention from Congress because of Government Accountability Office (GAO) concerns that the services were wasting money on duplicative research, development and testing of camouflage uniforms.

With respect to combat camouflage uniforms specifically, the September 2012 GAO report (GAO-12-707), "Warfighter Support: DOD Should Improve Development of Camouflage Uniforms and Enhance Collaboration Among the Services," highlighted the fragmented approach taken by the Army, Navy,

Air Force and Marine Corps. The report stressed the potential to save tens of millions of dollars in development, testing, logistics and inventory control for combat uniforms.

For the Army in particular, the decision to change camouflage patterns on uniforms and equipment affects an approximately $6 billion inventory of uniforms and equipment.

So, how much in T&E costs is enough to properly support an acquisition? The best answer for a seasoned acquisition professional is, "It depends."
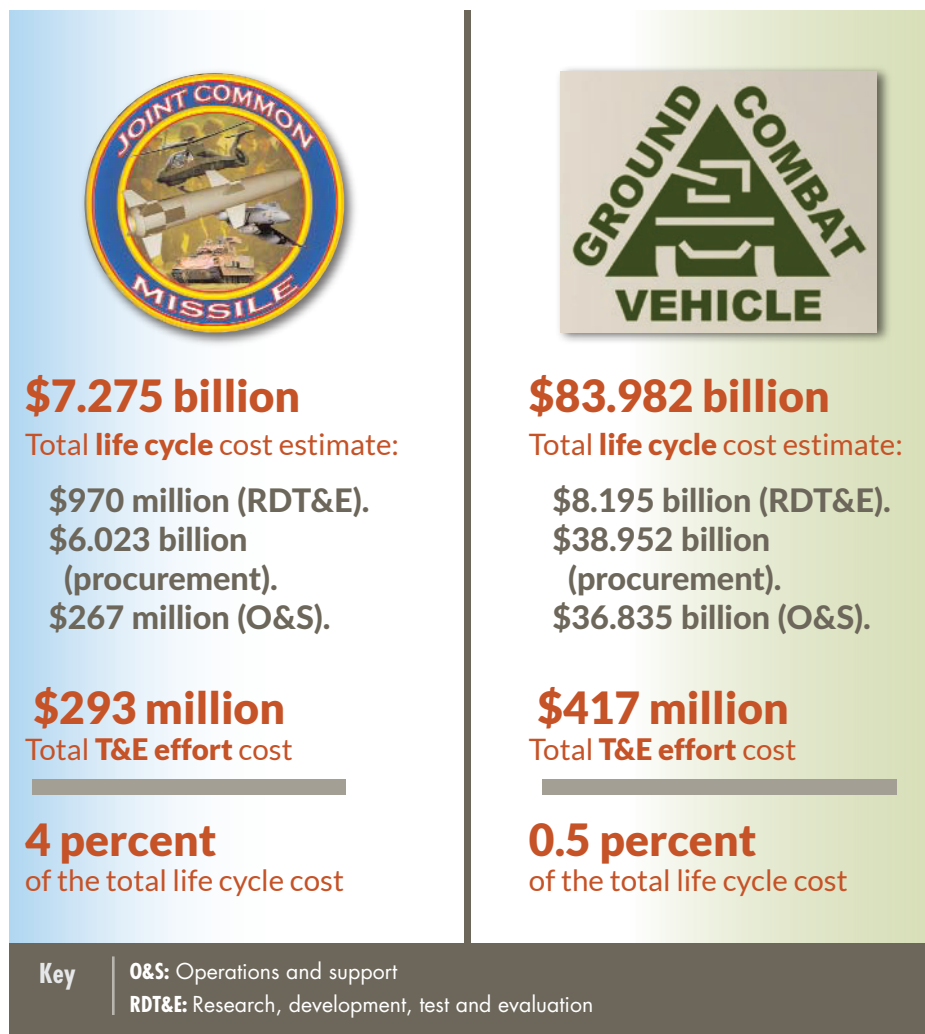
T&E IN ACQUISITION

There is no silver bullet or secret untapped method to fix T&E within defense acquisition because radical change is not needed. Incremental improvements can and do work, and the T&E processes within defense acquisition already use the best practices in commercial industry. In my experience, T&E efforts increase in scope not because of the project manager or testing agencies but because senior leaders don't understand either the program or the T&E strategy, and thus demand more testing before making a decision.

Recent Army acquisition reform and directives targeting the reduction of T&E do not improve acquisition outcomes. In fact, they may increase risk and potentially jeopardize Soldiers' safety. The Army doesn't need additional directives stating goals to "streamline T&E and minimize redundant testing." That's inherent in the project manager charter to develop a strategy that meets the program's objectives by balancing cost, schedule, performance and risk.

The testing itself is all about gaining knowledge, and the independence of the T&E agencies is necessary so that command relationships don't overshadow important technical perspectives. Comprehensive testing reduces risk and provides indications that there may be issues to address—perhaps requiring more testing.

FIGURE 2

$7.275 billion
Total **life cycle** cost estimate:

$970 million (RDT&E).
$6.023 billion
   (procurement).
$267 million (O&S).

$293 million
Total **T&E effort** cost

4 percent
of the total life cycle cost

$83.982 billion
Total **life cycle** cost estimate:

$8.195 billion (RDT&E).
$38.952 billion
   (procurement).
$36.835 billion (O&S).

$417 million
Total **T&E effort** cost

0.5 percent
of the total life cycle cost

Key	
O&S: Operations and support	
RDT&E: Research, development, test and evaluation	

IT'S ABOUT VALUE

Which program managed its test budget best? It's not as simple as looking at which spent the least amount of money on T&E. Different kinds of equipment require different evaluations: Testing a missile is always more expensive than testing a vehicle, since the missile is destroyed during the test process and the program goes through many of them. So simply imposing arbitrary caps on the dollars spent or percentage of total budget allocated to testing is not a smart way to lower acquisition costs, the author asserts. (SOURCE: The author)

It is a fool's errand to try to chase the "right" amount of T&E cost for a particular acquisition effort. In each case, the T&E strategy must be optimal to provide the knowledge that decision-makers need for the most informed decision possible.

Cost overruns and schedule slips are the result of immature technology, poor cost estimating, integration and interoperability challenges, and Murphy's Law. The business of acquisition involves risk, and it takes time to work through the multitude of issues that arise in the development of new capabilities.

In the T&E arena, the best use of time and energy for DOD senior leaders and decision authorities is to become knowledgeable about the acquisition effort in question and about acquisition T&E best practices in general.

CONCLUSION

The perception that the testing community, particularly operational test agencies, are causing program cost overruns and schedule slips is misguided and counterproductive—undermining the credibility of a dedicated acquisition T&E workforce.

The nature and extent of T&E is one of the main areas of policy emphasis in defense acquisition reform initiatives. On the one hand, senior leaders demand T&E efficiencies to fix the perceived high costs and long schedules of T&E efforts. On the other, decision-makers typically demand more, higher-quality T&E to satisfy their desires for the most complete information on a program's progress and risks as they prepare to make the most informed decisions possible.

