SEPTEMBER 2016

National DEFENSE

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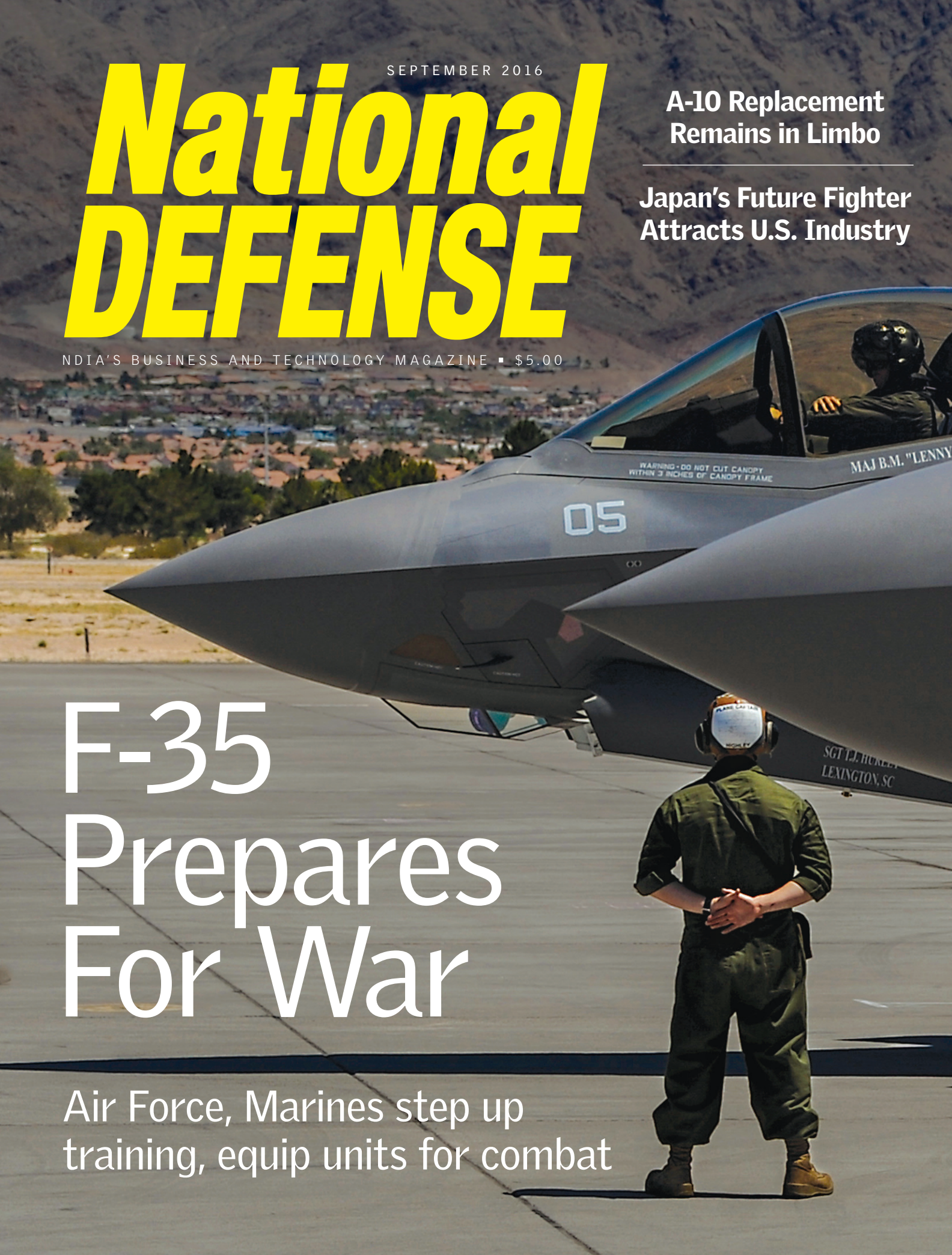
A-10 Replacement Remains in Limbo

Japan's Future Fighter Attracts U.S. Industry



F-35 Prepares For War

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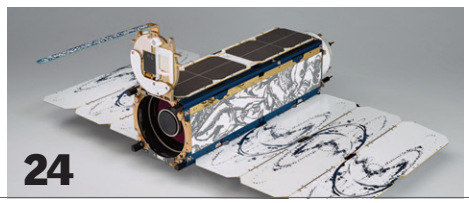

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By Craig R. McKinley

New President to Face Clear-Cut Choices

Labor Day always metaphorically signifies the end of the summer, and in those years divisible by four, it marks the final dash of presidential campaigns to election day. After the conventions of the two major parties in late July, which made Donald Trump the Republican Party nominee and former Secretary of State Hillary Clinton the Democratic Party nominee, the campaigns of the two major presidential contenders will begin in earnest.

Presidential campaigns are a uniquely American experience, one that has grown longer over time, and in the modern era seems to kick off right after the delivery of a new president's inaugural address. But whoever emerges victorious in November will face a number of vexing problems including a federal budget process that has become totally chaotic, federal funding levels for defense that are well below acknowledged requirements and political resistance to taking fundamental steps that would narrow the gap between recognized needs and funding allocations.

To elaborate, the process by which the federal government crafts the annual budget has largely come to a halt. The structured process of budget formulation and preparation, known on Capital Hill as "regular order," has largely vanished. The process by which the budget committees establish allocations, the armed services committees establish authorizations, and the appropriations committees actually appropriate the funds, has completely broken down. It has been replaced by a process where each of these steps has been hijacked by various political groups seeking to add additional complexity to an already complicated process by injecting debates about debt limits and numerous other policy issues. This shift to "irregular order" is what led us to the unfortunate Budget Control Act of 2011, which established discretionary spending caps.

Over the past 200 years, Congress has established a reasonable process for producing a budget, which is one of its most fundamental responsibilities. It founded several offices to assist with the details of budget formulation and to provide reasoned, non-partisan advice. It has established a schedule ending Oct. 1, which allows more than enough time to finish the task. Congress just needs to respect and follow its own process. This will have to be addressed by the new chief executive — a role of the president.

On the defense side, while we have committed the armed forces to constant conflict against dangerous non-state actors such as ISIS, and asked them to prepare for possible traditional conflict against a handful of rising powers, we have slowly been eroding their size and readiness levels by underfunding their needs. Under current projections, the amount of money spent on national defense efforts between 2012 and 2021 will be nearly a trillion dollars less than required — $911 billion to be specific, according to the Bipartisan Policy Committee. To accommodate this shortage, our armed forces are getting smaller while the challenges of the strategic environment are getting larger, and such essential items as readiness, maintenance and modernization are eroding.

In the past when we have significantly reduced forces, or reduced their readiness, it was in response to an improved threat environment. Today's reductions are driven by budget decisions that were made despite a deteriorating security climate. This has created an increasingly untenable situation that will have to be addressed by the new commander in chief — a role of the president.

Finally, whenever the Pentagon has proposed steps that would allow it to better bridge the gap between requirements and funding, Congress has declined to give it the necessary authorities. For example, the secretary of defense almost annually requests authority to conduct another round of base realignments and closures, which would build on the cost savings of the five previous rounds. Congress' refusal to authorize further closures and consolidations results in the retention of significant excess infrastructure that the Defense Department does not need, especially as it is mandated to reduce its force structure.

The department maintains a global real-property portfolio of more than 561,000 facilities valued at more than $879 billion, the report said. Getting a handle on what maintenance is needed to cover such a vast amount of holdings has been a problem for budget planners. It is made all the more complicated when they are trying to maintain buildings and property that are unneeded.

In addition, requests by the Pentagon to review and revise the traditional benefits and compensation processes have also been rebuffed. These issues will have to be addressed by the new chief management officer — again, a role of the president.

So the new president, who fills all of these roles, will find all of these issues piled high on the desk in the oval office. The question is: What does he or she do about them?

The late Sen. Warren Rudman, R-N.H., who led one of the early efforts to control federal spending by helping to craft the Gramm-Rudman legislation of the late 1980s, said that a new president comes to office with a finite amount of "political kinetic energy," fueled by the goodwill of the American people who are hoping for good results.

It is important, as Rudman argued, to focus this energy on the key issues and not waste it on secondary or tertiary ones. Many citizens will be eagerly informing the new president on which issues are truly the "key" ones, and many of their arguments will be compelling. But the new president has to realize that the armed forces are struggling under the current budget structure, and that there are clear choices to be made.

Going forward, defense programs have to be funded at the level current requirements demand, necessary cost reduction efforts have to be fully embraced, or the demands placed on the force significantly reduced. Simply put, those are the choices.

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 By Sandra I. Erwin

Acquisition Reforms Reach Critical Overload

House and Senate conferees are in the final stretch of the debate over hundreds of provisions that will end up in the 2017 National Defense Authorization Act.

As lawmakers and staff continue to fine-tune the language, the Pentagon and its contractors are bracing for the coming avalanche of new directives that should affect all aspects of the defense business.

Opinions diverge on whether the volume and pace of regulatory change will benefit the Pentagon and help unclog the much maligned procurement system. There is, however, a growing belief in the defense acquisitions world that reform efforts may have reached a point of diminishing returns as laws and executive rules have piled up over the years.

The new round of procurement and contracting reforms soon to be passed by Congress sets a 2019 deadline for the Pentagon to execute them. Considering that the Defense Department is still processing and putting into effect NDAA reforms dating back to 2012 and 2013, it could take the better part of the next decade to implement the measures that are already in law, let alone the many more that could come in this year's NDAA.

Pentagon officials told me they have no reliable data on how long it takes to carry out NDAA provisions. But they are fairly certain that the regulatory churn in defense contracting has become a full-employment act for government and industry lawyers and consultants.

House Armed Services Committee Chairman Rep. Mac Thornberry, R-Texas, has been an avid proponent of reforms, especially those aimed at accelerating innovation and expediting weapon system developments. He has hinted that next year, his committee would continue the push for reform, taking aim at two major areas: the Pentagon's arcane process for acquiring information technologies and the contracting of services from the private sector. It now appears that factions within the HASC believe the reform output should be slowed down next year to give the Pentagon some breathing room.

The Senate Armed Services Committee has been quiet on the issue, and likely will remain that way until we know who wins the Senate majority in November. The bulk of this year's reforms originated from Chairman Sen. John McCain, R-Ariz., a persistent advocate of overhauling the defense bureaucracy and the procurement system across the board.

If the Senate flips to the Democrats, the SASC would be led by Sen. Jack Reed, D-R.I. Industry insiders speculate Reed would be far less aggressive toward the Pentagon than McCain. Reed's spokesman Chip Unruh said any discussion on that topic now would be premature and far too hypothetical.

One of the problems with procurement legislation is that lawmakers, although well intentioned, do not always understand the issues, said retired Air Force Lt. Gen. Charles "CR" Davis, a former military adviser on acquisition programs. "If you haven't managed programs, it's difficult to write laws that are going to fix anything," Davis said.

A case in point is a litany of laws that has been passed to require the Pentagon to seek technologies from innovative firms and protect manufacturers' intellectual property rights. "No way are you going to fix this issue with additional report language in any authorization bill," said Davis. "Unfortunately, the more this seems to be the pervasive method of thinking, the worse the problem becomes."

From the Defense Department perspective, some laws cause more troubles than they solve, Davis noted. "DoD has to react to every provision. Before you know it, the oversight organizations continue to morph and grow," clogging up the system with more red tape. "People can't attack root causes of problems and are reacting to directives," he said. When Congress passed the Weapons Acquisition Reform Act of 2009, it took the Pentagon two to three years to digest it before it could start implementing clauses.

Government contracting lawyers continue to be astonished by the scope and depth of regulatory change in the defense sector. In addition to NDAA provisions, defense contractors have had to deal with a slew of new executive orders during the Obama administration. Some are labor rules, such as fair-pay and safe-workplace measures that require contractors to disclose violations or risk not getting paid.

The push since 2012 has been to require prime contractors to police subcontractors and enforce compliance of regulations across the entire supply chain. Rules to prevent human trafficking and counterfeit parts put the burden on prime contractors to ensure suppliers follow them. This has alarmed contractors, especially those that have suppliers overseas where it is harder to enforce U.S. laws, said John Chierichella, a partner at Sheppard Mullin's government contracts, investigations and international trade practice.

In the cybersecurity arena, the government keeps changing the rules for monitoring, tracking and reporting cyber attacks, he said. "You have to flow requirements down to subcontractors and report violations." Primes are having difficulties getting their arms around these rules, he added. Some third and fourth-tier suppliers are not dedicated Defense Department suppliers and don't have the means to comply with these complex policies.

In the ever-expanding thicket of regulations, some have legitimate purposes. The U.S. government historically has used contracts as vehicles or instruments of social policies. But Congress and the executive branch also have to weigh the economic costs of imposing more regulations on government contractors, Chierichella suggested. Companies will absorb the added requirements but then turn around and bill those costs back to the customer in the form of higher rates. That may be acceptable to the government but it makes American companies less competitive in the cutthroat global economy. "How much can a contractor afford to actually include in the rate when they bid proposals?" asked Chierichella.

The takeaway: Regulations are necessary to prevent fraud, waste and abuse. But someone at some point needs to weigh the unintended consequences.

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By Stew Magnuson

Chem-Bio Field Suffers a Knowledge Gap

On Aug. 3, helicopters dropped barrels of suspected chlorine gas on the Syrian town of Saraqeb, sending dozens of victims, including women and children, to the hospital.

A half a world away on the same day, the National Defense Industrial Association's chemical, biological and nuclear defense division held a conference at the Aberdeen Proving Grounds in Maryland, co-sponsored by the joint program executive office for chemical and biological defense.

One of the underlying messages at the three-day conference was that the mission to protect warfighters from these two categories of weapons of mass destruction doesn't receive a whole lot of attention in the halls of the Pentagon.

The often repeated joke among troops is that the NBC in nuclear-biological-chemical stands for "nobody cares."

Army Col. Scott Estes, deputy director of the joint requirements office for chemical-biological radiological and nuclear defense, said, "I carry stuff to generals all the time, [and] the first question I get is: 'Why are we doing this?' … And I think, 'Oh no, here we go again.' And this goes all the way up to the three-star level."

Estes was responding to an inquiry from Brig. Gen. William King III, commander of the Army 20th chemical-biological-radiological-nuclear and explosive command, as to why in more than three decades there hasn't been a major live exercise involving the simulated employment of weapons of mass destruction. A new exercise and its subsequent studies could inform the forces of their shortcomings and needs. The last one was the CANE exercises, or Combined Arms in an NBC Environment, where troops participated in full-blown wargames and were called upon to fight during simulated chemical and nuclear attacks. The Pentagon has two studies about CBRN threats in the works, Estes said, but King wondered how effective they would be.

"Yes, to answer your question directly, we are kicking the can to the right," Estes responded. CANE-type exercises are expensive to stage because they involve equipping and training soldiers, Estes said.

"It's not just cost, but it's senior leader bandwidth when right now they are trying to fight these wars ... but I will take things in there that I think are no-brainers — this is easy — first question I get [again] is: 'why are we doing this?'" Estes said.

King responded: "What gave us our 30-year plan was the CANE study. … The environment has dramatically changed. So we have to figure out how to take advantage of someone else's exercise and team with them or realize it's a big bill, but it's worth a 30-year investment if we do it now."