Project managers must balance those demands with cost and schedule constraints while ensuring compliance with applicable statutes. Early engagement and collaboration with all stakeholders in T&E planning, execution and analysis can help allay criticisms of the T&E program's adequacy. Thus, the best answer to the question, "How much T&E is enough?" is one that recognizes and accommodates the interests of all T&E stakeholders.

The appropriate T&E acquisition reform initiative might be to empower project managers and then trust them to build appropriate T&E strategies—and, of course, hold project managers accountable if the program fails to meet cost, schedule and performance goals. Above all, the most appropriate metric for T&E efforts is to measure whether those efforts provided enough information about the critical technical parameters, critical operational issues, effectiveness and operational suitability for an informed decision by senior leaders. More oversight, new commands and additional reporting requirements are not effective acquisition T&E reform initiatives.

For more information, contact the author at **rfmortlo@nps.edu**.

> *An extensive, comprehensive T&E program is a big part of building trust with warfighters, and acquisition professionals cannot afford to sacrifice that trust. The last thing the defense acquisition profession wants is for a Soldier, Airman, Marine or Sailor in combat to question whether their equipment works as required.*

ROBERT F. MORTLOCK, PH.D., COL., USA (Ret.), managed defense systems development and acquisition efforts for the last 15 of his 27 years in the U.S. Army, culminating in his assignment as the project manager for Soldier protection and individual equipment in the Program Executive Office for Soldier. He retired in September 2015 and is now a lecturer for defense acquisition and program management in the Graduate School of Business and Public Policy at the Naval Postgraduate School in Monterey, California. He holds a Ph.D. in chemical engineering from the University of California, Berkeley, an MBA from Webster University, an M.S. in national resource strategy from the Industrial College of the Armed Forces and a B.S. in chemical engineering from Lehigh University. He is also a recent graduate of the Post-Doctoral Bridge Program of the University of Florida's Hough Graduate School of Business, with a management specialization.

FACES *of the* FORCE

MR. ANTHONY M. TAYLOR

COMMAND/ORGANIZATION:
Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology

TITLE: Department of the Army system coordinator

YEARS OF SERVICE IN WORKFORCE: 13

YEARS OF MILITARY SERVICE: 12.5

DAWIA CERTIFICATIONS:
Level III in program management and Level I in engineering

EDUCATION: M.S. in engineering management, Missouri University of Science and Technology; master's certificate in program management, Villanova University; B.S. in mechanical engineering, North Carolina Agricultural and Technical State University; Project Management Professional

AWARDS: Army Achievement Medal for Civilian Service; Army Meritorious Service Medal (3); Military Outstanding Volunteer Service Medal; Field Artillery Honorable Order of St. Barbara; NATO and Kosovo Ribbons for Operation Joint Guardian; Federal Executive Board Excellence in Federal Career Bronze Award for Outstanding Para-Professional (Non-Supervisory) Technical, Scientific and Program Support – Team

Quiet, please

You can think of Anthony Taylor's 12-plus years on active duty almost like noise-canceling headphones: The experience he gained helps him identify and eliminate the chatter that often drowns out the more important information. Taylor is a DA system coordinator (DASC), supporting the assistant secretary of the Army for acquisition, logistics and technology (ASA(ALT)) and serving as primary acquisition staff officer for several programs of record, including Excalibur, the Gator Landmine Replacement Program, the Installation Information Infrastructure Modernization Program's Home Station Mission Command Center initiative, Medical Communications for Combat Casualty Care and the Reserve Component Automation System.

As a DASC, Taylor advises ASA(ALT) senior leaders on the oversight, management and execution of the programs he's assigned to, serving as the focal point for the justification and defense of programs before the Office of Management and Budget, the Office of the Secretary of Defense and Congress. "Along with the program offices, DASCs ensure that warfighter capabilities are provided in accordance with baselined cost, schedule and technical performance parameters," he said. "As a former Soldier, my greatest satisfaction is knowing that Soldiers in the field receive quality products that enable them to win."

Taylor, who served in the Army for 12 1/2 years, leans on his military training as a critical thinker and problem solver. "When things get hectic, it's important to sift through the noise to find the real issue, address it and move on to the next issue," he said. "In the military, leaders are often put in chaotic situations and we must isolate the issues from the chaos—by that, I mean break down a problem as simply as possible and then resolve it. Anything that does not directly relate to the problem is just noise."

He added, "As a DASC, the pressure is on me to be the acquisition expert in the room. We have to distill issues from a program manager's perspective and nest

them within the 'Big Army's' mission. To do that effectively, we must sift through the noise and ensure that the crux of the issue is presented to leadership so that sound decisions that help the warfighter can be made."

Taylor was commissioned in May 1998 as a field artillery officer. "My high school guidance counselor introduced me to a recruiter—I just happened to be in the library researching an engineering project and the Army ROTC recruiter was there giving a presentation. He convinced me to apply for a four-year ROTC scholarship. I had less than 24 hours before the deadline. 'Being in the right place at the right time' sounds cliché, but that's how it all worked out."

It's a recurring theme for Taylor: He got his start in acquisition by attending a change of command ceremony for a fellow company commander, where he met a newly assigned acquisition officer. "He told me that if I wanted to make a difference in the quality, functionality and type of equipment provided to Soldiers and put my engineering degrees to use, the acquisition career field was a good fit."

His first acquisition position was in 2005 with the U.S. Army Training and Doctrine Command Army Capabilities Integration Center, where he served as a combat developer. "I found the fact that I could influence the design, development and procurement of the very equipment I used as a field artillery officer appealing," said Taylor. "So if the equipment didn't work, I was at the forefront of the effort to ensure that didn't happen again."

In March 2018, he completed the Competitive Development Group/Army Acquisition Fellowship (CDG/AAF), a three-year developmental program that provides members of the Army Acquisition Workforce with expanded training through educational, leader development and broadening assignments. Similar to his decision to join Army ROTC, Taylor had just 24 hours to apply for the program once he heard about it.

Despite his last-minute start in the program, he has plenty of good things to say about his participation. "The CDG program came along at the right time in my career to broaden my experience, and the ASA(ALT) rotation allowed me to meet a host of people from different backgrounds. It taught me that networking and timing are crucial to one's success in the government. Exposure to the people I met through CDG expanded my network and helped me realize how important relationships are to building a successful career."

That networking has become extremely valuable as he works through what he sees as "cultural differences" in how acquisition gets done. "Occasionally I encounter people who aren't aware of what I have to offer because they don't know about my combat arms background or they think I'm not as experienced in acquisition as I am," he said. "But once the people I'm working with learn about my background, they're interested in the different perspectives I can bring to a project. In one rotation with a contracting shop, for example, the people in that organization realized I had program management experience, and asked for my insight on approaching a particular issue."

He hopes more people take advantage of the CDG/AAF, either through participating or through working with program participants. "I encountered a lot of people who hadn't heard of the program. I would think agencies would jump at the opportunity to develop aspiring acquisition professionals through rotational opportunities at no cost to the organization."