The 1983-1985 CANE exercises included large-scale nuclear-chemical scenarios with friendly and enemy units that lasted up to 96 hours. In some cases, soldiers were expected to carry out tasks in their full protective gear for up to 12 hours. The studies looked at different areas including the effects on infantry platoons, battalions and tank company teams.

The results were not surprising. Fighting on a battlefield contaminated by radiation and chemicals resulted in severe command, control and communications issues, large drops in fighting efficiency and the ability to return fire. The exercises resulted in numerous academic papers.

King's assertion that a lot has changed since then is, of course, true in many regards. Generations of leaders have cycled through the services since the CANE exercises were completed. The Army doesn't fight the same way it did in the Cold War era. One example King mentioned is how special operations forces are now fully integrated into missions.

And then there is the equipment. JPO-Chem-Bio has fielded an entirely new protective ensemble since then, and is about to embark on an effort to field a new one. The sensors it uses to detect threats have improved exponentially since 1985.

The world of command, control and communications is radically different, with new software defined radios coming online and cyber defense to keep in mind. How will personnel operate these delicate systems while wearing full protective gear?

There are entirely new platforms that didn't exist in 1985 such as Strykers, the Gray Eagle and smaller unmanned aircraft, plus a major new one to be fielded soon, the joint light tactical vehicle. For many speakers and participants at the conference, the signs of an impending WMD attack on U.S. forces are everywhere.

Army Lt. Gen. Thomas Spoehr, who retired the week of the conference after spending almost his entire career in the chem-bio protection field, said there have been 25 chemical incidents in Syria and Iraq since 2013. The chlorine being used today is newly manufactured and is not derived from old chemical weapon stocks. Intelligence indicates the Islamic State is working on manufacturing its own mustard gas.

"If they can gain an advantage, they will use them," he said.

Chemical weapons are dispersed in a relatively small area and are employed today primarily as a weapon of terror, although the CANE studies showed how effective they can be in slowing down a large army.

Nuclear and biological weapons are a whole different ballgame, with their employment potentially much more devastating and affecting wider areas. The Ebola crisis — while a natural phenomenon — is a good example of how catastrophic a biological threat can be.

Chemical, biological and radiation threats are lumped together but they are very different weapons requiring different kinds of protection, sensors, prophylactic and therapeutic medicines and decontamination technologies.

JPO-Chem Bio leaders report that they have good support on Capitol Hill. They have a few strong advocates there who understand the threat and have kept budget levels even as other programs have taken funding hits. A champion is now needed to find the money for a new series of CANE studies.

Hopefully, it won't take a chem-bio attack on U.S. forces to change "nobody cares" to "everybody suddenly cares."

Email your comments to smagnuson@ndia.org

Ethics Corner By Anne R. Harris

Balancing the Rules for Gifts, Hospitality

"OK, team, it's our first trip to visit the new customer in Asia. I read that in their culture, you're expected to show up with a gift. We need to decide what to give them and it has to be really special; I mean, this contract is worth millions and this is our chance to show them how much it means to us. Oh, by the way, Bob, are you coming to the game tonight with us? We're going to be in the consultants' skybox!"

This is a common scenario in many big businesses. Somewhere in the code of ethics and conduct of nearly every government contractor is a commitment to conduct business with integrity, compete fairly based on the merits of its products and services, and comply with all applicable laws and regulations.

Managing ethics and compliance issues around gifts and hospitality, however, is challenging. After all, business is conducted between people. Good working relationships are built on communications, which lead to understanding and successful execution, which in turn lead to trust. And in the interest of promoting positive relationships, it is customary for people to offer and receive gifts and hospitality.

There are numerous and complex rules and regulations pertaining to gifts and hospitality. They exist in the interest of fair competition and process integrity, but create a compliance landscape that can be tricky to navigate. Contractors need to be particularly mindful of the ethics rules affecting their relationships with U.S. government employees. In the international arena, there is an increasingly dense web of anti-bribery and corruption laws, as well as an environment in which cultural norms can cause confusion and concern.

The challenge for contractors is to adopt processes that allow them to cultivate business relationships for success, while also protecting the company by facilitating ethical conduct and compliance. A solid approach to gifts and hospitality management should include, at a minimum:

- Clear and understandable policies and procedures with as little ambiguity as possible;
- Guidelines for interactions with all business contacts, including commercial contacts, as well as those representing the U.S. government or other governments;
- Scenarios with situations typical to the business to guide employee understanding of what is and is not generally acceptable;
- Defined value thresholds, above which approval is required;
- Documented approval processes for items that exceed thresholds or require determinations of "reasonableness";
- Information on whom to contact for questions or approval and how to reach them promptly;
- A gift log of items offered and received and;
- Procedures to audit, monitor and track travel and expense records, as well as gifts and hospitality.

At Mission Essential Personnel LLC, gifts and hospitality policies are practical, reasonable and user-friendly. Mission Essential provides training not only on policy and guidelines, but also on the reasons behind them. Rather than publish rigid lists of prohibitions, they believe in treating employees like professionals, giving them responsibility and empowering them to make good decisions on a daily basis that support their functions.

According to John Lossing, senior director of compliance, it's critical that the ethics and compliance offices cultivate a relationship of trust and encourage open communication. Then if an employee encounters a unique and difficult situation, they will call to seek guidance. "Together, we can reach a decision that will align with the company's goals and objectives, but not cross lines we would want to avoid," he said.

"Most people want to make ethical decisions and do the right thing. But they may not know, in a specific circumstance, what is right. We need to give our employees tools and support to help them make good decisions," Lossing said.

Honeywell has developed a gifts and hospitality application available on smartphones to support over 120,000 employees in 70 countries. Farzaneh Paslar, general counsel of international transactions and compliance, led the initiative to develop the Honeywell G&H App, which is also web-based, using critical input from business leaders, sales and business development staff worldwide to ensure they captured their customers' feedback to make the process user friendly and efficient.

Using Honeywell's G&H App on a smartphone, laptop or iPad, an employee anywhere in the world can access user-friendly and current policies in their own language and submit requests for gifts and hospitality real time. If the request is compliant with Honeywell policies, the app will approve and archive the request. If the request exceeds the threshold in the policy, the app automatically emails the regional integrity and compliance director, who contacts the employee within 24 to 48 hours to support the request.

The G&H App is simple and intuitive to use. It even incorporates an automatic currency conversion function to make it easier for employees to submit requests without worrying about converting foreign currency to U.S. dollars. Another powerful feature is its archive of all requests, enabling data analytics for visibility into gifts, hospitality activity and spending across regions and business areas.

Paslar said the G&H app allows employees to comply with internal policies and support their customers without delay. It enables our employees to make "fast and right decisions that are fully compliant."

Contractors need to guide and support employees to make good ethical decisions and avoid conduct that could create a perception of unfairness. Every company's approach to gifts and hospitality management should be tailored to their needs and culture. But every approach should aim at balancing requirements for ethics and compliance with the recognition that the cultivation of positive relationships between people is what makes business succeed.

Anne R. Harris is principal of Ethics Works LLC, an ethics and compliance consultancy. She formerly served as chief ethics officer for General Dynamics Corp. Contact her at anne.harris@ethicsworks.com.

By Kerry Shannon Burke and Matthew C. Franker

Cybersecurity a Risk for Boards of Directors

Reports and survey data clearly indicate that cyber attacks on businesses are pervasive and growing rapidly. Various reports estimated the annual cost of cyber crime in 2015 at $400 billion to $500 billion, an amount that quadrupled since 2013 and that is forecast to quadruple again by the end of the decade.

Although this trend should be alarming for all companies, cybersecurity is particularly important for companies in the defense industry, which face significant regulation and reporting requirements with respect to their government contracts and heightened risk of sophisticated attack from hostile governments and non-state actors due to the highly sensitive nature of some of their programs.

In addition to posing fundamental business, security, contracting and reputational issues, cybersecurity presents a governance challenge for boards of directors. However, boards can take practical steps to reduce the possibility of a catastrophic cyber attack and defend their conduct in the wake of an event.

The best-designed network security plan in the world will be as ineffective as the compromised system on which it is saved if the board of directors is not committed to developing a corporate culture that takes cybersecurity seriously. This process does not require that directors become technical experts on such threats, but rather that the board emphasize and cultivate a culture of awareness and accountability throughout the organization. Steps that boards can take in this regard including the following:

- Ensure that cybersecurity is addressed by the board committee charged with risk oversight;
- Emphasize that responsibility for compliance with the cybersecurity plan and achievement of plan objectives is not a task for the information technology function, but instead an obligation that transcends the company's reporting structure;
- Mandate a company-wide cybersecurity training program and instruct management to review and update existing training programs to address new threats;
- Develop procedures to provide for timely internal reporting of cyber breaches and the discovery of new risks;
- Incorporate cybersecurity objectives into the incentive compensation structure for the CEO and other senior managers;
- Include cybersecurity oversight in director education programming and;
- Include experience managing cyber risks in director recruitment and in the board's evaluation of the skill set of the board as a whole.

As cybersecurity has risen to become one of the most significant enterprise-wide issues facing companies, it has become clear that strong corporate governance requires that boards of directors actively engage on this issue. Without board leadership, a company's cyber defenses may languish and its response to material cyber incidents is likely to be haphazard. Over time, this approach increases the risk of a significant loss that would harm shareholder value and expose directors to shareholder litigation — and the prospect of personal liability for directors.

Corporate directors generally owe their companies duties of good faith, care and loyalty. These duties encompass the board's responsibility for risk oversight — the obligation to pay sufficient attention to business risks to be capable of acting on them in an informed manner. To protect against claims involving a failure of oversight, the board should consider adopting a reasonable information and reporting system that would include cybersecurity reporting and consciously monitor and oversee its operation.

To address the challenges presented by cybersecurity risks and, in a worst-case scenario assist directors in demonstrating that they have met their fiduciary duties, boards should be actively engaged in the development and oversight of companies' cybersecurity strategy.

Such engagement should direct the design of a robust corporate cybersecurity plan that is tailored to the company's business, industry and risk profile. It should also evaluate implementation and make adjustments to the plan as necessary to close any disconnect between the plan and the company's actual practice. It should ensure allocation of sufficient resources to implement the cybersecurity plan and reevaluate existing controls to determine how they are affected by cyber issues and any new or amended plan that the company adopts.

The board should monitor cybersecurity threats and the effectiveness of the company's plan, including timely identification, assessment and response to compliance challenges, plan deficiencies and the emergence of new risks as well as regularly dedicate board and committee meeting time to cybersecurity, including presentations from management and outside experts.

They should also consider conducting tabletop exercises with senior management to facilitate incident response planning and management preparedness, and consider whether to obtain or maintain insurance for cyber events.

Boards potentially can reduce the risk of post-breach investigations and litigation by maintaining robust documentation of cybersecurity oversight. In addition, companies' disclosures should address this focus on cybersecurity, while emphasizing that significant risks nonetheless remain.

Boards should consider documenting their activities by identifying board and committee responsibility for cybersecurity as a component of the risk oversight function in corporate governance principles and committee charters.

They should retain board and committee presentations and reports relating to cybersecurity and document discussions in meeting minutes, and ensure that appropriate due diligence is conducted and reflected in reports for potential acquisition candidates, and that cybersecurity integration steps are documented for completed acquisitions.

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By Jon Harper

The Obama administration discusses the New START Treaty in 2010.

Nuclear Modernization May Be Scaled Back

The Pentagon has ambitious nuclear modernization plans, but President Barack Obama could downsize them in the final months of his administration.

In order to push the New START arms control treaty with Russia through Congress in 2010, the commander in chief promised to modernize the nation's nuclear arsenal in conjunction with efforts to shrink the total size of the force.

The Pentagon has estimated that procuring new intercontinental ballistic missiles, long-range bombers, ballistic missile submarines and other nuclear assets will cost $350 billion to $450 billion over the next 20 years. The Air Force recently solicited requests for proposals from industry for the new ground-based strategic deterrent and the long-range standoff weapon cruise missile.

"It is a simple fact that the modernization plan was put together in a different budget environment," Deputy National Security Adviser for Strategic Communications Ben Rhodes, one of Obama's closest aides, said at a recent conference hosted by the Arms Control Association.

"The modernization budget will force difficult trade-offs in the coming decades," he added. "The president will continue to review these plans as he considers how he wants to hand the baton off to his successor."

Rhodes acknowledged that major nuclear spending would still be needed.

"There's going to have to be a significant investment in that," he said. "The question presented is simply whether or not the scale of the plan fits into the long-term budgetary picture, [and] what trade-offs would that force on future administrations, including on important conventional capabilities?"

Rhodes' comments raised alarm bells among Republicans on Capitol Hill, prompting Sen. John McCain, R-Ariz., the chairman of the Senate Armed Services Committee, and Sen. Bob Corker, R-Tenn., the chairman of the Senate Foreign Relations Committee, to write a pointed letter to Obama.

"We write to share our concern with efforts that may be underway in the closing days of your administration to abandon commitments you personally made to the Senate," they said in the letter.

Obama's promises to modernize the arsenal across the board were "instrumental" in lawmakers' decisions to support the New START treaty, they said.

Scaling back the plans would be contrary to "military necessity," they argued.

The senators noted expected shortfalls in nuclear modernization funding in the out-years. "We are committed to working with you to remedy these shortfalls," they said.

Nuclear funding dilemmas will continue to plague future administrations as well as Congress, analysts said.

"Regardless of what happens during the remainder of the Obama administration, the next president will likely be faced with a number of increasingly urgent questions about America's nuclear modernization project, including its affordability, opportunity costs, impacts on global stability and more," said Kingston Reif, director for disarmament and threat reduction policy at the Arms Control Association.

The Defense Department is facing a modernization bow wave in the 2020s. If the budgetary environment doesn't improve before then, officials will have to make "very difficult trade-offs" when it comes to allocating funding between conventional and strategic weapons systems, said Mark Cancian, a senior adviser at the Center for Strategic and International Studies.

"When those trade-offs start to become apparent, you're going to see a lot more discussion about options on the nuclear programs," he said. "So far [those nuclear plans] haven't made that many fiscal demands."

WHITE HOUSE

NASA Funding Trends Bode Well for Industry

■ Funding for NASA is likely to remain strong, with major implications for the aerospace and defense industry, a recent report by analytics firm Govini found.

Spending on the agency's top five product and service categories increased by 78 percent between fiscal years 2012 and 2015, according to the report, "The 2016 Federal Scorecard: National Aeronautics and Space Administration."

"NASA partners with some of the largest aerospace and defense contractors to develop and implement cutting-edge technologies critical to the advancement of the U.S. defense industrial base," it noted.

Market analysis indicates that agency spending is on track to grow again in fiscal year 2016 after increasing 8 percent in 2015, the report said.

NASA's ability to produce advanced aeronautics and space technologies would make it an optimal partner for the Pentagon as it pursues the so-called third offset strategy, the report said. The strategy is designed to enable the U.S. military to acquire cutting-edge capabilities to maintain its advantage over sophisticated adversaries.

NASA's annual budget authority for its top accounts is expected to be between $10 billion and $15 billion through fiscal year 2021, the report said.

The space agency's R&D efforts could aid the Defense Department and its modernization programs.

"Contractors seeking to benefit from the monumental modernization effort would also benefit from strengthening its ties to NASA programs, particularly early-stage research," the report said.

Space agency spending "will continue to rise and then will stabilize at higher levels as the agency transitions existing research-and-development efforts to fully functioning space vehicles, propulsion technologies and other deep space capabilities," it said.

Boeing and Lockheed Martin "have a lock on funds" budgeted for space exploration through their multi-year development programs, it said. The companies drew $2.5 billion and $2.1 billion in revenue, respectively, from NASA for exploration technologies between fiscal years 2012 and 2015, according to the report.

CalTech, Russian space agency Roscosmos, SpaceX, Orbital ATK and United Launch Alliance also have captured a large percentage of NASA science and space technology funds, it said.

Investments in advanced exploration systems that are expected to eventually bring astronauts to Mars, will lead to further increases in spending in fiscal year 2019, analysts predicted.

The prioritization of these efforts "will further entrench Boeing and Lockheed's competitive position at NASA," the report said.

Their dominant role in NASA exploration programs gives them a competitive advantage when those technologies are adapted for military use, it said. But "significant opportunity exists for others capable of maturing and transitioning technology from the private sector or in the incubation phase at research-and-development centers."

ARMY

Troop Level Decision Adds to Fiscal Burden

■ President Barack Obama's decision to keep more troops in Afghanistan longer than previously planned could come with a hefty price tag and lead to another budget battle with lawmakers.

The commander in chief abandoned his plans to cut U.S. troop levels in Afghanistan to 5,500 by the end of this year. Instead, he will keep 8,400 there into 2017 to train and assist Afghan government forces, and conduct counterterrorism missions.

"The security situation in Afghanistan remains precarious," he said in July when he announced his decision.

Obama's move may require a significant amount of additional funding.

The marginal cost of deploying troops in Afghanistan has averaged about $1.2 million per year per service member, according to Todd Harrison, director of defense budget analysis at the Center for Strategic and International Studies. If that trend continues, keeping an additional 2,900 troops there through fiscal year 2017 should cost about $3.5 billion, he said in an email.

Before Obama revised his plans, his administration requested $59 billion for overseas contingency operations funding in fiscal year 2017.

"His budget does not have room for the troops he is committing," House Armed Services Committee Chairman Rep. Mac Thornberry, R-Texas, said in a press release after Obama unveiled his decision.

"The White House must submit a supplemental funding request to accommodate troop levels in Afghanistan immediately," he said.

Harrison said there is "a good chance" that Obama will submit one in the coming months.

A spokesperson for the White House Office of Management and Budget said the Obama administration is assessing the cost of the additional troops.

"Together with the Department of Defense, we are actively looking at funding needs related to the revised force posture," the spokesperson said in a statement provided to National Defense. "In the coming months and into the fall, we will work with Congress to ensure the necessary funds are available."

A decision to submit a supplemental funding request — which, as of press time, has yet to be made — would be "consistent with the Bipartisan Budget Act of 2015 by adhering to the principle that any increase in [federal] funding must be shared equally between defense and non-defense" agencies, the spokesperson added.

The White House's position could lead to another political standoff with Republicans who are looking to beef up the Pentagon's budget without giving more money to other departments.

Email comments to jharper@ndia.org

Southcom Partnering Up to Combat Threats

U.S. Southern Command is developing new networks in an effort to combat illicit activity in its area of responsibility, its commander said recently.

Southcom Commander Adm. Kurt Tidd announced that the combatant command — which covers Central and South America and the Caribbean — recently invited its regional partner-nation liaison officers to participate in weekly intelligence briefings. He called the development "a major first," as the meetings were historically closed to foreign officers — even those serving at Southcom's headquarters, he said during remarks at the Atlantic Council, a Washington, D.C.-based think tank.

The invitation recognizes that more cooperation is needed across borders to address new and existing transnational threats, he said.

"I've asked that we do a better job of empowering our team, including our partner-nation liaison officers, with knowledge … that when applied in a cohesive manner, will make us all more effective in defending our shared home," he said.

The multinational exercise Panamax — which tests regional forces' collective ability to defend the Panama Canal — ran July 25 through Aug. 4 in Florida and was seen as a way to improve interoperability among partner states, Tidd said. For the first time, all of the forces were led by Chile, Colombia, Peru and Brazil, instead of the United States.

Southcom is also exploring ways to share access to cutting-edge research, new technologies and health system capabilities with its partner states "to ensure every partner can detect, prevent and respond" to regional health epidemics, natural disasters or conflict, Tidd said.

The effort to share more information and create cross-functional teams is "especially critical because regional teams are no longer solely combating illegal drug, weapon and human trafficking, but must confront the networks behind the criminal activity," he said.

"We talk a lot about dismantling networks, but we almost never talk about building our own," he said. "When it comes to addressing those threats and challenges, we're proud to say that we, too, have a network for that."

Meanwhile, Southcom is monitoring the growing influence of Islamic extremism across the globe.

"Radicalization is occurring," Tidd said. The Islamic State has attracted between 100 and 150 recruits from Latin America, he said. "We just have to recognize that this theater is a very attractive target, and is an attractive pathway that we have to pay attention to."

Tidd also challenged the notion that external actors like China, Russia or Iran don't pose a significant threat to the United States' near-term interests in Latin America.

"What happens in Latin America or the Caribbean can't be divorced from what's happening in the rest of the world," he said. "It is important that we closely scrutinize and clearly understand the activities of these actors in the Western Hemisphere."

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DEFENSE DEPT.

Training Program Merges Air-to-Ground Comms

■ Cubic Global Defense — a developer of virtual, game-based military training systems — has integrated air and ground communication technology into one cohesive training program, a company executive said.

Cubic combined existing air combat maneuvering instrumentation with communications systems on the ground, establishing new channels of contact for airmen and infantry, said Tim Loy, program manager for the company's Canada air ranges program. "It's been an exciting process."

Cubic, along with Mirabel Aerospace Centre — which is based in Canada — adapted its current operational flight program with modifications that allow air-to-air signals to simultaneously transmit to forces on the ground.

By having an integrated air-to-ground communication system, soldiers in vehicles and on foot are able to relay positions, real-time kill notifications and weapon delivery with unprecedented accuracy, Loy said.

"Transmitting signals around weapon delivery means that we can see where and when we dropped a bomb and the effects of that action as well," he added. "We can look at the system and verify who is in the area at the point of weapon impact and say, 'These people are now killed or disabled.'"

The system was tested during Exercise Maple Resolve — a collaborative training program that brought together over 6,000 Canadian troops, 1,200 American soldiers and roughly 150 members of the British military. Training took place at Canadian Forces Base Wainwright in Alberta, Canada, from May 23 to June 6.

"It's essentially a force-on-force exercise with tanks and guys on the ground using weapons effect simulation systems," Loy said. "Basically a sort of laser tag for people on the ground with our ACMI system incorporated into the mix."

Before this integration, both ground and air forces trained separately, losing valuable information about how actions in the air affected boots on the ground. With ACMI now working hand-in-hand with the Canadian weapon effect simulation, Loy is hopeful that situational awareness for both pilots and infantry will be that much stronger.

"We are now able to see the full picture — where the bad guys were and where the friendlies were at the time of an attack," Loy said.

ACMI integration is "a baby step" for Cubic's goals, he added. The company plans to take lessons learned from Maple Resolve and apply it to other training programs, such as its P5 combat training system/tactical combat training system that the United States and its allies employ.

The U.S. Marine Corps has recently shown interest in adapting the program to its own training. "We need to get the program out there," Loy said. "This is just the beginning of what we hope to accomplish."

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DEFENSE DEPT.

ONR Chief: Inefficiency in Tech Development a Concern

■ As the Pentagon looks for new ways to maintain its technological advantage over adversaries, potential duplication of efforts worries the chief of naval research.

"What keeps me up at night? Inefficiency," said Rear Adm. Mat Winter in July.

Maintaining close partnerships with other military organizations is key to preventing this overlap, he said recently during remarks at the Center for Strategic and International Studies, a Washington, D.C.-based think tank.

The Office of Naval Research — which has an annual budget of about $2.1 billion — is working closely with the Defense Department's strategic capabilities office led by William Roper, he noted.

"We look at where our intersections lie in understanding the opportunities for his mission success and our mission success. His focus is department-wide, not just naval or Marine Corps applications," Winter said.

ONR also intends to partner with the Pentagon's Defense Innovation Unit-Experimental. The office — with hubs in Silicon Valley and a newly opened facility in Boston — is meant to facilitate communication between the Defense Department and non-traditional technology companies.

During a recent meeting with Raj Shah, the director of DIUx, Winter told him "we want to be a provider, a performer for DIUx. But we also want to be selfish and ask … [DIUx] to be a performer for us."

The organization has fostered relationships with companies that typically do not work with the Pentagon, Winter said. Such partnerships help the government crack some of its toughest technological nuts. ONR can leverage those new ties for its own programs, he added.

Meanwhile, Winter said it is critical that when looking for cutting-edge technology that researchers and engineers think about the "business of science," he said. ONR doesn't invest in new weapons because they are "cool," but rather because they enable war fighters to complete their missions safely.

"You got to make sure you've got a foundation of effective and efficient business of science," he said. "That means when the cool science is happening, when it hits the belt sander of contracting or funding types … [that we] look at the business of science as much as the science of science.

"Sometimes I get accused of making ONR more business focused than it should be — I'm not here to make this a business," he said. "But I'm here to say that if we don't … use some of the innovative models that corporate America uses then we're not using every tool in our tool box."

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Company Offers Light Carbon Fiber Gun Barrels

As carbon fiber technology becomes increasingly popular for the construction of small arms, industry executives continue to push the envelope when using the material for weapon development.

Proof Research, a firearm developer based in Columbia Falls, Montana, has produced carbon fiber-wrapped barrels to improve accuracy, durability and barrel-longevity. The switch from traditional steel barrels to the carbon fiber-wrapped version reduces the weight of the rifle, allowing soldiers to hit targets with more precision for a longer period, according to Chad VanBrunt, a weapons engineer at the company.

The design is 64 percent lighter than traditional steel barrels, and has improved heat dissipation for cooler and longer lasting barrels and reduced vibration, according to the company's website.

"Our design methodology ensures the stress state of the barrel is consistent through varying temperature ranges," VanBrunt said. "With the carbon fiber technology you get weight savings without losing performance."

The company used customer research to determine what type of barrel development would interest users.

"Carbon fiber technology has been around for a while … but we feel we have a real differentiator and advantage over other products in the market," VanBrunt said. "We have a lot of design flexibility with composite materials, so whether you want a barrel optimized for stiffness versus one to resist pressure, we're able to do it."

The company's products are created with a variety of consumer bases in mind, including defense, aerospace and hunters. But the materials and development used across the board include similar carbon fiber applications.

The company adjusts individual aspects of its barrels to fit customer needs, but the construction and design doesn't change much from project to project, VanBrunt said. "We appeal to hunters, competitive shooters and the military segment because of the barrel's appeal on all characteristics."

"We have no scaling limitations with the carbon fiber barrel," VanBrunt said. "We keep working toward the possibility of eventually having the barrels installed in tanks, airframes and cruiser weapons."

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Raytheon Australia to Develop New Test Range

The Australian government has committed to building a new military testing ground at the largest such land-based facility in the world.

Raytheon Australia was awarded a $219 million contract to develop an advanced weapons test range at the Royal Australian Air Force Woomera Range Complex, according to a June press release.

The announcement came on the heels of a long-awaited defense white paper and an integrated investment program released by the Australian government, said Charles Forrester, a senior defense analyst with IHS Jane's.

"The government said it was looking at increasing the [Woomera] site's capabilities in electronic warfare testing and development, as well as its capabilities for air weapons testing and evaluation," he said. The Australian government has said it plans to invest between $365 million and $560 million to upgrade the test range between 2018 and 2026, he said.

Woomera covers about 47,000 square miles in South Australia near Adelaide, according to Raytheon Australia. It has been used as a test area for rocket systems, air-launched weapons, space monitoring and training, Forrester said.

The contract reflects the Australian government's renewed commitment to defense upgrades after being hampered in recent years by both program and government delays in committing to new procurement, he said.

"The trend since 2001 has been joint operability, and working with the United States in particular," he said. "But they want to get some sovereign capability rather than rely on partners to do it."

Australian Prime Minister Malcolm Turnbull emphasized the commitment to invest domestically in its defense industry during a visit to Raytheon Australia's new naval and integration headquarters in Adelaide, according to the press release.

Australia must ensure that it creates "economic growth here at home," Turnbull said. There needs to be investment in new technology and developing a highly skilled workforce, he added.

Australia has several major procurements on the horizon, Forrester said, including electronic warfare systems such as the Gulfstream G550 signals intelligence aircraft currently on order, and 12 Boeing EA-18G Growler aircraft to be delivered in 2017. Procurement of Northrop Grumman's MQ-4C Triton unmanned surveillance and patrol aircraft system has also been confirmed, he said.

BAE Systems, Italy-based group Fincantieri and Spain-based group Navantia are competing to build nine new ships for Australia's SEA 5000 future frigate program. French firm DCNS recently won a contract to replace Australia's Collins-class submarines with its Shortfin Barracuda nuclear attack submarine. Australia has also committed to purchasing Lockheed Martin's F-35A joint strike fighter.

The government has set a target to allocate 2 percent of its annual GDP to defense spending, which Forrester said they should achieve by 2021.

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Spider Silk Fibers Could Strengthen Soldier Garments

Genetically modified silkworms could be the key to creating lightweight, flexible and strong fabrics for protective garments worn by soldiers, said one company executive.

Kraig Biocraft Laboratories, which is based in Ann Arbor, Michigan, has taken ordinary silkworms and genetically modified them to produce strong and flexible spider silk, said Jon Rice, the company's chief operations officer.

"The premise is pretty simple — silkworms make silk, right? They've been doing it for thousands of years," he said. If the worms could produce spider silk — which is one of the toughest natural fibers in existence — that could open up a slew of opportunities in the manufacturing of textiles, Rice said.

Despite being "promptly laughed out of every scientific room [and by] every venture capitalist saying, 'This idea could never be,'" researchers at the company teamed up with the University of Notre Dame to create a "recipe" for a spider silk protein, he said.

"We've created this recipe, this package, this instruction manual that takes the recipe for spider silk and introduces it into the silkworm," he said. "The silkworms remember that recipe generation upon generation. So we essentially have a brand new genetic line of silkworm that now produces this high-strength, high elasticity fiber."

Spider silks can come in nearly endless configurations, Rice said. There are hundreds of thousands of species of spiders, each with their own special silk attributes. Additionally, each species produces eight different types of silks. That includes "everything from the sticky silk that holds prey in their web to the supporting strands that hold their webs together," he said.

The company's best performing genetic line is known as Dragon Silk. The fiber is 10 times more elastic and has about two-thirds the strength of current material used in bulletproof vests, he said. That combination makes the fiber tougher, he added.

Kraig Biocraft was recently awarded its first U.S. military contract with the Army to produce Dragon Silk for ballistic shoot packs, which are layers of fabric that can be sewn into protective garments such as bulletproof vests.

"Under the first phase of the project … we're producing about 15 kilograms of our strongest, most elastic material to date," Rice said. "We'll provide a variety of thicknesses and a variety of layers so they can test to see how well this material performs in critical protective applications."

The contract has a total value of $1 million if an option phase is awarded. The base effort is funded at about $100,000 and lasts 10 months, Rice said. Genetic modification allows Kraig Biocraft to tailor its product to the Army's needs, he said.

"If they find out, 'Hey, this is a really neat material but we'd like it to be a little bit less elastic and a little bit stronger,' we can go in and make those modifications," he said.