—*MS. SUSAN L. FOLLETT*

TEAMING FOR SUCCESS
Taylor, left, and other CDG/AAF participants take a break after a training course at the University of Virginia's Darden School of Business that uses rowing to help develop foundational knowledge for creating high-performing teams. With Taylor are, from left, Charles Parsons, Rachel Overman, Roger Gray, Natasha Owens, Kenyatta Juniel and Matt Warner. (Photo courtesy of Natasha Owens)

MASTERING ACQUISITION

The DACM Office and the Naval Postgraduate School realign degree programs to boost technical education of civilians and officers.

E arlier this year, I was in beautiful Monterey, California, to help put the final touches to a new effort for the Army Acquisition Workforce at the Naval Postgraduate School (NPS). Starting this fall, the civilians that the U.S. Army Acquisition Support Center's Director for Acquisition Career Management (DACM) Office sends to NPS will be pursuing an M.S. in systems and program management. Officers will pursue an M.S. in systems engineering management starting this summer. Previously, the professionals we sent to NPS were seeking an MBA.

The new programs that we're sending our students through—Curriculum 522 for officers and Curriculum 722 for civilians—will focus on getting them greater exposure and training across multiple career fields with added emphasis on critical thinking across domains; however, the curriculum has much of the same content as the previous master's program. In addition to their master's degree, civilians in a distance learning program will earn training equivalent to Level III Defense Acquisition Workforce Improvement Act training in program management and in engineering, Level II in test and evaluation and at least Level I in contracting. Any time you can get training and education simultaneously, you've got a greater opportunity to employ them in the experiential environment.

Eligible resident officers completing the 522 degree program also will obtain their Joint Professional Military Education and Level III training in program management, engineering and contracting, plus Level II training in test and evaluation.

The impetus behind the change is Lt. Gen. Paul A. Ostrowski's belief that if you want to be a great program manager or a great contracting officer, you have to thoroughly understand the technical acumen that's needed for both parts of our

MORNING COLORS
Sailors raise a pennant that reads "Don't give up the ship" during morning colors in front of NPS' Herrmann Hall. NPS is now offering new curricula in systems and program management and in systems engineering management to students from the Army Acquisition Workforce. (Photo courtesy of NPS)

KNOWLEDGE = SECURITY

Service members stand in formation in front of Herrmann Hall. The mission of NPS is to provide relevant and unique advanced education and research programs to increase the combat effectiveness of commissioned officers of the naval service and thus enhance the security of the United States. (Photo courtesy of NPS)

business. If you're running a program and haven't been trained in contracting, when your contracting officer starts reeling off contracting jargon, you're just going to agree to whatever they say and maybe not make the best choices for a program. And if you're on the contracting side and you don't have a solid understanding of engineering and program management, a contractor can overwhelm you with details and you might not make the best decisions for the government.

The push for the change began with Lt. Gen. Michael E. Williamson, Ostrowski's predecessor as the principal military deputy to the assistant secretary of the Army for acquisition, logistics and technology and director of the Army Acquisition Corps.

This change is about exposing more of our professional workforce to greater technical education. The key word here is

"technical." We're very confident that throughout their careers, our civilians and our officers have a variety of opportunities to get leadership and management training and experience. But technical training is probably the most difficult to achieve. And so we're trying to focus a lot of our education programs, NPS being one of them, to increase the number of people that have a greater exposure to technical content.

A key component in this change is NPS. The true power that NPS can provide, and needs to focus on providing in the future, is its operational relevance. When you get an MBA or an M.S. in systems and program management, an M.S. in systems engineering management or any other graduate degree from NPS, you should have been exposed to enough experienced operators to flavor it so that a lot of what you're getting is real-world practical experience that you can apply to DOD.

We can send anybody anywhere for a systems engineering degree or an MBA. There are great institutions all over the world. But there are very few accredited institutions that can provide real-world practical operational experience from practitioners who have walked in the shoes you will be walking in as an acquisition professional.

EDUCATION PARTNERSHIP

Craig A. Spisak, left, the Army DACM, and Professor John T. Dillard, Col., USA (Ret.), NPS senior lecturer in systems acquisition management and technical representative for the new curricula, hold the memorandum of agreement signed by Lt. Gen. Paul A. Ostrowski and NPS President Ronald A. Route, Vice Adm., USN (Ret.), on May 18 at the Pentagon. The memorandum cements a partnership to provide relevant education to the Army's military and civilian acquisition workforce. (Photo courtesy of John T. Dillard)

The faculty understands the pitfalls that you will face. They've worked inside the DOD system. Very few schools of higher education and learning can offer that. That's the power that NPS has, and that's the focus it needs to maintain. The faculty's operational relevance is what sets NPS apart and makes it unique. If NPS strays from that, then it's forced to compete with every other college and university in America. If it loses track of that niche, NPS will be of less value to us as the sponsor of these programs.

We've had a long-standing relationship with NPS, and we look forward to continuing that through many, many years. NPS will face, as any college or university does, the difficulty of adjusting its curriculum to changing times. But the fact that NPS is a DOD institution allows it to translate our real-world needs into viable education programs. In the future we may have another emerging requirement for our students who go there to understand at the graduate level. And we will need to be able to transmit that requirement to NPS as the sponsor of the programs and have it adapt and adjust the curriculum in real time. We need that kind of responsiveness and partnership. They're the professionals at educating people. We have to see the world today and into the future to determine what skill sets should be embedded in the NPS curriculum.

LEARNING OPPORTUNITY

Sailors approach Herrmann Hall. NPS' new curricula in systems and program management and in systems engineering management for students from the Army Acquisition Workforce support its overall mission as well as the specific needs of Army acquisition professionals to understand the technical aspects of their jobs. (Photo courtesy of NPS)

The **411** on 522 and 722 at **NPS**

CURRICULUM 522
**Systems Engineering Management
System Acquisition**

Audience: Army acquisition officers.

Description: An interdisciplinary program combining systems engineering with acquisition management knowledge and skills. Intended to broaden the technical competence of officers with nontechnical backgrounds so that they can manage and lead acquisition programs for complex combat systems. Students learn the systems engineering process, from establishing system requirements through test and evaluation; and how to manage, schedule and budget programs and work with DOD suppliers through contracts to meet program obligations.

Requirements: A baccalaureate degree with above-average grades is required. Completion of at least two semesters of college algebra or trigonometry is considered the minimum mathematical preparation.

Program start dates: January and July.

Program length: Six quarters.

Training method: Resident.

Degree: Master of Science in Systems Engineering Management.

Certification training included: Joint Professional Military Education; Defense Acquisition University equivalencies for Defense Acquisition Workforce Improvement Act training for Level III in program management, Level III in engineering, Level III in contracting and Level II in test and evaluation.

CURRICULUM 722
**Systems Engineering Management
Systems and Program Management**

Audience: Army acquisition civilians.

Description: An interdisciplinary program combining systems engineering with program management knowledge and skills. Intended to broaden the technical capabilities of acquisition workforce members with nontechnical backgrounds so that they can successfully manage and lead programs or projects in support of the defense acquisition system. Students learn the systems engineering process, from establishing system requirements through test and evaluation; and how to manage, schedule and budget programs and work with DOD suppliers through contracts to meet program obligations.

Requirements: Candidates for the program must have a baccalaureate degree. This program is available only through the Army DACM Office.

Program start date: September.

Program length: Eight quarters.

Training method: Distance learning.

Degree: Master of Science in Systems and Program Management.

Certification training included (for civilian students already Level II certified in program management): Defense Acquisition University equivalencies for Defense Acquisition Workforce Improvement Act training for Level III in program management, Level III in engineering, Level II in test and evaluation, Level II in production, quality and manufacturing, and Level I in contracting.

CHANGING with SMALL BUSINESS

Small business is huge for the Army, but while 'small business' was set to become a separate career field, it will now be a career path.

by Ms. Jacqueline M. Hames

I n May, Dr. James Galvin, acting director of DOD's Office of Small Business Programs, announced that the small business career field will instead become an official acquisition career path.

"Small business" as a career field was originally intended to be a distinct, overarching discipline, like program management or contracting, said Sharon Morrow. She serves as the small business liaison for workforce development and the Small Business Innovation Research and Small Business Technology Transfer programs at the Army Office of Small Business Programs.

In July 2017, the Office of the Undersecretary of Defense for Acquisition, Technology and Logistics issued the revised "DOD Instruction 5000.66: Defense Acquisition, Technology, and Logistics Workforce Education, Training, and Career Development Program," which effectively froze the current acquisition career fields. While there will be no small business career field for the foreseeable future, there is still a small business career path. A career path is a specialty nested under another core career field, a way of refining an acquisition workforce member's skills to focus on small business. Think of it as the difference between a college major (such as engineering) and a specialization or minor (civil engineering).

SMALL BUSINESS CAREER PATH BENEFITS

Facilitates development of in-depth small business expertise through training.

Enables individuals from other career fields to specialize in small business as needed.

Allows for cross-functional acquisition training.

Improves small business support to increase capability and readiness.

Provides greater control of, and access to, training and resources.

More accurately defines career pathways and increases professional development opportunities.

As a result of the revised instruction, Galvin decided that implementing a small business career path under the contracting career field would be the best course of action. This way, professionals on the small business path can retain their acquisition program code and career series while also having a subspecialty code that recognizes their small business duties, Morrow added.

Implementing the career path "easily identifies that we have small business duties" and helps track professional development and workforce numbers, Morrow said. Acquisition workforce members who focus on small business, once referred to as small business specialists, will now be called small business professionals, she explained.

Currently, there are about 160 professionals specializing in small business in the Army Acquisition Workforce, including some active-duty Soldiers. But there is still a great need for small business professionals, who "can add value when they are a part of acquisition planning at an early stage" by bringing small business capability to bear on mission requirements, Morrow said. Small businesses are more agile, responsive and innovative, and they can make decisions more quickly than larger corporate counterparts. Small business professionals in the acquisition workforce should have good business acumen and a depth and breadth of experience in

acquisition planning and execution if they want to follow this career path, she said.

All major service components across DOD are working together to create the small business career path, said Giselle Whitfield, proponent officer with the Army Director of Acquisition Career Management Office at the U.S. Army Acquisition Support Center at Fort Belvoir, Virginia. An implementation plan for the small business career path is under development, she added, and small business courses are currently available at the Defense Acquisition University. Whitfield encouraged anyone who is interested to take a small business course, as small business knowledge overlaps with many other career fields.

For more information and updates about the small business career path, go to **https://asc.army.mil/web/dacm-office/** *or* **http://osbp.army.mil/**.

MS. JACQUELINE M. HAMES is a writer and editor with Army AL&T magazine. She holds a B.A. in creative writing from Christopher Newport University. She has more than 10 years of experience writing and editing for the military, with seven of those years spent producing news and feature articles for publication.

ON THE MOVE

1: DASA(R&T) TECH DIRECTOR RETIRES

Matthew Donohue, left, director for Ground Maneuver Portfolio, received his retirement award May 31 from **Jeffrey D. Singleton**, director of technology for the Office of the Deputy Assistant Secretary of the Army for Research and Technology (ODASA(R&T)). Donohue was with the organization for 19 years and 11 months, starting as a military officer, then through an Intergovernmental Personnel Act assignment, and finally as a federal employee. Donohue is a graduate of the U.S. Army Command and General Staff College and the Advanced Program Management Course at the Defense Systems Management College. He is Level III certified in program management, science and technology management and in business – financial management, and is Level I certified in engineering and in test and evaluation. (U.S. Army photo by Stephanie Schwind, ODASA(R&T))

2: C3I DIRECTOR APPOINTED AT ODASA(R&T)

The DASA(R&T) has appointed **Nora Pasion** as the director for command, control, communications and intelligence (C3I). She will direct and oversee the Army C3I program, which has an annual budget of about $400 million and is executed by and through the U.S. Army Research, Development and Engineering Command, the U.S. Army Corps of Engineers Engineer Research and Development Center and the U.S. Army Space and Missile Defense Command Technical Center.

Pasion began her civilian career in 1988 with the U.S. Army Test and Evaluation Command. One year later, she accepted a permanent position with the Vulnerability Assessment Laboratory, which became the U.S. Army Research Laboratory's (ARL) Survivability/Lethality Analysis Directorate. In 1995, she was selected to help establish a cyber-vulnerability assessment capability within the directorate and worked to develop and execute network vulnerability assessment processes that were implemented as part of materiel release. Pasion was selected to serve as the ARL liaison to the assistant secretary of the Army for acquisition, logistics and technology (ASA(ALT)) in 2011. She has also served as ASA(ALT) acting director for basic research and as the director for cyber.

Pasion received an M.S. in industrial engineering and a B.S. in electrical engineering, both from New Mexico State University. She holds active certifications as a Certified Information Systems Security Professional and a Certified Ethical Hacker.

U.S. ARMY COMMUNICATIONS-ELECTRONICS RESEARCH, DEVELOPMENT AND ENGINEERING CENTER

3: NEW DIRECTOR FOR CERDEC CP&ID

Christopher P. Manning has been named to the Senior Executive Service and assigned as director of the Command, Power and Integration Directorate (CP&ID) within the U.S. Army Communications-Electronics Research, Development and Engineering Center (CERDEC). As director, he is responsible for planning and executing the Army's science and technology investments in mission command; power generation; position, navigation and timing; and quick reaction and prototyping technology.

Manning previously served as the acting director for CP&ID and as chief of CP&ID's Prototyping, Integration and Testing Division. Before joining CERDEC, he was the deputy chief of staff for the Program Executive Office for Command, Control and Communications – Tactical (PEO C3T). He also served as deputy director of forward operations for the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology and project director for Communications Security within PEO C3T.

Manning was commissioned as a second lieutenant in the Signal Corps through the ROTC program at Michigan State University, where he received a B.S. in electrical engineering. He received an M.S. in engineering from the University of Pennsylvania. Manning is Level III certified in program management and in systems engineering, and is a graduate of the Program Manager's Course. He is a member of the Army Acquisition Corps.