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KRAIG BIOCRAFT

Foreign Military Sales: Reforms Needed

Congressional Perspective

By Rep. Vicky Hartzler

At a recent training event for fighter pilots at Nevada's Nellis Air Force Base, aircraft from several North Atlantic Treaty Organization countries engaged in aerial combat exercises in difficult conditions akin to what they experience while deployed over countries like Afghanistan and Syria. Through exercises like Nellis' Red Flag, pilots, maintenance crews, intelligence officers and other personnel strengthen military coalitions by improving communications and building trust based on shared experiences and capabilities.

At recent Red Flag events, the Royal Norwegian Air Force brought 10 F-16 Fighting Falcon jets and two C-130J Hercules cargo planes and the Royal Australian Air Force deployed 400 personnel and 14 aircraft, including a C-17 cargo plane and F/A-18 strike fighters. All of these aircraft are flown by the U.S. military and by other allies and security partners around the world.

These exercises are all the more effective when allies are using the same aircraft, weapons and other equipment, allowing them to become what, in military parlance, is called "interoperable" — effectiveness that is replicated when these same forces are called to fight together.

For example, personnel from the United Kingdom have worked alongside U.S. Navy crews in "Operation Seedcorn" to become proficient in the P-8 maritime surveillance aircraft. With the recent announcement that the United Kingdom will buy several P-8s, these personnel will now be able to effectively operate their own aircraft — sometimes in conjunction with the U.S. Navy — in operations to protect the North Sea from Russian encroachment or anywhere else maritime surveillance capabilities are needed.

Norway, Australia and the United Kingdom acquired these American-made aircraft through the Foreign Military Sales (FMS) process administered by the Departments of State, Defense and Commerce. These multinational exercises and operations truly underscore the value of FMS as a critical component of U.S. national security. This value is demonstrated every year in exercises and operations around the world.

Allowing the opportunity for our allies to buy U.S. defense products — and thus more effectively train and deploy together — solidifies relationships between our military forces. And in those nuanced interactions, trust is key. The underlying level of trust between two countries is a great indicator of future success in that relationship.

By allowing certain countries to purchase some of the most advanced systems in our military inventory — systems used by our own men and women in uniform — the United States is signaling a high degree of confidence in those nations as allies and as future coalition partners. With proper vetting, we trust that a foreign customer will use our technology as they say they will and protect that technology from being misused or acquired by other countries that do not have America's best interests at heart.

In turn, a foreign customer places trust in the United States as the military supplier of choice. Our soldiers, sailors, airmen and Marines defend American freedom and democracy around the world, deployed with products from the U.S. defense industrial base and the assurance they have the best of the best in that fight. It is that superiority that other countries seek, as they trust American standards of excellence.

Not only do other countries look to our manufacturers for reliable and effective defense equipment for their armed services, but through the FMS process, they give full authority to U.S. government personnel to purchase those from the defense contractor. Foreign customers authorize the U.S. defense acquisition workforce to spend billions of dollars on their behalf, trusting the professionalism of those contracting officers. DoD trains and certifies its acquisition workforce, and holds those with spending foreign money accountable as they are with U.S. taxpayer dollars.

There are reports, however, suggesting that the FMS process is "obtuse, stovepiped, and prone to delay." Nations seeking to procure defense equipment and services through the FMS process are confronted with an opaque bureaucracy that could take over a year to get on contract, let alone see deployed in theater.

To that end, I led a series of congressional oversight events as chairwoman of the House Armed Services Subcommittee on Oversight and Investigations to identify roadblocks in the FMS process and opportunities for its reform. My colleagues and I are continuing to study areas throughout the process that could be made more efficient and effective. The security of our nation and that of our allies depends on this process.

It is my hope that the reforms I have embarked upon with my colleagues in the House will make an already burdened, but not-yet-broken process more streamlined. Foreign military sales not only make the U.S. military departments an even more effective fighting force, but also make our alliances that much more effective a deterrent to aggressive actions against us. **ND**

Rep. Vicky Hartzler, R-Mo., serves on the House Armed Services, Agriculture and Budget Committees. In the 114th Congress she was named chairwoman of the oversight and investigations subcommittee of the Armed Services Committee to oversee the administration's defense policies.

AIR FORCE, U.S. CONGRESS

New Thinking on Performance-Based Logistics

Industry Perspective

By Kevin Deal

As military equipment becomes more complex and budgets become more scrutinized, defense organizations are looking at ways to not only improve asset availability but reduce operating costs.

Performance-based logistics, or PBL, is now a mandated consideration for major new procurement projects and becoming a serious consideration for maturing defense industries in the BRICS — Brazil, Russia, India, China, South Africa — and Asia-Pacific.

PBL strategies are already in use in commercial aviation, often referred to as "power-by-the-hour." In the defense market, one of the first implementations of PBL dates back to the late 1990s, when the Air Force sought to improve the readiness of the F-117 fighter.

Fast forward to now with the implementation of PBL for the military, where active management of the sustainment process — forecasting demand, maintaining inventory and scheduling repairs — has become the responsibility of the support provider.

This changes the incentives for the supplier. The supplier, with a properly structured PBL program, is encouraged to improve the reliability of systems and reduce inventories of spare parts to meet a guaranteed level of performance.

The question for defense organizations has always been how much do you outsource?

The answer is that each outsourced PBL project should strive to be a "win-win" for both the customer and supplier. This can only happen with personal and institutional confidence between provider and client, and this depends on good management and decision support information.

Intuitively, the military may not want to outsource support capability, but realistically they recognize the benefits of industry involvement.

Contracting out support still leaves the military holding the operational risk. The "burning platform" driving the military toward PBL is largely budgetary. The warfighters are then effectively dependent for their lives on the success of a commercial arrangement some way down the support chain to provide their tools. Without doubt if it goes wrong, their degree of pain is much higher than for one of the industrial partners.

The military clearly needs confidence in the support before it can reasonably be expected to willingly go into harm's way underpinned by a PBL strategy. The key confidence builder is the visibility of information to all in the support chain, so that it is indisputable that all parties in the enterprise are getting what they need from the arrangement. PBLs only have problems when they are built on islands of information. These can then become islands of distrust, and then islands of ineffectiveness. This insular mindset can lead to big cost and, more importantly, big risk.

The ever-growing complexity of equipment is inflating the cost of maintenance, operations and support. And the demand for these shrinking fleets is increasing. In the air environment within defense, there is the added challenge of needing to conform to tight regulation. This means more training, quality assurance requirements and legislative risk for shrinking teams of military maintainers and operators to manage.

The move towards PBL solutions is therefore an inevitable necessity.

PBL has achieved some notable success as a tool for sustaining defense operational capability at a reasonable cost. Recent studies have shown that performance-based arrangements are a strong tool for incentivizing productivity and innovation in both industry and government.

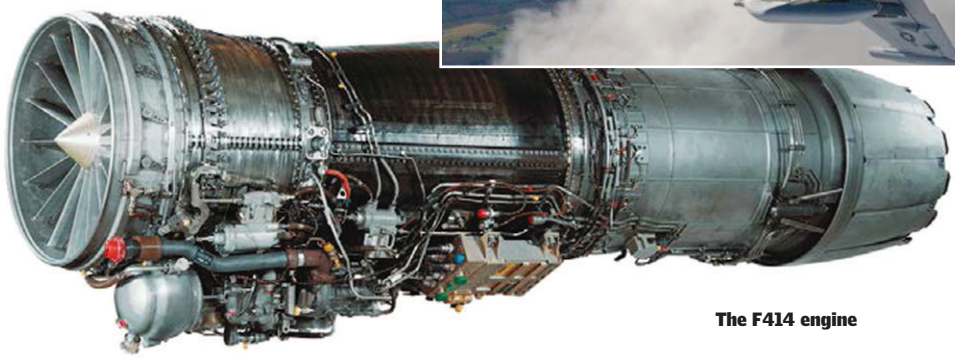
When properly structured and executed, PBL arrangements reduce the services cost per unit-of-performance while simultaneously driving up system, subsystem or component readiness — with an average annual cost saving or avoidance of between 5 percent and 20 percent, according to recent studies.

General Electric's F414 engine has powered the U.S. Navy's F-18s for many years. Now, the F414 enhanced engine is supporting the next generation of combat needs with up to 18 percent more thrust and twice the horsepower of its predecessor. The PBL project for the new enhanced engine, which won the prestigious Secretary of Defense PBL award in 2013, is a collaborative effort between GE Aviation, IFS North America, Sogeti USA and Navy PBL personnel.

The PBL supports more than 1,200 engines in the Navy inventory. It has delivered over $110 million in direct savings to the Navy fleet flying hour program and provided availability levels of over 95 percent, as well as infrastructure cost avoidances. ND

Kevin Deal is vice president of aerospace and defense at IFS North America.

"PBL has achieved some notable success as a tool for sustaining defense operational capability at reasonable cost."



The F414 engine

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Space Systems Enter a Pivotal Moment

Viewpoint

By Dan Hart

This is a pivotal time for the future of our space infrastructure and how it will support activities and missions here on Earth. Our leaders across all facets of the government space enterprise are currently engaged in the process of defining the future of our space-based capability.

Recently a strategy and framework for the future of national security space was rolled out in the form of "The Space Enterprise Vision." From the recognition that space is no longer a safe haven, to revolutionary new technologies, new products and architectures — we are beginning to lay the foundation for a wholesale change across government satellites and systems. When we look back 30 years from now, we will likely recognize this as a pivotal time when key decisions were made that guided the future of our space-enabled mission capabilities.

The U.S. government, with the support of industry, is grappling with a confluence of factors that will drive both future government satellite architectures and acquisition approaches. Space is now a contested environment. Survivability against man-made threats will forevermore be a key requirement that will drive the engineering of our space systems. In addition, with the increasing number of international partnerships and the sophistication and proliferation of commercial satellites, we have begun to reevaluate how we obtain needed capabilities and have opened the door to new procurement options.

Finally, more than ever before, federal budget pressures are driving our government leaders to consider how government agencies can meet their mission needs at a dramatically lower cost.

All of these factors are converging at a time when the United States is about to decide how its next generation of military satellite communications, navigation, missile warning, surveillance and civil programs will be recapitalized moving forward.

How will it all turn out? No one knows for sure; however, based on current trends across the Department of Defense and civil space, here are a few likely scenarios.

First, the Air Force will continue to maintain our navigation system through the evolution of GPS, which has become a critical tool for our military, civil agencies and the global commercial sector. These satellites will continue to be infused with more modern technologies such as flexible, digital-navigation payloads that will allow them to overcome the limitations of the current GPS analog systems. Also, the increased flexibility provided by hosted payloads will augment the system.

> "The use of laser communications will dramatically change the rate at which data is transmitted."

BOEING

On the military strategic satellite front, functions aboard what are currently large, complex and expensive satellites will be separated into smaller mission-specific systems. The tactical missions on satellites like Advanced Extremely High Frequency (AEHF) and Space-Based Infrared System (SBIRS) will be separated and reallocated to achieve greater flexibility, costs savings and resilience. For example, the AEHF satellite system has two functions that can be disaggregated: the nuclear command-and-control function, which allows the U.S. government to command and control its nuclear forces, and the protected tactical communications mission, which provides protected and secure communications capability for troops on the ground. Separating these two functions will result in a simpler, more resilient, and more affordable nuclear command-and-control satellite constellation.

We will see changes to the Wideband Global SATCOM (WGS) system as protected tactical wideband communications become more broadly required. The WGS system will rapidly evolve with modifications to the ground infrastructure to make use of the protected tactical waveform. Adaptive nulling will also be incorporated enabling robust anti-jam and jammer geolocation capabilities. Incremental modifications to the constellation will then be made through modifications to future satellites incorporating additional anti-jam functionality.

The Department of Defense's narrowband communications system, which is currently composed of the Ultra High Frequency Follow-On System and the Mobile User Objective System, will likely evolve into a new architecture made up of satellites capable of communicating with smaller, handheld size terminals as well as using smaller satellites or hosted payloads to augment narrowband service.

At the same time, with the growing sophistication and proliferation of commercial satellites and affordability of bandwidth and drive for resilient architectures,

commercial satellites will continue to satisfy a healthy portion of the department's communication needs through leasing arrangements. Some commercial systems will adopt increased levels of jam resistance and security to provide flexible, ubiquitous communications for Ku- and Ka-band users. Hybrid commercial satellites, similar to what we have today with Inmarsat-5 and Intelsat-29e — both provide some military satellite communications services — will act as a bridge between a military architecture of purpose-built satellites and purely commercial satellite systems.

NASA will begin fielding applications of laser communications in support of data-relay needs for both deep-space and near-Earth systems. The use of laser communications will dramatically change the rate at which data is transmitted and will support the infrastructure that will enable human spaceflight to Mars. Establishment of a NASA lasercom core capability in orbit may spawn offshoots in the commercial satellite communications sector as operators look for higher data rates and alternate spectrum.

Finally, whether it's a navigation, military communications, missile warning, space surveillance, a civil space asset, or any future government system, resilience will be an important factor moving forward for every constellation and all aspects of the ground infrastructure. Effective space protection systems will require a combination of new architectures, technologies, operational techniques and a ground-control architecture to manage an integrated enterprise.

There will not be a single silver bullet that will protect our space infrastructure. There are a wide range of emerging threats that will evolve in the years to come. An effective response will require reassessing the entire space architecture and how the various components are integrated together across government and commercial systems and across domains.

Critical to enabling us to outpace the threat environment will be the ability to increase the velocity at which new systems and technologies are developed, flown and deployed. Agile approaches to both procurement and development must be leveraged to keep government space ahead of the curve.

We live at a time of possibilities, when diverse considerations are competing to define a host of new systems and capabilities and there are a myriad of potential outcomes. What does all this mean for industry?

The past few years have seen commercial-space enterprises pushing industry forward at an aggressive pace, resulting in significant industry investment. Industry has continued to evolve the tools, operating models and products that have created a new generation of high-throughput satellites; a large diversity of spacecraft sizes, orbits and functions; new launch capabilities; and the development of modern, service-oriented ground systems.

These innovations are critical to the commercial sector and will continue to evolve. They have also become available to the government sector at just the right time and will save time and money in satisfying our future government needs. However, to make full use of them we must marry these advances with focused government research-and-development investment to further mission-specific technologies, aggressively pursue prototypes and experiments, and perform flight test programs.

Together we can kick start a rapid, risk-managed period of innovation. We can develop a new, affordable, capable and highly resilient government space infrastructure and satisfy critical mission needs in the years and decades to come. **ND**

Dan Hart is vice president of Boeing Government Satellite Systems.

Aegis Ashore Adapts Sea-Based Missile Defense System to Protect Europe

Viewpoint **By Edward Lundquist**

The U.S. Navy is building on the success of the Aegis Combat System's ballistic missile defense capability — literally — to protect Europe.

Four guided-missile destroyers (DDGs) with the proven Aegis BMD system are now forward deployed to the U.S. 6th Fleet area of operations, as part of the European phased adaptive approach (EPAA). Joining those ships is Aegis Ashore, a land-based version of the same Aegis BMD capability located at Deveselu, Romania. The Deveselu site sits on a former Warsaw Pact airbase.

Aegis Ashore was developed and constructed by a unique government-industry team created to build a shipboard weapon system at a shore facility to meet the EPAA requirements.

EPAA Phase II was declared complete on May 12 when the Deveselu site was operationally certified. A second Aegis Ashore missile defense system will be located in Redzikowo, Poland, and will be operational by 2018 as part of Phase three.