4: GCSS-ARMY GETS NEW PRODUCT MANAGER

Lt. Col. William Reker will take over as product manager for the Global Combat Support System – Army at Fort Lee, Virginia, in August. He will be responsible for planning and executing the Army's investments in its tactical unit and installation logistics and financial systems. Reker currently serves as the military deputy for the CP&ID within CERDEC. He holds an M.A. in human resources management from Webster University, an MBA from the University of Delaware and a B.A. in history and speech communication from the University of Illinois at Urbana-Champaign. He is a member of the Army Acquisition Corps and has completed the Program Manager's Course.

JOINT MUNITIONS COMMAND

5: CHANGE OF COMMAND AT JMC

Gen. Gustave F. Perna, left, commanding general of the U.S. Army Materiel Command (AMC), received the unit colors from **Brig. Gen. Heidi J. Hoyle**, right, as she relinquished command of the Joint Munitions and Lethality Life Cycle Management Command and the Joint Munitions Command (JMC) at a ceremony April 17 at Rock Island Arsenal, Illinois.

Hoyle, now chief of ordnance at the U.S. Army Ordnance School at Fort Lee, Virginia, relinquished command to **Rhonda VanDeCasteele**, who will serve as executive director until a new director is named.

"Under Brig. Gen. Hoyle's leadership, JMC closed out the fiscal year by distributing more than 350,000 short tons of ammunition around the world to our entire military for both training and operational purposes," said Perna. "On behalf of the entire AMC family and the hundreds of thousands of Soldiers, Sailors, Airmen, Marines and Coast Guard personnel that you supported, thank you for a job well done." (Photo by Tony Lopez, JMC)

JOINT PROGRAM EXECUTIVE OFFICE FOR CHEMICAL, BIOLOGICAL, RADIOLOGICAL AND NUCLEAR DEFENSE

1: PROMOTION AT JPM MCS

Col. Jeanne Norwood received her promotion from lieutenant colonel from **Col. David P. Hammer**, joint project manager for Medical Countermeasure Systems (JPM MCS), at an April 13 ceremony at Fort Detrick, Maryland. Norwood is joint product manager for the Joint Vaccine Acquisition Program at JPM MCS, which is one of five JPMs under the Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense. (Photo by MCS Graphics)

ARMY RAPID CAPABILITIES OFFICE

2: LEADERSHIP, STRUCTURE CHANGE AT RCO

Douglas K. Wiltsie, founding director of the Army Rapid Capabilities Office (RCO), retired from government service at the end of May after a 34-year career. RCO's new director, **Tanya M. Skeen**, a member of the Senior Executive Service (SES), joined the organization on April 15.

Wiltsie, who had served as Army RCO director since August 2016, simultaneously built the organization and executed its rapid prototyping mission. While leading RCO, he also oversaw the System of Systems Engineering and Integration (SOSE&I) Directorate within the Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology (OASA(ALT)). He previously served as the program executive officer (PEO) for Enterprise Information Systems and as deputy PEO for Intelligence, Electronic Warfare and Sensors. Wiltsie was appointed to the SES in 2008.

Skeen comes to the Army RCO after serving as deputy director of test and evaluation for the U.S. Air Force and as the PEO chief engineer at the Air Force RCO. She was commissioned in the U.S. Navy following graduation with the highest distinction from Purdue University with a B.S. in aeronautical and astronautical engineering. She also holds an M.S. in mechanical engineering from the University of Central Florida and is Level III certified in program management, engineering and test and evaluation.

With Skeen's arrival, the RCO and SOSE&I separated into two distinct organizations, and SOSE&I missions transitioned to the new OASA(ALT) Office of the Chief Systems Engineer (OCSE). RCO will lead rapid prototyping and rapid acquisition for the Army, while OCSE will serve as the focal point for system-of-systems engineering and oversight across the Army's materiel development community.

Col. Joseph Capobianco, RCO's chief of staff, will retire in October after a 30-year military career. **Col. Allen Horner** began serving as the RCO's acting chief of staff in April. (U.S. Army photo by Claire Heininger, RCO)
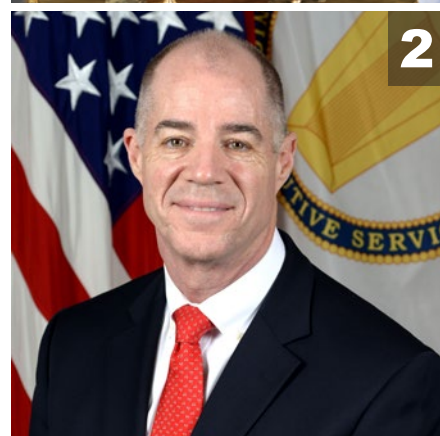
PROGRAM EXECUTIVE OFFICE FOR AVIATION

3: RETIREMENT CAPS 44-YEAR CAREER

Marsha Jeffers, director of human resources and administration at the Program Executive Office (PEO) for Aviation, received a U.S. flag flown over Afghanistan from **Brig. Gen. Thomas Todd**, program executive officer, at a ceremony marking her retirement after a 44-year federal career. Jeffers, who joined PEO Aviation in 1987, also received the Order of St. Michael Bronze Award during the ceremony, held April 13 in Huntsville, Alabama. (U.S. Army photo by Shannon Kirkpatrick, PEO Aviation)

4: NEW G-1 APPOINTED

Raymond Nabors joined PEO Aviation in March as the assistant PEO for G-1 Personnel. In that role, he is responsible for civilian and military manpower management and personnel-related issues, human capital strategic planning, leader development and performance management. Nabors comes to PEO Aviation from the U.S. Army Aviation and Missile Command. (Photo courtesy of PEO Aviation)

5: SEMA MARKS CHANGE OF CHARTER

Sam Lamb, left, accepted the flag from **Todd Miller**, acting director of PEO Aviation's Fixed Wing Project Office, in assuming responsibility as the product director of the Special Electronic Mission Aircraft (SEMA) Directorate. **John Bullock**, second from left, acting deputy product director for SEMA, and **Derek Long**, right, outgoing product director, were also on hand during the April 30 change of charter ceremony on Redstone Arsenal, Alabama. Lamb retired from the Army as a lieutenant colonel in 2008 and brings 30 years of aviation and acquisition experience to PEO Aviation. (U.S. Army photo by Michelle Miller, PEO Aviation)

6: COST-SAVING EFFORTS EARN ARMY MEDAL

Chief Warrant Officer 5 William Rawlings, UH-60 maintenance test pilot and logistics fleet manager for PEO Aviation's Utility Helicopters Project Office, received the Meritorious Service Medal Feb. 1 from **Greg Gore**, deputy project manager. Rawlings helped to increase readiness for the Black Hawk fleet and saved the Army millions of dollars over the course of his three-year assignment with PEO Aviation. He will remain at Redstone Arsenal and joins the U.S. Army Redstone Test Center, a subordinate organization of the U.S. Army Test and Evaluation Command. (U.S. Army photo courtesy of PEO Aviation)

PROGRAM EXECUTIVE OFFICE FOR COMBAT SUPPORT AND COMBAT SERVICE SUPPORT

7: CWO RETIRES TO CAP 26-YEAR CAREER

Chief Warrant Officer 5 James R. Shoebridge, chief warrant officer (CWO) for the Program Executive Office for Combat Support and Combat Service Support (PEO CS&CSS) since 2015, retired March 9 after more than 26 years on active duty. Shoebridge was honored in a ceremony led by former PEO **Scott J. Davis** at the Detroit Arsenal in Warren, Michigan, during which he received the Legion of Merit.

As the first logistics-focused warrant officer in PEO CS&CSS, Shoebridge brought maintainer and logistician perspectives to acquisition decisions across a diverse system portfolio. He inaugurated the use of commercial off-the-shelf manuals on select programs; executed a pilot for video technical manuals; and simplified the logistics approaches for many of the organization's programs.

Shoebridge enlisted in the Army in 1992 and was appointed to the Warrant Officer Corps in 1997. He was among roughly 75 CWO 5s in the Ordnance Corps, which numbers 100,000 Soldiers. Before coming to PEO CS&CSS, he held assignments in the U.S. Army Combined Arms

Support Command; served as the ordnance organization integrator in the Army G-3; and served on the Army Evaluation Task Force. He holds a Master Logistician certification from the International Society of Logistics and Army Logistics University, and is a member of the Ordnance Order of Samuel Sharpe.

Replacing Shoebridge is **CWO 5 Leonard Levy**. He comes to PEO CS&CSS from U.S. Army Africa, where he served as senior maintenance adviser. (U.S. Army photo by Ted Beaupre, U.S. Army Garrison – Detroit Arsenal)

PROGRAM EXECUTIVE OFFICE FOR COMMAND, CONTROL AND COMMUNICATIONS – TACTICAL

1: DPEO RETIREMENT CAPS 32-YEAR CAREER

Mary E. Woods, deputy program executive officer (DPEO) for Command, Control and Communications – Tactical (C3T), retired on May 31, ending a career of more than 32 years.

Woods had served as DPEO since May 2013, helping to manage a workforce of more than 1,600. She was the director of operations and business management for PEO C3T from September 2005 to January 2010, and was chief of staff from 2010 until 2013. Before coming to PEO C3T, she held positions as a programming planning specialist, Pentagon liaison officer and director of battle command for the assistant secretary of the Army for acquisition, logistics and technology (ASA(ALT)). (U.S. Army photo)

2: CHANGE OF CHARTER AT AMF

Lt. Col. Brandon J. Baer, center right, assumed the charter of the Product Manager for Airborne, Maritime and Fixed Station during a ceremony May 22 at Aberdeen Proving Ground (APG), Maryland, presided over by **Col. James Ross**, center, project manager for Tactical Radios (PM TR). Relinquishing the charter was **Lt. Col. Monique N. Rivera**, left, who had served as product manager since May 2015. Assisting in the ceremony was **Maj. Zachary Valentine**, right, an assistant product manager assigned to PM TR.

Baer was commissioned as an armor officer in May 1999, transitioned to the Signal Corps in 2001 and began his career in acquisition in 2008 with PEO C3T. He returns to PEO C3T after serving the past four years in the Office of the ASA(ALT) as a DA systems coordinator and in the Special Programs Directorate. He holds an M.S. with a specialization in Army operations and national security from the University of Maryland University College and a B.S. in law enforcement from Minnesota State University, Mankato. (U.S. Army photo)

3: CHANGE OF CHARTER AT COMSEC

Michael Badger assumed the charter of the Product Lead for Communications Security at a Feb. 14 ceremony at APG presided over by **Stanley Niemiec**, project lead for Network Enablers. Badger succeeded **Kevin Walsh**. (U.S. Army photo)
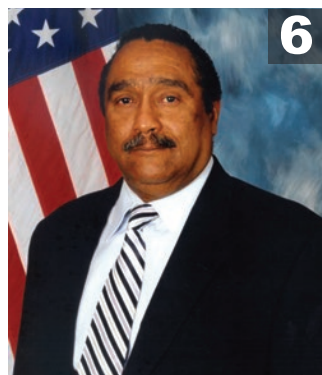
PROGRAM EXECUTIVE OFFICE FOR
ENTERPRISE INFORMATION SYSTEMS

4: NEW PEO ASSUMES EIS CHARTER

Lt. Gen. Paul A. Ostrowski, principal military deputy to the assistant secretary of the Army for acquisition, logistics and technology (ASA(ALT)) and director of the Army Acquisition Corps, presided over an assumption of charter ceremony at Fort Belvoir, Virginia, April 27, officially recognizing **Chérie A. Smith** as the program executive officer for Enterprise Information Systems (PEO EIS).

As PEO, Smith is responsible for managing more than 60 DOD and Army acquisition programs across the business, warfighting and enterprise information missions. With a staff of more than 1,500 military, civilian and contractor personnel around the world, PEO EIS executes approximately $3 billion in programs annually. (U.S. Army photo by Racquel Lockett-Finch, PEO EIS)

5: APEO RETIRES AFTER 35 YEARS

Chérie Smith, left, PEO EIS, presented **Michael Padden**, assistant PEO for Network and Communications, with a certificate of retirement and a certificate of appreciation at a Jan. 12 ceremony at Fort Belvoir marking Padden's retirement after 35 years of government service.

Padden was appointed as assistant PEO in September 2017, overseeing the integration and security of the organization's information technology. He had served as project manager for Installation Information Infrastructure Communications and Capabilities for more than three years. Before joining PEO EIS, Padden was the acting deputy and executive director for acquisition of services in the Office of the ASA(ALT), and assistant PEO for operations and chief of staff for PEO Aviation.

Padden's awards and recognitions include the DA Decoration for Exceptional Civilian Service, the Superior Civilian Service Award, the Achievement Medal for Civilian Service, the Commander's Award for Civilian Service, the Industrial College of the Armed Forces (ICAF) Commandant's Award for Excellence in Research and Writing, the Maj. Gen. Antonelli Award for ICAF Industrial Study Excellence and the David Packard Excellence in Acquisition Award. (U.S. Army photo by Racquel Lockett-Finch, PEO EIS)

6: DLS PRODUCT LEAD RETIRES

Stanley Davis, product lead for PEO EIS' Distributed Learning System (DLS), retired March 30 after 30 years of government service in acquisition, leadership, training and management. Davis had been product lead since April 2010, setting the strategic vision for the program and ensuring that DLS met all cost, schedule and performance goals. He oversaw five components of the DLS program: Army e-Learning, Digital Training Facilities, Army Learning Management System, Enterprise Management Center and Deployed Digital Training Campuses.

7: FORMER APEO RECEIVES FIRST STAR

Lt. Gen. Paul A. Ostrowski, principal military deputy to the ASA(ALT) and director of the Army Acquisition Corps, administered the Officer's Appointment Oath to **Brig. Gen. Michael E. Sloane** during a March 8 ceremony at Fort Belvoir marking Sloane's promotion from colonel. Sloane's wife, Debbie, joined him in the ceremony. Sloane was the assistant PEO for Enterprise Resource Planning Integration for PEO EIS from December 2016 to June 2018. He now serves as PEO for Simulation, Training and Instrumentation. (U.S. Army photo by Racquel Lockett-Finch, PEO EIS)

OFFICE OF THE CHIEF OF STAFF,
ARMY GENERAL OFFICER ASSIGNMENTS

Maj. Gen. Daniel G. Mitchell, deputy chief of staff for logistics and operations, U.S. Army Materiel Command, Redstone Arsenal, Alabama, to commanding general (CG), U.S. Army TACOM Life Cycle Management Command, Warren, Michigan.