Construction for the new base was managed by the U.S. Army Corps of Engineers. Kellogg Brown and Root was the construction manager.

The ashore-system deckhouse structure, which houses the SPY-1 radar arrays and combat information center, looks similar to a DDG. That's by design.

To reduce risk and cost for the shore based sensor, launchers and missiles, the Missile Defense Agency and the Navy applied the same solution as the ship-based system. The equipment and software is the same as DDG 113, and reflects the latest Lockheed Martin Aegis "baseline" and the newest Raytheon SM-3 IB missile and the MK 41 vertical launching system, supplied by the two contractors, which is found throughout the fleet and with navies around the world.

There are several phases to the EPAA. Phase one began in 2011 with the arrival of the Norfolk-based BMD-capable Aegis guided missile cruiser, USS Monterey, CG 61, in the Mediterranean. A forward-based Army Navy/transportable radar surveillance system, AN/TPY-2, was also installed in Turkey.

Phase two includes the ashore site at Deveselu, with Aegis Baseline 9 and upgraded SM-3 Block IB interceptors, along with the four Aegis BMD-capable guided missile destroyers now stationed at Rota, Spain, and "forward deployed" to support ship stationing requirements for the U.S. 6th Fleet.

With Phase three, the second ashore-system in Poland will augment the four ships and the Romania Aegis Ashore site for a fully integrated system. The result is that with each successive phase, the EPAA will have more advanced systems and missiles.

To validate the concept and further reduce risk, the prototype shore-based Aegis deckhouse was built at Lockheed Martin's Moorestown, New Jersey, facility, next to the "Cruiser in the Cornfield" that has been used to test the original Aegis system. Aegis first went to sea aboard the test ship USS Norton Sound in 1973, Ticonderoga-class ships starting in 1983, and Arleigh Burke-class destroyers in 1991.

While the Moorestown site could radiate and track targets, it couldn't actually fire missiles. So to fully test its capabilities, the Missile Defense Agency completed the Aegis Ashore missile defense test complex at the Pacific Missile Range Facility in Kauai, Hawaii. The Aegis system employed in Hawaii was first integrated into the deckhouse destined for Romania, built on site at Moorestown, where initial tests were conducted. The weapon system was then removed and shipped to Hawaii where it was integrated with a duplicate deckhouse built there.

> "Aegis and the standard missile have both undergone a continuous evolution."

Aegis Ashore missile defense system in Romania

MISSILE DEFENSE AGENCY

The site has conducted three live-fire flight tests, and will continue to be the test platform for Aegis Ashore, Baseline 9, and SM-3 capability through delivery of Phase III in 2018, said agency spokesman Christopher Szkrybalo.

Brendan Scanlon, Lockheed Martin's Aegis Ashore program manager, said the goal was to take the proven sea-based Aegis system and bring it to land with as few changes as possible.

There are some differences. On the ship, the launchers are located near the radar. On land, the launchers are farther away. "That was the principal modification to the Aegis Weapon System software. We hardly had to change anything at all. We modified less than one half of one percent of the code base," he said.

The cable lengths between components didn't need to be as long as they are on the ship, but were kept at the same length so there would be no impedance mismatches. Likewise, a stationary building doesn't need a gyro, but this version has two, because it needs heading inputs.

The equipment was installed on 6x12 foot palletized portable equipment units that could be assembled, tested and easily transported as a unit on a "skid" inside a container. Even the radar arrays were installed in large frames prior to shipping. With these frames, the array could be lifted into its place in the deckhouse in about 20 minutes whereas for a ship it would take weeks to be fully installed.

The naval architect firm of Gibbs and Cox has been in the design and integration role starting with the first DDG 51 up until the most recent ships of the Arleigh Burke class, and now with Aegis Ashore.

According to Gibbs and Cox Chief Engineering Officer Tom Schubert, it's a big challenge to make a sophisticated combat system fit and function on a surface combatant.

"It's close to what we do every day, even though it's a completely different application," said Schubert. "It's a shipboard combat system from an Aegis destroyer implemented in a land-based building."

Gibbs and Cox used the same design process of model management and design integration it uses for ships, and applied it to the land facility. The different stakeholders involved worked together at the design center, hosted by Gibbs & Cox at its Arlington, Virginia, offices. The team included Lockheed Martin for the combat system; program executive office C4I; Naval Surface Warfare Center Philadelphia for machinery controls; Black and Veatch, the architect/engineering firm; Missile Defense Agency; and Gibbs and Cox.

Keith Harper, vice president and group manager of the Gibbs and Cox design group, said the participants worked together capturing ownership and responsibility for all of the systems requirements. "Through all the reviews, it's all about ownership and everybody agreeing that they're ready to proceed to the next step, and at the end of each meeting you have a set of milestones that everybody agrees to.

"This visibility and transparency for all the participants reduces the risk later of somebody saying that something doesn't work," said Harper.

"We took all the models from each of the participants and merged them into a design control model, which is a very familiar role for us," said Joseph Daley, senior program manager. "The result was a 3D CAD model that includes all the systems, including the combat system; command and control; mechanical and electrical; and heating, cooling and air conditioning."

"Our process for CAD model development is a series of reviews with increasing expectations for the maturity of the models," said Daley. "The earlier arrangement review will have the location of the major elements. By the time you're through with the final review everything is located and verified to meet requirements, such as door swings for maintenance access, required clearances around radar waveguides, and human factor considerations are accounted for."

Daley said most of the participants have worked together on naval programs before and were familiar with the process, but for Black and Veatch, it was a new experience.

Some aspects of Aegis Ashore are identical to an Aegis destroyer, such as the radars and waveguides, but stability and buoyancy are not factors. There are also some things that you don't have to worry about on a ship. For example, there are stairwells that meet land-based safety building codes dimensions — which take up a considerable amount of space — instead of the ladders and hatches found on ships. While some aspects of the construction adhere to typical military specifications or marine classification requirements, it also had to meet the appropriate building code for wherever that particular structure is being built.

"People who build buildings typically don't build ships," Scanlon said. "But together we had a very collaborative environment to understand how to integrate it all together. The partnership between industry and government was key to reduce risk and to our success."

"While the equipment, missiles, computer programs and sensors are essentially the same, the difference is how we put it together, along with the requirement to be able to take it down," said Lockheed's Director of Aegis Navy programs Jim Sheridan. "We have to be able to put the puzzle pieces together and take it apart. This isn't the way we build ships now. We are partnering with the Navy to take lessons learned from Aegis Ashore and apply it to shipbuilding."

Aegis and the standard missile have both undergone a continuous evolution.

The standard missile 3 is identical to the sea-based version. The only difference is its launch point, with the launchers located apart from the deckhouse.

"SM-3 is a three-stage missile with the ability to reach far out into space to engage enemy ballistic missiles before they re-enter the Earth's atmosphere," said Dean Gehr, director for the land-based standard missile for Raytheon Missile Systems. "It can engage a wide variety of advanced threats from short to medium to intermediate range ballistic missiles. It has much greater range and defended area than any other ballistic missile interceptor deployed today. This is a key reason that it was selected to be the primary component of the phased adaptive approach defending all of NATO."

"Land-basing provides added flexibility," said Gehr. "The same SM-3 interceptor proven in nearly 30 successful, hit-to-kill space intercepts and widely deployed on Navy ships around the world is now available for land-basing."

According to Gehr, the SM-3 has a proven, evolutionary roadmap. The progression began with the widely deployed SM-3 Block IA and advanced to the SM-3 Block IB, which is presently in production and deployed. The most recent evolution is the next generation, longer range SM-3 Block IIA, which began flight testing last year and will be deployed in 2018.

"Land-based SM-3 is very flexible and can take cues from external sensors like the Raytheon TPY-2 X-band radar," Gehr said. "The TPY-2 radar allows SM-3 to maximize its reach and defended area."

"When Aegis was conceived, we never thought we would be shooting down warheads in space," said Sheriden.

One more reason the system is like a ship — it's manned by highly trained sailors. "Their battlespace is outerspace," said Cmdr. Jonathan Lipps, Aegis Ashore Romania commanding officer. ND

Edward Lundquist is a contributing writer.

Small Satellites: Obvious Benefits But Also Concerns

By Vivienne Machi

Commercial technology companies are providing key imaging and communications services via small satellite systems that may provide cost-effective options for boosting the United States' space resiliency, and they're developing them faster than the U.S. military can, experts said.

"We are seeing a pace of innovation that will provide a yield of applications that no one has thought of before," said Brian Weeden, technical advisor for the Secure World Foundation, a space security think tank based in Colorado.

Small satellites — typically considered to be systems weighing 500 kilograms or less — can provide additional data to current imaging systems and provide broadband internet to users in remote locations.

San Francisco-based imaging company Planet is one of several Silicon Valley startups focused on small satellite imagery. Its constellation of CubeSats — a set of miniaturized systems measuring about 10 centimeters cubed — situated in low-Earth orbit can snap pictures more frequently than a traditional remote sensing satellite, Weeden said.

"It's not very high-resolution imagery… you can't fit six feet of glass into a 10-centimeter cube," he said. "You wouldn't use it to try and figure out where a tank might be hiding in a field, or to measure the precise size of most things," but it would be useful to monitor changes in forest cover or to analyze weather patterns, he said.

Planet co-founder and chief strategic officer Robbie Schingler said his company's products provide the "peripheral vision" that then is able to inform more high-resolution imaging systems. This could assist with the monitoring of borders, disaster response and preparedness and other military missions, he said.

Persistent surveillance is a key attribute that satellite operators are trying to bring into the space industry, said Arun Kumar Sampathkumar, an aerospace and defense expert at Frost & Sullivan, a market consulting firm.

On-demand geographic information systems — that can capture, store and display geographic positioning data — will be seen as a key disruptor in the industry, where business models like Planet's pay-per-image product may be financially appealing to existing commercial and government customers, Sampathkumar said.

It may also draw in new customers who may not have been able to afford satellite imagery in the past, he added. Users "don't need to invest in extensive infrastructure to access these GIS products straight to their laptops and smartphones," he said.

The push to develop small satellites comes from new space companies and Silicon Valley startups rather than the traditional defense industry, Weeden said. "But you are seeing some of the legacy industry players start to take notice," he said.

Boeing is one such contractor, who is joining SpaceX and Channel Islands-based global communications company OneWeb in efforts to each launch a constellation of hundreds of small satellites into low-Earth orbit to expand broadband access to previously uncovered areas of the world.

With such constellations in orbit, a ground station could have connectivity with four to eight satellites at any given time, Sampathkumar said. "This is going to establish reliable, seamless connectivity covering the entire globe," he said. All three companies have filed requests with the Federal Communications Commission to operate within as-yet unused portions of the radio spectrum.

About 1.75 billion more individuals will have access to broadband internet because of small satellite technology by 2027, Sampathkumar said. "It will benefit the entire e-commerce market," he said.

The commercial small satellite industry is "moving much faster than the traditional large satellite acquisition process," which the military should take advantage of, Weeden said. The systems are faster to develop and enable less expensive payload launches.

"The usage of commercial-off-the-shelf products … has resulted in standardized platforms," Sampathkumar said. "This has subsequently brought the manufacturing cost down for small satellites … [and] allowed the customer to field multiple satellites in orbit."

This has been a boon for the National Reconnaissance Office, director Betty Sapp said recently at the 2016 GEOINT Symposium in Orlando, Florida.

"Small satellites combined with affordable launch — that's a huge enabler for us," she said. The NRO is now able to conduct certain missions with small satellites that were cost prohibitive in the past, although she declined to comment on the nature of those missions.

Geospatial intelligence plays a critical role in the United States' efforts to counter potential threats in space and on the ground, and to maintain an edge in the domain over adversaries like Russia and China. As the military engages in an ever-more contested space environment, its strategy will be resilience, Weeden said.

"This means making the space capabilities — not necessarily satellites themselves — more resilient to attacks," he said. Part of that strategy might include having spare systems, so that if one satellite gets jammed or destroyed, it's not too difficult to switch to another system, he said.

The NRO announced in July with the National Geospatial Intelligence Agency a joint activity to take advantage of emerging commercial technology. The Commercial GEOINT Activity, which is due to begin operations late this month, will allow the two organizations to conduct joint assessments, explore alternatives to traditional collection and analysis, and synchronize joint acquisition opportunities.

But for all of their likely and demonstrated benefits, the small satellite market remains restricted by a lack of dedicated launch platforms, Sampathkumar said.

"So far, small satellites have been piggybacking with bigger satellites, [and] oftentimes the launch costs are higher and have a longer wait time," he said. The price variance, along with the wait times, renders many missions financially infeasible and complicated for the small satellite operators, he said.

Planet's Schingler said joint launches are "a good way to do a tech demo and get into space, but when you're coming up with unique missions, the orbits mat-

The company Planet uses a series of CubeSats.

ter, and that's where dedicated launch vehicles are important."

More than 2,600 small satellites will be launched into low-Earth orbit by 2023, and many launch operators won't begin operations until 2017, Sampathkumar said. NASA has issued contracts for small satellite launch operations to several companies, including Virgin Galactic and Firefly Space Systems, he said. Virgin Galactic is expected to perform its first test launch in 2017.

Even as these launch platforms prepare to begin operations, the question still remains of how to mitigate the inevitable — and already existent — spread of debris from inactive, degraded or destroyed satellites, analysts said.

"At the moment, there are roughly 1,400 active satellites in orbit around the Earth," Weeden said. He estimated at least 3,000 to 4,000 more will be launched in the next five to 10 years, although he has seen estimates for up to 10,000. Some of these are being planned for the same altitude as existing systems, which would increase the risk of congestion and collisions.

"So many satellites are going up into LEO, and not all of them are going to decay on their own and not all of them are going to burn out in the atmosphere," Sampathkumar said. Establishing a system and the capabilities to properly de-orbit satellites will be a key area of development, he said.

More satellites in operation will also mean sharing increasingly less available radiofrequency spectrum. "Most of them need to communicate using radio signals. … You're dealing with congestion, not just between satellites, but between satellites and the Earth," Weeden said.

If it were a question of two planes about to collide in mid-air, the Federal Aviation Administration would be authorized to regulate how each aircraft moved and operated in relation to the other. But there is currently no such global agency for space systems that has the power to order an operator to move one system away from another to avoid a collision, Weeden said.

The 1967 Outer Space Treaty states that the activities of private sector entities in outer space require authorization and continuing supervision by their state. The United States currently does that via licensing, but "some of these new and innovative applications fall outside of the current licensing boxes," Weeden said.

Lawmakers are working to bring oversight to space: Rep. Jim Bridenstine, R-Okla., introduced the American Space Renaissance Act this past April, which includes over 100 pages of policy suggestions related to commercial, civil and national security space systems. It includes proposals for space traffic management and authorizes over $27 million in funding for up to four small launch vehicle contracts.

The intent is not to pass the act in its entirety, but to provide a slew of ideas that could be implemented into other pieces of legislation, such as the 2017 National Defense Authorization Act, Bridenstine said in a speech at the 32nd Space Symposium in Colorado Springs, Colorado.

In May, the House Appropriations Committee approved an amendment to the fiscal year 2017 Transportation, Housing and Urban Development appropriations bill, to increase the funding for the FAA's office of commercial space transportation by $1 million, to $19.8 million — a proposal suggested in the Space Renaissance Act.

If "the small satellite boom" is not managed in an efficient manner, it may have an impact, Weeden said. "You may see services get interrupted or disrupted, or the space environment degraded to the point where future business models don't happen," he said.

Even as these emerging small satellite developments claim to offer great benefits to existing capabilities, many applications and business models have yet to be proven in practice, Weeden said. "There's a lot of venture capital and investment, but very few of [the companies] are actually turning revenue," he said.

Despite their cost and maintenance appeal, analysts and officials alike did not see a near future where small satellites could truly compete with, much less overtake, traditional satellite systems.

"It absolutely is not going to be small satellite data completely replacing the existing ones," Sampathkumar said. "But a large part of the small satellite market would be comprised of new customers coming into these new web-based markets — they never had the budget to afford these big money solutions."

Sapp said there are potential drawbacks.

"Having something up there that's extremely survivable but doesn't do the job you need it to do isn't very helpful; having something up there that's really optimized for the job that's not survivable isn't very helpful either," she said. "You need to find that balance between." ND

Email comments to vmachi@ndia.org

Marine Corps Experimenting with New Drones

By Yasmin Tadjdeh

The hum of unmanned aerial vehicles could be heard during a recent experiment in California. Tiny quadcopters zipped across the sky as an MQ-9 Reaper flew overhead.

The test — known as the Marine Air-Ground Task Force Integrated Experiment, or MIX-16, and hosted by the Marine Corps' warfighting laboratory — marked an effort by the service to study and eventually acquire new, powerful drones to give troops increased situational awareness and communication abilities.

Unmanned aerial vehicles evaluated at the event — which took place in California at Camp Pendleton and Twentynine Palms in July and August — included a mix of tiny drones that could fit in a Marine's hand to systems that weighed thousands of pounds, said Lt. Col. Noah Spataro, unmanned aerial systems capabilities integration and requirements officer at the Marine Corps' capabilities development and integration office.

The service — which currently operates systems such as the Raven, Wasp, Shadow, Puma and Blackjack — is looking for new systems that can provide troops with increased capability, and is especially interested in small systems, he said.

Vertical take-off and landing aircraft, also known as VTOL, could be especially useful, he noted.

"Those right now aren't part of our program of record, and so that's where this experiment is really important because it's helping us define how do you operate with these things? How do you sustain them? What are the best tactical scenarios to integrate them with?" Spataro said.

Such systems would be ideal in urban environments where buildings can make it challenging to launch fixed-wing drones, he said.

"If you are say in a city and you need to get eyes on a specific area, or you're doing a patrol through a city and you have all these vertical obstructions, it's really hard … to try and launch this aircraft if you've got fixed wings," he told National Defense.

At the same time, VTOL systems often have limited battery life, making a fixed-wing asset potentially more useful for certain missions, he noted.

"With the fixed wing, you need a little bit more space for launch and recovery but you're going to get better endurance," he said. Plus, "it's going to orbit the target so you're going to get a bunch of different views while it's flying around."

The Marine Corps will need a combination of both kinds of systems in the future, he said. During MIX-16, it tested systems such as Prox Dynamics' PD-100 Black Hornet, PSI Tactical Robotics' InstantEye and Lockheed Martin's Terminator. It is also looking at potentially acquiring a medium-altitude, long-endurance system, such as a Reaper, he noted.

At the exercise, the service used an MQ-9 as a way to create a communication network with Marines on the ground, Spataro said. "It's providing a mesh network overhead — so basically Wi-Fi for grunts. I like to call it GruntNet."

Using a connected radio, "I can talk over a mountain. … I can talk to folks in vehicles that are moving, Marines on patrols," he said. "All those things can be networked together and they can share their position, their actual location information. They can chat with each other and they can even push video."

Marines on the ground "are looking for something that is over the shoulder that is able to give them that heads up and it feels like a guardian angel," he said.

Large systems often need to be stealthy. That would not be the case for a system the Marine Corps would purchase, Spataro said.

"To keep things cheap for like a Group 5, I don't know that … [a low-observable capability] is specifically a key performance parameter. It may be important but the Marine Corps is not rich," he said. Group 5 systems weigh more than 1,320 pounds and fly at an altitude of more than 180 feet.

The service is also interested in employing a mother ship concept for its unmanned systems, he said. The Marines could fly a Reaper to a certain location and once it reaches its endurance limit it would launch smaller systems, he noted.

"It would extend the network, it could extend the sensors," he said. "When you're done with the mission … ideally you'll recover it back and be able to use it again and maybe even refuel it off the big aircraft, the mother ship. But if you lose it, it's not the end of the world either."

For these smaller systems, which would likely be Group 3 aircraft such as a Shadow or Blackjack, there would be a need for them to be stealthy, he said. Group 3 systems weigh less than 1,320 pounds and fly at an altitude of less than 180 feet at speeds of less than 250 knots.

"That's kind of what I'm thinking is the future — you have big things carrying smaller things and that will be able to affect a higher threat environment where low-observable [technology] might be more important," he said.

Peter W. Singer, a strategist and senior fellow at New America, a Washington, D.C.-based think tank, said small drones

A Marine launches an InstantEye drone during MIX-16.

would be a top priority for the Marine Corps.

"The future is more likely to be smaller systems, regardless of the region" the Marine Corps operates in, he said in an email. "They are not just cheaper and thus more disposable, but also have been the ones that have received the most enthusiasm in exercises."

Systems that work in urban environments will be a priority, he added.

There is "a greater need for systems that can aid in the urban fight," he said. "Urbanization is taking off regardless of region, so it's a good bet that future USMC deployments, whether in war fighting to humanitarian disaster relief, will be in an urban zone."

Purchasing new unmanned systems will be critical for the Marine Corps as it goes back to its sea-based roots, said Paul Scharre, director of the 20YY Future of Warfare Initiative at the Center for a New American Security, a Washington, D.C.-based think tank.

"The situation the Marine Corps has been in for the last 15 years has actually been a little unusual in that in some ways they have been functioning as a second land Army in Iraq and Afghanistan," he said. "The Marines have been going back to the sea. They've been transitioning to a posture where they are back on ships and they are ready to respond to crises around the world. That's ... sort of reinvigorating some training and doctrine that they haven't used in a while and it certainly has implications for their unmanned aircraft."

The service will likely need aircraft that can be rail-launched off ships to protect Marines on the ground, he said. Such systems could also be recovered with a hook or a net.

"Having a larger fixed-wing aircraft that could fly off of an amphib … [would put] powerful capabilities over Marines' heads," he said. "You could have persistent surveillance, you could have weapons on board, you could have communication relays which is very valuable for them in the kinds of environments they are going to be in sometimes — where they're going to be pretty austere."

But such a system could affect deck space, making a smaller, VTOL aircraft a more appropriate choice, he said. They have "limited range and endurance, [but] there is a benefit because they can … [take off and land] without disrupting deck operations for Marines and their amphibious ships."

There is an effort by industry to create larger VTOL systems, Scharre said. These systems could be "game changers," he noted.

"I've seen a lot of really interesting designs from companies where now that you're building something that doesn't have a person on board, you just can do a lot of innovative things in terms of aircraft design," he said.

The Marine Corps may one day want a large VTOL system, he said.

"As we see the technology develop you'll see a desire in the Marine Corps for larger, vertical take-off things that might be like a tilt-rotor, like an Osprey, or some other type of transitional aircraft," he said.

While the Marines will invest in new UAVs, they will also look at developing powerful new sensors to put on board those systems, Scharre added.

"The most interesting sensor development in the last couple of years that has just sort of flirted with operational maturity are these wide-area surveillance sensors," he said. "Instead of putting one camera on a drone why can't I put 60 cameras, like a fly's eye that can survey an entire city and then stream down [data]?"

Wide-area sensors would make a massive difference for troops on the ground, he said. While the technology is still being developed, it could be ready for primetime within the decade.

"You could see this being increasingly valuable — you could have drones overhead that are actually telling the Marines on the ground what the things are that are coming," he said. "Instead of having someone watch the video feed and look for objects, the drone is actually watching. It's actually sensing and detecting the environment and it's telling them, 'There's a car approaching. There's a RPG [rocket-propelled grenade] up ahead.'"

While the Marine Corps has focused its missions in the Middle East over the past decade and a half, in the future it may operate in areas such as the Asia-Pacific.

"If you think about the Asia-Pacific, you think about systems that are survivable in contested airspace," said Philip Finnegan, director of corporate analysis at the Teal Group, a Fairfax, Virginia, defense and aerospace market analysis firm. "That means they need to be faster, stealthier and have greater autonomy than existing systems."

Such a system would have to be relatively large, on the scale of a medium-altitude, long-endurance unmanned aircraft, he said. A Gray Eagle might be one option, he said.

As the Marine Corps considers whether to purchase such a system, industry is keeping its ears perked up, he said.

"There are … companies that want to get into the MALE market and this could be an entry point for them," he said.

Lockheed Martin, General Atomics, Northrop Grumman and Boeing would all likely be interested in competing for such a contract, he said.

"It's those larger players with a lot of aircraft capability that are going to be" interested in this, he said. However, it will ultimately depend on the direction the Marine Corps decides to go, and it is still early in the process, he noted. **ND**

Email comments to ytadjdeh@ndia.org

T-X Competition Pits Established Aircraft Against New Designs

By Stew Magnuson

After years of waiting for the Air Force to move forward with a program to build a new end-to-end jet fighter training system, four teams have come forward to compete for the potentially lucrative contract.

Two of those teams have training aircraft being sold internationally that they say fit all the Air Force requirements. Raytheon and its partner Alenia Aermacchi, part of the Leonardo group of companies, are offering the T-100, which is based on the Italian manufacturer's M-346.

Lockheed Martin is proposing its T-50, an aircraft it developed with Korea Aerospace Industries.

Rivals Boeing-Saab and Northrop Grumman are countering with so-called clean-sheet designs, aircraft they will build from the ground up based on Air Force specifications, although Northrop officials have indicated that the company has a prototype nearly ready to fly.

The Air Force intends to buy 350 of the trainers, which it says are needed to replace the aging T-38. A draft request for proposals went out to industry in late July, with the final RFP due in December, Air Force Secretary Deborah Lee James said recently.

"We're very focused on the future of the trainer force," James said at a talk organized by Defense One.

"I believe that [there] has been an unprecedented level of discussion on requirements with industry about both the baseline requirements as well as what are considered the higher level requirements," she said.

As industry waited for the Air Force to obtain funding from Congress and move forward with the program, several participants over the past two years either left the competition or created new alliances.

BAE Systems — with Northrop Grumman as a partner — at one point was offering the British-built Hawk, a training aircraft BAE has fielded in various iterations since the 1970s. It has withdrawn that aircraft from consideration and joined a newly formed team with Northrop Grumman, which is now serving as the program lead. Northrop announced plans for a new design that it is creating with its subsidiary Scaled Composites, BAE and L-3, which will provide the ground simulators.

The Air Force is calling for potential vendors to deliver an end-to-end solution, which will include the ground-based systems.

General Dynamics announced a partnership with Alenia Aermacchi in 2014 to build a follow-on to the Italian-made M-346, but it withdrew its participation. Raytheon has stepped in as the project lead.

"We consider the T-100 a block upgrade to the baseline M-346," said Dan Darnell, vice president of strategic initiatives for Raytheon Space and Airborne Systems.

"We have an airplane that is mature. It is flying in four countries now operationally, and all of them are very happy with it," he said.

Singapore, Italy, Israel and Poland have purchased a total of 68 aircraft.

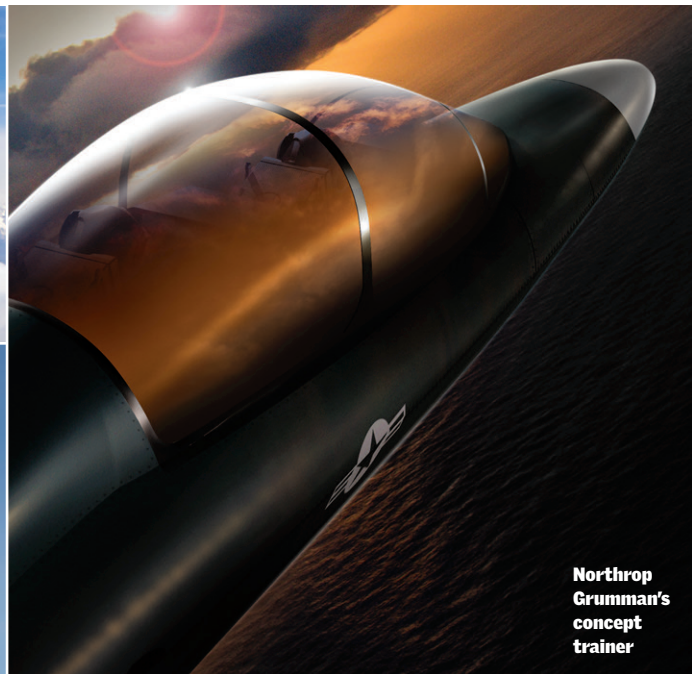
After seeing the draft RFP, Raytheon believes there will be little need for a major redesign. One big change, though, will be a large-area display in the cockpit, which will replace three smaller displays in the M-346.

The Air Force wants a flexible display that can replicate what pilots will see on their screens. It will not only mimic the fourth and fifth-generation fighter aircraft screens, it will allow for live, virtual and constructive training.

Trainees looking at the large-area display will see enemy aircraft and readings from sensors that are not actually there. The embedded tactical training system on the aircraft will give instructors the ability to pre-program a mission on a cartridge and download it into the computer before the lesson. The trainee will see on the display simulated enemy aircraft on a non-existing radar. Such

Raytheon's T-100

Lockheed Martin's T-50A


Northrop Grumman's concept trainer

high-tech sensors are too expensive to integrate into training aircraft.

"You can program it the way you want it and display it any way that makes sense to the user," Darnell said. The ground-based training system Raytheon is proposing is mature and is being used by the Italian air force, he said.

Instructors can modify the simulations in flight. They can reset the lesson as many times necessary if the student isn't grasping how to do the task. They can change the ranges of enemy aircraft, adjust the characteristics and dynamics of the intercepts and rearrange ground targets as well, he added.

The T-100 also features "stadium style" seating for instructors, who will be able to look over their students' heads.

"It sounds like a small thing but it's a big thing when you're an instructor when you have that kind of capability," he said.

"You have to have an airplane that is a good compromise between safety, predictability and an aircraft that is good enough to transition to fourth- or fifth-generation students that are going to fly the F-16, F-16, F-22, F-35," Darnell said.

The Air Force is asking for "safety," and while it doesn't spell out a requirement for more than one engine, the T-100's twin engines are inherently safer, Darnell noted.

When Poland, Israel and Singapore competed contracts for new trainers, the M-346 went up against the Lockheed Martin-Korea Aerospace built T-50 and was chosen in all three cases, Darnell noted.

That may be, said Mike Griswold, advanced pilot trainer capture lead at Lockheed Martin, but countries that need new trainers now, or in the near future, are in a wait-and-see mode. They want to know what the U.S. Air Force will chose.

Lockheed Martin and KAI have sold some 150 training and light attack variants of the single-engine T-50. Anticipating the draft RFP, it has built and flown two upgraded prototypes it calls the T-50A.

One of them has an optional aerial refueling capability.

There is no firm requirement for the T-X to have a refueling system from the start. It's an "objective" requirement, meaning if a contractor can deliver the capability, they might earn some "extra credit," he said. It's a similar concept to the F-16's conformal fuel tanks, although it isn't a tank but an adapter, he said.