Brig. Gen. Richard R. Coffman, deputy CG (Maneuver), 1st Infantry Division, Fort Riley, Kansas, to director, Next-Generation Combat Vehicle Cross-Functional Team, Fort Benning, Georgia.

Maj. Gen. Rodney D. Fogg, commandant, U.S. Army Quartermaster School, U.S. Army Sustainment Center of Excellence, Fort Lee, Virginia, to deputy chief of staff for logistics and operations, U.S. Army Materiel Command, Redstone Arsenal.

Brig. Gen. David M. Hodne, deputy CG (Maneuver), 4th Infantry Division, Fort Carson, Colorado, to commandant, U.S. Army Infantry School, U.S. Army Maneuver Center of Excellence; and director, Future Soldier Lethality Cross-Functional Team, Fort Benning.

Brig. Gen.(P) Paul H. Pardew, CG, U.S. Army Expeditionary Contracting Command, Redstone Arsenal, to CG, U.S. Army Contracting Command, Redstone Arsenal.

Brig. Gen. Michael E. Sloane, assistant program executive officer (PEO), Enterprise Information Systems, Fort Belvoir, Virginia, to PEO for Simulation, Training and Instrumentation, Orlando, Florida.

THEN & NOW
1965 & 2018

SEEING
AROUND CORNERS

Advances in night vision technology give Soldiers capabilities considered impossible some 50 years ago.

"On the battlefield of the future, if you're standing still, you're dead," has become something of a truism in the conversation about multidomain battle. The expectation that a fight in the future across air, land, sea and the internet will move faster than warfare ever has drives a lot of current decision-making about what to develop, buy and train for. Speed matters.

The Army researchers exploring night vision in 1965 knew that speed mattered, too, and sought to transform the night vision camera they were experimenting with from a heavy box that required a 20-minute exposure into something more useful on a battlefield. The Army then was working out the basic technology that would be useful for a Soldier in a fixed position at night, looking at one area for a while. The night vision camera wasn't portable. It needed a considerable amount of ambient light from the stars and the moon to function, and it took a long time to produce a grainy image.

Dr. Wilhelm Jorgensen described the focus of the Army's early night vision research in the September 1965 issue of Army Research and Development Newsmagazine (AL&T's predecessor). "Programs have been initiated … to decrease the exposure time and to provide operational equipment that is more practical and useful," he wrote.

This summer, the Army is preparing to field a night vision device that can summon up a picture out of darkness in seconds, allows Soldiers to see in two directions at once, and updates the image continuously as the Soldier moves. A Soldier walking through a dark alley can toggle between two crisp video feeds of who or what's in front of him and

SEEING IN THE DARK

Soldiers assigned to Combined Joint Task Force – Horn of Africa's East African Response Force fire M240 machine guns and practice bounding movements in November in Djibouti. Night vision capabilities, which use the infrared spectrum to see in the dark, have evolved from bulky, long-exposure cameras to portable goggles and rifle sights that Soldiers can use easily and reliably. (U.S. Air Force photo by Senior Airman Erin Piazza, Combined Joint Task Force – Horn of Africa Combat Camera)

what's off to one side. (One feed comes from the helmet-mounted goggle tube, and the other from the rifle sight.) The pairing is called the Enhanced Night Vision Goggle (ENVG) III, and it's worlds away from that long-exposure camera, though it relies on the same fundamental science.

Embryonic night vision devices existed before the 1960s—very large "infrared spotlights," mounted on the back of a truck, were in use in World War II. But these worked by scanning the dark sky with an infrared light, and so eventually became a liability that could give away the Allies' position.

In 1965, the research team's investigations rested on what was still being discovered about the infrared spectrum of light, which is invisible to the naked eye. Finding the right base material for

night vision lenses was another focus of research. "If successful, the technique has potential application in the development of wafer-size image intensifiers for miniaturizing infrared night-vision viewing equipment," Jorgensen wrote of the search for ways to render electronic current signals visible. "With suitable optics, the technique could be used as a horizon scanner to locate warm vehicles, infrared equipment and other heat sources," he concluded, anticipating the kind of equipment most Soldiers—and plenty of civilian hunters looking for an edge on the deer—would start carrying in the 1980s and 1990s. Early night vision devices exploited the near end of the infrared spectrum; decades later, scientists developed the ability to peer into the far end of the spectrum to make more things more clearly visible at night.

The Evolution of Night Vision Devices

1940: World War II
SNIPERSCOPE

1972: Vietnam
AN/PVS-2 STARLIGHT SCOPE

1985: Gulf War
AN/PVS-7 GOGGLE

2000: Operation Enduring Freedom
AN/PVS-14 MONOCULAR NIGHT VISION DEVICE
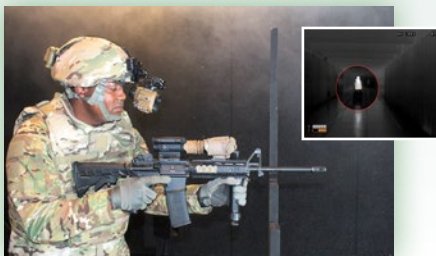
2017
ENHANCED NIGHT VISION GOGGLE III

The two foundational capabilities that make it possible to see in the dark are image intensification, used in the earliest scopes, and thermal imaging, the addition of which has improved more current night vision devices. Image intensification works by amplifying ambient light; thermal imaging works by detecting differences in heat radiated by an object and the background.

Most Soldiers now use a one-eyed night-vision goggle, the PVS-14, that uses image intensification and produces an image almost instantly, moving with the Soldier. Some have received the Enhanced Night Vision Goggle I and II, which were fielded in limited numbers starting in 2008 and improve the ability to see in dim, smoky or foggy daytime conditions. The main change from PVS-14 to the enhanced versions is the use of thermal imaging as an additional vision technology. With the ENVG III, Soldiers have the option to fuse both kinds of vision into a single display or to look through the device in either mode by itself.

Night vision technology is also now not only portable and wearable, but untethered from goggles. One lens on a weapon can wirelessly send an image to a Soldier's helmet display; a key change from the ENVG II to the III is that the ENVG III can now be wirelessly linked to the weapon sight on a Soldier's rifle (the Family of Weapon Sights – Individual), which allows Soldiers to see what their rifle is aiming at, either in total darkness or low-light conditions, without having to raise it to eye level. Putting the night vision camera on a rifle instead of a goggle also keeps Soldiers out of harm's way longer—a Soldier searching a building at night can point his rifle around a corner and see what's on the other side on his helmet display.

Though all the currently fielded night vision devices weigh far less and produce sharper images than the 1965 camera, advances in power technology and screen display are now making it possible to produce night vision systems that are so much lighter and clearer that the difference is like, well, night and day.