"It's alternate mission equipment that can be loaded if the training requires refueling," he said. The adapter is an attachment that can be bolted on near the tail of the fuselage. There is some "plumbing" involved, but it is a functioning refueling system developed at Lockheed Martin's Skunk Works laboratory.

"We took the time to come up with an innovative flexible, low-cost solution for the Air Force," he said, noting that few training sorties will actually require refueling, so it makes sense to have a bolt-on system that will only be used as needed.

As for the ground-based simulators, and the new cockpit display, those solutions are coming from Lockheed's in-house capabilities. It is simply dropping the large-area display it developed for its F-35 joint strike fighter into the T-50A. The ground simulators come from its training and simulations division based in Orlando, Florida.

Lockheed is putting a lot of emphasis on flexible open architecture so the aircraft's mission can be expanded.

"The T-38 has flown for over 50 years, and the T-X could fly that long as well so you want to have a good solid baseline that you could grow on," he said.

Along with South Korea, Indonesia, Thailand, Iraq and the Philippines have purchased the T-50 or its variants. The aircraft has flown more than 200,000 flight hours and trained more than 1,000 pilots since it was introduced in 2005.

Both the T-50A and T-100 meet all the Air Force requirements for speed and maneuverability, which translates to sustained G-levels and tight turns.

Lockheed Martin has already refurbished a factory in Greenville, South Carolina, to build its jet trainers. Raytheon has not made a decision as to where it would manufacture the aircraft if it were to win, but somewhere in the United States, Darnell said.

Boeing-Saab and Northrop Grumman meanwhile, declined to make executives available to talk about their potential entries.

Northrop Grumman would be considered the incumbent contractor. Its legacy company, The Northrop Co., built the first T-38s for the Air Force in 1961 and delivered the final of more than 1,100 it manufactured by 1972.

Katherine Thompson, a Northrop Grumman spokeswoman, said, "The Air Force delivered the draft [RFP] as we anticipated, and we are progressing forward. Our team is working to evaluate and understand all the information and implications of the draft, and continue the open communication we have with the customer."

Executives from Northrop Grumman and its subsidiary Scaled Composites told National Defense the new aircraft would have its inaugural flight in 2015, but later changed it to this calendar year.

There will be more news about its prototype "in the coming months," Thompson said.

"What sets our solution apart is the team we have assembled to build and deliver it. No other industry competitor has the years of pilot training experience that this team cumulatively brings to the program. Northrop Grumman's history with the T-38, BAE Systems' history with Hawk, and pilot training delivered by L-3 that dates back before World War II brings together over 180 years of experience that is serving as the foundation of our solution," she said. She added that the company wasn't ready to announce where it would manufacture its aircraft.

Even more reticent was the Boeing-

Saab team. Spokeswoman Rachelle Lockhart declined to share any details other than it would be a purpose-built aircraft.

Senior aircraft/engine analyst at Forecast International, Douglas Royce, who recently penned a report on the international trainer aircraft market, said there are arguments to be made for both new designs and off-the-shelf solutions.

"A clean-sheet design that is designed according to the requirements should be a better match than an existing aircraft," he said. "But from an Air Force perspective, there is always an issue of developmental and program risk."

The T-50 and T-100 will be in the running, even if they weren't exactly designed to specifications.

The Boeing-Saab and Northrop Grumman teams probably won't reveal what they have in mind "until the last minute," he added.

As for the payoff, there is the possibility for international sales beyond the 350 aircraft the Air Force wants.

Potential customers like knowing that the U.S. military aircraft will be inline for steady upgrades throughout the years, and that they will benefit from this investment. Other countries don't have a good reputation for customer support, and some of these aircraft will be in service for 30 or 40 years, he added.

It's not a particularly active market but it does account for about 80 to 100 aircraft per year. "But it's a valuable market in the sense that these are expensive jets with a lot of electronics," he added.

And the trend now is to not only buy the trainer, but the ground simulators as part of a larger package.

The report forecasts a potential market for 748 jet trainers worth $13 billion from 2016 to 2025. The T-X accounts for only a few of those sales since it is not expected to go into production until the early 2020s.

The report, however, noted that "many world air arms are reducing the size of their fleets of fighter and attack jets. Fewer pilots need to be trained to fly military aircraft, and this leads to a corresponding reduction in the number of pilots in the training pipeline at any given time. That, consequently, reduces the need for large fleets of new training aircraft." ND

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Air Force Contemplating New Close-Air Support Platforms

By Jon Harper

The A-10 Thunderbolt II attack aircraft, also known as the Warthog, is slated to be retired in 2022. Many questions remain as to what the next-generation system will look like, but the Air Force could pursue a number of paths as it seeks to replace the U.S. military's close-air support workhorse.

In June, then-Air Force Chief of Staff Gen. Mark Welsh compared the desired capabilities for the new system to the convenience and flexibility of a soda machine.

"Imagine the … flying Coke machine and just having a Coke machine overhead, and you put your quarter in and you get whatever kind of firepower you want when you want it," he said at a breakfast with reporters shortly before he retired. "In the perfect world, that's close-air support of the future."

But the Air Force isn't sure what form such a system would take.

"Is it manned, is it unmanned? Is it just more responsive [than current systems]? Is it a number of smaller things that arrive and deliver weapons? Is it one big thing that orbits? … I don't know," Welsh said.

A secretive office in the Pentagon is working on a project that could potentially fit the bill for the type of capability that he envisioned.

"We've done a lot of work with the Air Force over the last year on developing a very large prototyping program called arsenal plane, which is trying to get sensors and shooters separate [and] have large aircraft that can carry lots of weapons to feed into the battle so that planes don't have to land and resupply," said William Roper, the director of the strategic capabilities office.

The focus of the SCO is to advance or repackage existing technologies rather than starting development from scratch. That should help speed their delivery to the force, he said at a recent conference.

"We're very interested in seeing if legacy systems can play a role of the big warehouse carrying weapons into the fight, and without breaking an arm and a leg can we get these networked with forward systems" that could relay targeting information, he said.

"It could be a completely game-changing [concept of operations] if

A-10 Thunderbolt II

we get it right," he added.

Although Pentagon officials are slowly pulling the curtain back on the arsenal plane concept, there is still a great deal of mystery surrounding the platform itself, including which legacy system it will be based on.

Anonymous defense officials have told reporters that the Pentagon is considering modifying B-52 or B-1 bombers to meet arsenal plane program objectives. But Roper declined to tip his hand.

It is a "risky prototyping effort," he noted. "We want to give ourselves a maximum chance to look at various options before we neck down and say, 'Here's what it is.'"

The revolution in precision-guided weapons technologies has given older bombers the ability to provide close-air support, said Mark Gunzinger, a former B-52 pilot, who is now a senior fellow at the Center for Strategic and Budgetary Assessments.

But a non-stealthy bomber's ability to do the job well could depend on the sophistication of enemy air defenses.

"In contested environments, that would be more of a standoff aircraft and that might not be conducive to the close-air support mission," he told National Defense.

"In a permissive environment … an arsenal plane such as a B-1 or B-52 that carries a large payload of [precision-guided munitions] would be able to penetrate and survive … and perhaps support close-air support missions," he said.

There could also be a major role for drones going forward, analysts said.

"We're using long-loitering aircraft like Reapers that can just stay in the air for a long time," said Todd Harrison, director of defense budget analysis at the Center for Strategic and International Studies. "They've got a small payload but they can hit a target in a very timely manner very accurately."

The Air Force should consider making the next-generation attack plane unmanned, he added.

Another contender is the multi-mission joint strike fighter. The Air Force's F-35A reached initial operating capability in August.

Speaking at a recent conference, Secretary of the Air Force Deborah Lee James said the aircraft would have "limited" close-air support capabilities after IOC was achieved, not the "full-up" capabilities that are expected to come later.

Adversaries are developing advanced anti-access/area denial weapons that could make it more difficult for a relatively slow moving, radar-observable plane like the A-10 to survive in combat. In contrast, the joint strike fighter is stealthy and could operate more freely in less permissive warzones.

"When you look at Afghanistan today, and for that matter Syria and Iraq, those are not necessarily indicative of the kinds of environments the Air Force is going to have to fight in" in the coming decades, Gunzinger said. "That is a factor to consider when you are designing future air forces."

But critics of the F-35 have argued that the plane won't be as effective as the single-mission A-10 when it comes to providing close-air support. Sen. Kelly Ayotte, R-N.H., vowed to prevent the Air Force from prematurely retiring the Warthog "until an equally capable replacement is fully operational."

"We should now get to work on the development and procurement of an aircraft that can eventually replace the A-10 and provide even better close-air support capabilities for our troops," she said in a statement earlier this year.

Welsh said Air Force officials "don't think this would take that long" if the system were designed to operate in low to medium-threat environments.

But following the drumbeat of warnings by Pentagon officials about emerging adversary counter-air capabilities, it might be difficult for the Air Force to convince Congress to fund a new non-stealthy attack plane.

"I think there would be questions raised," Gunzinger said. "Why do we need to replace an aircraft that cannot fight in contested conditions with another aircraft that cannot fight in contested conditions?"

In light of fiscal constraints, some experts believe that keeping the A-10 in service longer than currently planned would be the right move.

Gunzinger said the Air Force should hold onto the plane as long as possible and "fly the wings off it" until it ages out. Keeping it in the inventory rather than starting a new development program in the coming years would free up resources to fund other critical modernization needs, he noted.

The plane's service life could prob-

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ably be extended into the late 2020s or beyond, he said.

"There might need to be a little bit of investment to extend its service life," he said. But "we bought it, we're operating it, it's mature. We have a highly trained cadre of pilots and maintainers operating them and supporting the fleet. It doesn't make sense to necessarily walk away from that investment we've made in time and treasure."


A-29 Super Tucano

Service leaders are open to the idea of holding onto the A-10 until a follow-on system is in the works, the new Air Force Chief of Staff Gen. David Goldfein said at his confirmation hearing in June.

"Right now we're looking at that as an option," he told the Senate Armed Services Committee. "The challenge will be to keep the capability so that [during] the fight we're in today there's no degradation to any of the soldiers, sailors or Marines or my airmen that are on the ground."

The Warthog force is the best of the best in its attack role, he noted.

"The A-10 community is actually our Ph.D. force when it comes to close-air support, and they set the bar," he said.

Although the Defense Department has pushed to retire the Warthog to save money, powerful supporters in Congress have continued to fund it. It remains to be seen whether the plane will actually be phased out in 2022 as planned.

"The only thing absolutely certain about the A-10 is that it absolutely will be retired some day," Gunzinger joked. "Who knows?"

If continuing to fly the aircraft is deemed cost prohibitive, the Air Force could look for relatively inexpensive, non-developmental alternatives.

During a recent discussion with Gunzinger and other independent defense analysts, a senior Air Force official said that a non-developmental platform, referred to as OA-X, could potentially supplement the A-10 and provide a bridging solution until a next-generation aircraft, termed A-X2, is available.

Gunzinger declined to name the senior official, citing the ground rules of the closed-door meeting.

Systems such as the A-29 Super Tucano, built by Embraer, and the AT-6 Wolverine, manufactured by Beechcraft Defense, were bandied about as examples of an OA-X type of plane, Gunzinger said.

"The emphasis there would be how quickly could industry field a variant of an existing system for close-air support and at what cost?" he said.

Although no specific timelines were mentioned, Gunzinger deduced from the meeting that the service would like to have the OA-X within five to six years, if not sooner, if that path is chosen.

Harrison said such a system could potentially be purchased with overseas contingency operations funds — which aren't constrained by budget caps — in the coming years because the Air Force could argue that they are needed for the fight against the Islamic State and other militant groups.

The A-X2 would likely be a longer-term project, Gunzinger said, estimating that it probably couldn't be fielded until the mid to late-2020s even if funding were to become available in the next few years.

"I have not actually seen a proposal on any of this that has come forward to me, so it for sure is predecisional," said James, the Air Force's top civilian official. "Where would we get the money? [That's] not at all clear to me."

The service is in the process of modernizing its fighter, bomber and tanker fleets and other assets.

"If you just look at the Air Force's budget and the totality of their modernization needs, it's hard for me to believe that they could afford to begin funding a next-generation close-air support aircraft today," Gunzinger said.

Harrison said developing a new platform from scratch and fielding it could cost tens of billions of dollars, depending on how many were procured and other factors. It would have to compete for limited funds during the Air Force's looming modernization "bow wave" in the 2020s, he noted.

Nevertheless, Goldfein promised lawmakers that moving forward with planning for a next-generation system would be one of his top priorities.

"My focus is going to be on ensuring that I go back to the doctors of CAS — the A-10 fleet and the A-10 operators — and say, 'What is the future of close-air support?'" he said.

The Air Force's top officer offered a glimpse of some of the questions he wants to ask as the service ponders what comes next.

"Why is it that I only get a minute-and-a-half of trigger pull on a 30mm bullet?" he said. "Why don't I get 10 minutes and why is not every bullet precision guided?

"Why do I spend so much time having to figure out who is actually friend and foe on the ground when we have technology to be able to help us do that? Why is it that I have to do all the work for collateral damage estimates when I have a machine that can help me do that?" he added.

The service needs to develop a clearer vision as it plans for the next-generation system, he noted.

"My commitment to you is that … I will take this on," Goldfein told lawmakers.

Regardless of how the process plays out, the Defense Department needs to ensure that no capability gap develops, he said.

Soldiers rely on the Air Force to pound enemy ground forces. But Army Chief of Staff Gen. Mark Milley isn't wringing his hands about the uncertain future of close-air support.

"I have enormous confidence that they will make the right decisions on the platform," he said at a recent conference.

The Army leader is system neutral as long as it gets the job done.

"As a soldier and a guy who's been in my share of firefights, the only thing I care about is the effect on the target, and I don't give a rat's ass what platform brings it in," he said. "I could care less if it's a B-52, if it's a B-1 bomber, it's an F-16, an F-15, an A-10. I don't care if the thing was delivered by carrier pigeon. I want the enemy taken care of." ND

Email comments to jharper@ndia.org

DEFENSE DEPT.

Japan's Search for New Fighter Draws Attention From Industry

By Jon Harper

Japan's plan to acquire a next-generation fighter jet to replace the aging F-2 could offer a major business opportunity for aerospace firms, and U.S. defense primes would have the edge in any international competition, according to analysts.

In July, the Defense Ministry in Tokyo released a request for information regarding fields of technologies or products that industry could contribute to the development of a new fighter. It also sought information about fighter types that companies would propose if Japan decided to buy or upgrade an existing one to meet its needs.

Responses were due back by the end of August, said Air Attaché Col. Yasuhiro Ogawa during an interview with National Defense at the Japanese Embassy in Washington, D.C.

"We're going to find out which is best for us in terms of performance, cost efficiency and so on," he said.

Tokyo has three options for pursuing the next-generation fighter, also known as the F-3, he noted: build a new fighter indigenously; partner with foreign firms for co-development; or purchase/upgrade an existing aircraft.

The Defense Ministry's new Acquisition, Technology and Logistics Agency will conduct an analysis of alternatives. The process is in its "early stages," he said.

Up to two additional RFIs could be issued. A decision about which path to pursue is expected by the end of Japanese fiscal year 2018, which is March 31, 2019, Ogawa said.