CONCLUSION

The cross-functional team focused on making Soldiers more lethal has identified better night vision as a key component of that project, and is pushing forward a binocular night vision goggle of the kind special operations forces use. Other improvements under consideration would incorporate the night vision images into a stream of data that Soldiers see on their display—along with, for example, GPS information, or the location of allied troops. As scientists discover more about the infrared spectrum and how to see into it, more improvements become possible. Early breakthroughs in night vision technology enabled then-Secretary of the Navy John Lehman to declare in 1991, "We own the night." In the words of the organization that inherited the research mission Jorgensen described in 1965 (the U.S. Army Communications-Electronics Research, Development and Engineering Center), current night vision technology, with its emphasis on cutting through smoke, fog and sandstorms, is on the cusp of letting Soldiers "own the environment."

*For more information, go to **https://asc. army.mil/docs/pubs/alt/archives/1965/ Sep_1965.PDF**. To explore the Army AL&T archives, go to **https://asc.army.mil/ web/magazine/alt-magazine-archive/**.*

—*MS. MARY KATE AYLWARD*

New look, same url: ASC.ARMY.MIL

The USAASC website has been reorganized based on user feedback and most viewed pages. On the home page, you'll find career information, news and U.S. Army weapon systems data. Landing pages for civilians, officers and noncommissioned officers (NCOs) have been created to make it easier and faster to locate what you need. Now all of the career information relevant to you is available from a single starting point.

Simple navigation and user-centric career resources
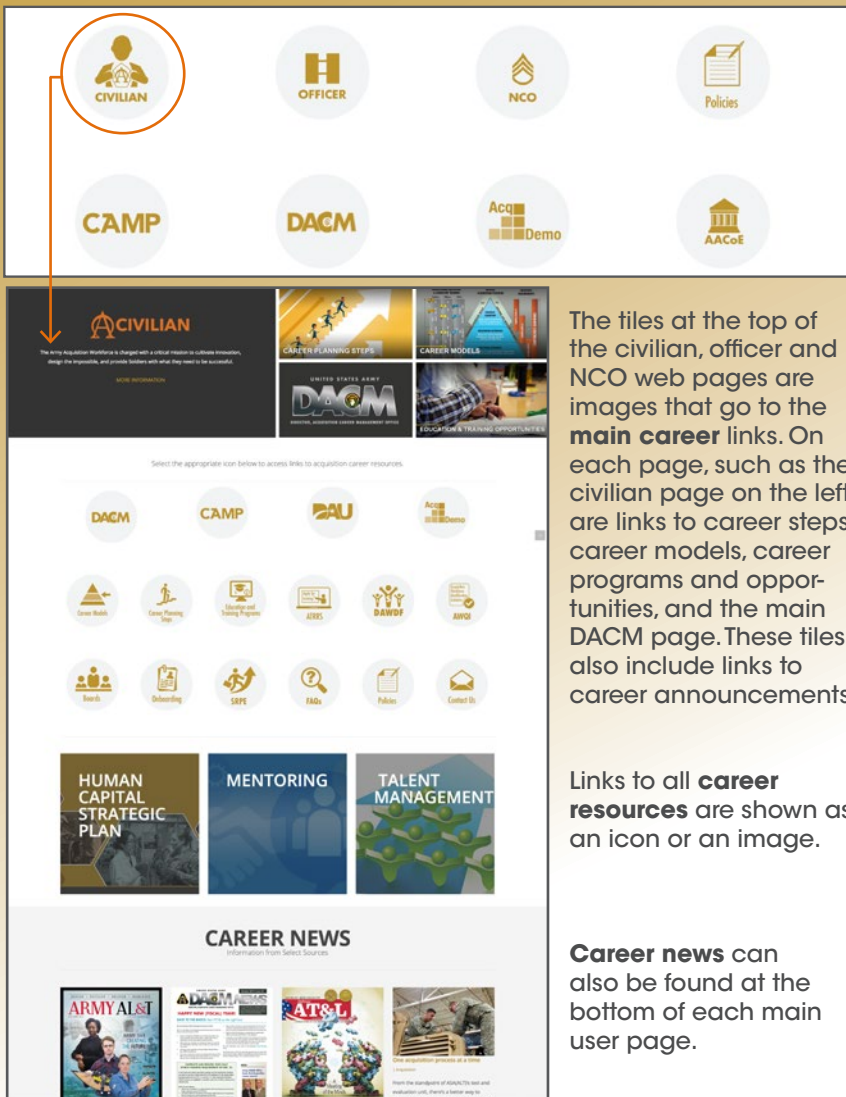
The tiles at the top of the civilian, officer and NCO web pages are images that go to the **main career** links. On each page, such as the civilian page on the left, are links to career steps, career models, career programs and opportunities, and the main DACM page. These tiles also include links to career announcements.

Links to all **career resources** are shown as an icon or an image.

Career news can also be found at the bottom of each main user page.

The search function has been updated. Enter your search terms in the box that appears. Only the USAASC site is searched; results won't include outside links.

Home button

Menu icon opens menu window

About the Army Acquisition Workforce

Under each civilian, officer and NCO main tile is a "MORE INFORMATION" link that will take you to a page that explains who's in the AAW and what the AAW does. This page is also accessible under the About header of the menu.

Policies and FAQs have their own search

The dedicated search function for these pages quickly direct users to polices and FAQs. Click on the headers underneath the search function to reorganize the information on the page.

Print Pages

New policies, new blog articles and weapon systems have a print widget like this one that allows the page to be printed, saved as a PDF and emailed.

2018 Army Acquisition Awards

SUBMIT YOUR NOMINATIONS NOW!

DEADLINE IS JULY 27

The 2018 Army Acquisition Executive's Excellence in Leadership Awards applaud individuals and teams whose outstanding contributions and achievements merit special recognition. The winners will be announced at the Army Acquisition Awards ceremony later this year. Awards will be presented in the following categories:

INDIVIDUAL AWARDS:

- Acquisition Support Professional of the Year
- Business Operations Professional of the Year
- Defense Export and Cooperation Professional of the Year
- Engineer and System Integrator of the Year
- Logistician of the Year
- Project Management/Project Director Professional of the Year (O-6 Level)
- Product Management/Product Director Professional of the Year (O-5 Level)
- Science and Technology Professional of the Year

TEAM AWARDS:

- Project Management/Project Director Office Team of the Year (O-6 Level)
- Product Management/Product Director Office Team of the Year (O-5 Level)

For more information and to submit nominations, go to
https://asc.army.mil/web/acquisition-awards/

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SAAL-ZA

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BG Anthony Potts
PEO Soldier

Mr. Craig Spisak
Director USAASC

* Deputy for Medical Systems. Receives acquisition oversight but reports to the Surgeon General

"Which fantastical elements invented by Q, Stark, Calvin or Shuri can (and should) be engineered in our real universe, with our real physics, and real flesh-and-blood Soldiers?"

Dr. Elizabeth Mezzacappa
*Human Research Lead,
RDECOM ARDEC's Tactical
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Page 59

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