The replacement jet needs to be factored into Japan's next midterm defense program planning cycle, which runs from fiscal years 2019 to 2023. The F-2 is expected to reach the end of its service life around 2030, he noted.

Meanwhile, China continues to improve its fighter capabilities — it has developed two stealth prototypes — and has been acting more aggressively towards its neighbors.

The number of Japanese fighter scrambles against Chinese aircraft increased from fewer than 100 in 2010 to more than 500 in 2015, according to the Defense Ministry.

"The security environment around Japan has become increasingly severe," Ogawa said. The "F-2 replacement program is one of our efforts to maintain air defense capability and to ensure air superiority surrounding Japan."

The capability requirements for the F-2 replacement have yet to be firmly decided, but broadly speaking Japan is interested in stealth, maneuverability, sensor fusion and new engine technologies, he said. The ability to conduct ground-strike and close-air support missions could also be sought, he added.

Japan has already committed to buying 42 stealthy F-35 joint strike fighters, but the aircraft might not meet Japan's needs for air-to-air combat against an advanced enemy, said Richard Aboulafia, vice president of analysis at the Teal Group, an aerospace and defense market analysis firm.

"They want a fast, high-altitude … air superiority fighter and interceptor," he said. "The F-35 is no one's idea of that plane."

The Defense Ministry procured more than 90 F-2s, Ogawa noted. It is unclear how many next-generation fighters Japan would ultimately buy to replace them.

"If you're going to spend the money on developing them then you want to buy in bulk," said Dan Darling, an Asia and Pacific Rim military market analyst at Forecast International. Procuring 100 would be "a decent ambition," he said.

Ogawa said the Defense Ministry would need to come up with detailed cost estimates for the new project as the next midterm defense program is developed.

"Obviously the F-2 replacement program is a very, very important program in terms of national defense or air defense of Japan," he added. "It's a very big project. We need a lot of budget and we take accountability for the taxpayers."

The Defense Ministry and Mitsubishi Heavy Industries are already doing research-and-development work in pursuit of new fighter technology. In April, MHI completed the first flight of the X-2 advanced technology demonstrator, which the company described in a press release as a "prototype stealth aircraft" that has been "engineered for extremely high maneuverability."

"The purpose of the X-2 project is … to get technology to develop a next-generation fighter by ourselves," Ogawa said.

"But at the same time we want some kind of bargaining

Japan's F-2 fighter

AIR FORCE

F-22 Raptor

power," he added. "We would like to demonstrate our technology to others" to gain leverage in potential negotiations with overseas partners.

Much more work would be required to turn the X-2 design into a combat-ready plane, experts noted.

"Scaling it up — that challenge is huge," Aboulafia said. "But it does show they've got the intent and the design teams capable of working on a larger fighter. It would just take a much greater allocation of resources."

MHI did not respond to a request for comment on the F-2 replacement project.

Developing a new fifth-generation fighter indigenously from scratch would likely cost $30 billion to $40 billion, at minimum, Aboulafia said. Such a price tag could be cost prohibitive.

"I'm not sure where it would come from just given the size of the Japanese budget," he said. "It just doesn't have the bandwidth for anything like that."

Cooperating with overseas partners on the F-2 replacement would likely be much more cost effective than trying to develop it indigenously, experts said.

"Mitsubishi can maintain its cutting-edge skills while still partnering with a Lockheed Martin" or another company, said Loren Thompson, a defense industry consultant and the chief operating officer at the Lexington Institute. "It would just make more sense to partner than to go it alone."

Contracts for an F-2 replacement could be lucrative, as competition in the defense aerospace market grows fiercer.

"That's a big fighter project, and if anybody can angle themselves in there it's worth their time," Darling said.

U.S. defense contractors are already in talks with Japanese officials about participating in the effort.

"We are certainly interested in another potential opportunity to bolster our longstanding partnership with Japan," Lockheed spokesman John Losinger said in an email.

"We are proud of our successful partnerships with Japan on the F-35 program and Mitsubishi Heavy Industries on the F-2 program," he added. "We look forward to learning more about Japan's F-3 plans as discussions progress."

Boeing also has the project on its radar.

"Should Japan decide to invite international collaboration, we would be interested in participating," Boeing spokeswoman Caroline Hutcheson said in an email. "Boeing's history, spanning more than 60 years of partnerships with industry in Japan, sets us apart from our competitors."

The company has had discussions with representatives of the Japanese government and industry about development of the F-2 replacement, according to a source at Boeing who requested anonymity to discuss the status of talks.

Other options for Japan include buying an existing European fighter or co-developing a new one with a European manufacturer such as Saab or the Eurofighter consortium.

But analysts said such an outcome is unlikely, noting that there are no Europe-made stealth fighters and no European companies have ever served as a prime contractor on such a project.

"The Europeans do not have credible credentials" to help lead a fifth-generation fighter program, Thompson said.

Japan's strategic relationship with the United States could also give U.S. companies an advantage, analysts said.

"Between the defense cooperation between the two countries, the security policies that are very close and intertwined, and the fact that the U.S. already has vendors producing stealth [aircraft] … it gives them a very big leap ahead of anybody else," Darling said.

U.S. firms have an established foothold and a long practice of working with local aerospace companies such as Mitsubishi, he noted. "I would never say never but I would give it long odds" that a European prime would win.

Ogawa said that a desire for interoperability could potentially benefit U.S. companies in any competition.

"We have a long experience and history cooperating with each other and introducing arms including fighter aircraft," he said. "We have no European fighters and we have no experience introducing European fighters."

A spokesperson for Saab declined to comment for this story. The Eurofighter consortium did not respond to a request for comment.

Among U.S. primes, experts said Lockheed has a clear advantage when it comes to winning a potential F-2 replacement contract.

"Lockheed would bring the technological knowhow to the table, so it would defray some of the cost on the Japanese side," Darling said.

The company is the prime contractor on the F-35 program, and also helped develop the F-2.

Lockheed is "the global leader in fifth-generation fighter technology" and "the logical partner" for Japan, Thompson said.

In its search for an F-2 replacement, the Defense Ministry isn't just looking to acquire greater air combat capability.

"We also need to consider maintenance and the enhancement of the Japanese industrial and technology base through this program," Ogawa said. "We are also looking to factor in a spinoff effect on the private sector, and also to gain future aircraft technology."

A licensing or co-development agreement with a foreign firm could fit the bill in this regard.

"If there was any kind of partnership for technology transfer it would almost certainly be to Lockheed's advantage,"

AIR FORCE

Aboulafia said. "They're the only stealth fighter producer in town right now."

While Boeing has a long-standing relationship with Japan, it is not currently building any stealth fighters.

Paying Boeing to develop a new one from scratch could be cost prohibitive for the Defense Ministry. The Japanese government might need the company to contribute significant funds to the project, which could be a deal-breaker for Boeing, Aboulafia said.

"In the absence of a willingness to invest their own cash in a stealth fighter, which of course is something they would never ever do [for Japan], they don't have much of a chance here," Aboulafia said.

As an alternative, Boeing could offer to enhance the capabilities of the F-15 as a lower-cost option, Aboulafia said.

"One extremely unlikely but not inconceivable possibility is that Boeing approaches them with the Silent Eagle and says, 'Hey, look, it gives you some [limited] stealth. The systems are great. … You have the F-15 in your inventory. You even have an industrial base that could build major chunks of it [and] work with us on this.'"

However, Japan might view the F-15 design as too old, he noted.

When it comes to potentially purchasing existing fighters, analysts believe Japan would buy the F-22 Raptor, built by Lockheed and Boeing, if it were available.

"It meets their needs exactly," Aboulafia said. The F-22 is "as good as you'll get given current technology."

Years ago, Tokyo expressed interest in procuring the Raptor but was prevented from doing so by a U.S. congressional ban on exporting it. The production line has since been shuttered after funding dried up and the Pentagon focused on the F-35.

"If the U.S. restarts the F-22 and allows Japan to buy it, then problem solved," Aboulafia said.

But analysts don't view that as a likely path.

Given "the amount of cost and time to rev that thing back up, I just don't see the F-22 as any kind of option," Darling said.

Ogawa said the F-22 has "very good" performance, but the price tag would be a consideration.

"We have interest but it depends how much it will cost," he said. "It's a matter of … cost efficiency."

The most likely outcome is Japan deciding to pursue a modified joint strike fighter, experts said.

"If they bought off the shelf it would be logical to just buy a bigger lot of F-35s," Darling said. The country is already slated to have joint strike fighter assembly and maintenance facilities located in Japan, he noted.

Thompson said: "I expect that in the end Japan will buy a larger number of F-35s than it's currently committed to. … I think there are ways of making the F-35 address the requirements that are driving the perceived need for a Japanese fighter, and that's probably the low-cost route to go."

Japanese industry could participate in F-35 modification and upgrade efforts to enhance their industrial base, he added.

Ogawa said procuring some version of the joint strike fighter has not been ruled out.

"We have to study about introduction of existing aircraft, or some upgrade of existing aircraft," he said. "Technically speaking, it means the F-35 can be one of the options."

Aboulafia said the implications of the F-2 replacement project could be profound. "It would be either a nice enhancement to the F-35, the perfect enabler for an F-22 restart, or the emergence of Japan as a fighter producer." **ND**

Email comments to jharper@ndia.org

Marine Corps' Joint Strike Fighter Prepares for Combat

By Yasmin Tadjdeh

NELLIS AIR FORCE BASE, Nev. — On a flight line in the hot and dusty desert near Las Vegas, military aircraft queued to take off. F-16 Fighting Falcons, F-22 Raptors and KC-135 Stratotankers were on the flight line. But it was the F-35B joint strike fighter, making its appearance for the first time at the famed Red Flag exercise, that caught everyone's eyes.

During Red Flag 16-3 — an advanced aerial combat training exercise — the aircraft participated in a series of air-to-air and air-to-ground missions, Marine Corps officials said.

The exercise marked another milestone in the aircraft's journey toward deployment and flying in combat. Last year, the Marine Corps declared the F-35B operational, more than three years later than originally planned. In late June, a trio of aircraft landed for the first time in the United Kingdom in conjunction with the Royal International Air Tattoo and Farnborough Air Show. That same month, the Marines stood up a second F-35 squadron to be based in Yuma, Arizona.

At a briefing with reporters during Red Flag, Lt. Col. J.T. Bardo, commanding officer of Marine Fighter Attack Squadron 121, the service's first F-35 squadron, said the Marine Corps was thrilled to debut the aircraft at the exercise.

"These opportunities are rare … so we are very excited to be here to bring the F-35 to the exercise, capitalize on its strengths and integrate with all the other … [aircraft] that are out there," he said.

Red Flag 16-3 lasted for three weeks in July. During the briefing — which took place a week into the exercise — Bardo said the F-35B had so far participated in every training scenario and performed well.

Having the joint strike fighter at Red Flag — which included a detachment of six airplanes — was invaluable training, said Air Force Col. Bradley Bird, vice wing commander of the 552 air control wing at Tinker Air Force Base, Oklahoma, who was at Red Flag monitoring safety.

The services can better understand the strengths of the plane and how it can be "integrated with all of the other fighters to include fifth-gen F-22 … [and] fourth-generation F-15, F-16, etc.," he said. It "is invaluable to be able to bring them out and get our first look."

Red Flag is so far the largest exercise that the F-35B has participated in, Bardo said. "Since IOC we have done numerous different events between the Marine Corps and the Navy and the Air Force," he said. "This is probably the first exercise of this magnitude." About 100 aircraft and 3,500 personnel attended

Red Flag 16-3, Bird said.

The aircraft dropped live ordnance, including laser-guided and precision-guided weapons weighing between 500 and 1,000 pounds.

The service's fifth-generation fighter — which has faced cost overruns and schedule slippage — will replace aging Harriers, Hornets and Prowlers, said Gen. Robert B. Neller, the commandant of the U.S. Marine Corps. With a second squadron now in place, the service is looking toward deploying the aircraft abroad.

"We're going to start to see that airplane deploy … overseas after the first of the year," he said during remarks at a Washington, D.C.-based think tank in August.

Lt. Gen. Jon Davis, deputy commandant for aviation, said VMFA-121 — the Marines Corps' first operational F-35 squadron — would deploy to Japan in January with 10 airplanes, followed by six more in July 2017. A second squadron, known as VMFA-211, will go to sea in the summer of 2018, he added.

"It's happening," he said. "We've got a jewel on our hands and we've just started to exploit that capability and we're very excited about it. I can't get them fast enough."

Based on recent training missions, the F-35B is performing well, Davis said.

The service is learning "how to fly and integrate this airplane," he said. "It does best when it's out in front … doing the seeing, doing the killing and all that."

One of the most important components of the F-35 is its software capability that analyzes and collects information, said a Congressional Research Service report on the aircraft that was released in July. The system has 24 million lines of code.

"The F-35's integration of sensors and weapons, both internally and with other aircraft, is touted as its most distinctive aspect. As that integration is primarily realized through complex software, it may not be surprising to observe that writing, validating and debugging that software is among the program's greatest challenges," the report said.

Last year, when the Marine Corps declared the F-35B operational, the service accepted the aircraft with what is known as the 2B software block, not a more advanced version known as 3F that is still in development by aircraft manufacturer Lockheed Martin Corp.

That hasn't hindered the plane so far, Davis said.

"The F-35 even in its current configuration is doing a phenomenal job at killing its target," he said. "I talk to my guys … [and] if they thought the thing sucked or wasn't good, they are not shy to tell me. … Not a one would go back to fly an F-18, a Harrier or a Prowler."

The advanced 3F block is scheduled for release in the fall of 2017, said Art Tomassetti, program manager for the Marine Corps' F-35B at Lockheed Martin. As the F-35B participates in exercises and training events, Lockheed is learning and fixing any deficiencies that pop up.

"Obviously there are always challenges as we find new things that the customer wants fixed in the software," he said. "They go to an exercise like Red Flag and they get to do things with the airplane that perhaps they haven't done yet. … They may uncover something … [and say], 'Hey, we got to go take a look and make a change.' The airplane and the system overall is still maturing. We're still finding out things about it."

Right now, the service's F-35Bs are flying with either Block 2B or Block 3i, a precursor to 3F. "There's a mix right now of the final version of 2B that's out there — and that's kind of what the Marine IOC configuration was — and then from our LRIP [low-rate initial production] six airplanes and on they're

DEFENSE DEPT.

all flying with a version of 3i which is the initial Block 3 software," he said.

As long as there are no major hiccups, Lockheed is on track to release Block 3F in the fall of 2017, he said.

At the beginning of the F-35 program, it was Lockheed's job to load updated software blocks onto the airplane, Tomassetti said. Beginning with 2B that task was transferred to the Marine Corps. When a specific aircraft will receive updates depends on scheduling managed by the service, he added.

F-35Bs from LRIP lot five and below will require some hardware modifications in order to accommodate 3F, he said.

Some experts have accused the Marine Corps of declaring initial operating capability when the system only had a basic level of capacity, such as with the 2B software. However, Davis pushed back on that notion.

"There were a lot of people out here in the press that said, 'Hey, the Marines are just going to declare IOC because it's politically untenable" not to, he said. "[We're] not going to do that. IOC in the Marine Corps means that we'll deploy that airplane in combat. It's not a decision I was going to take lightly."

In order to really prove itself, the Marine Corps will need to do just that, said Richard Aboulafia, vice president of analysis at the Teal Group, a Fairfax, Virginia-based defense and aerospace market analysis firm.

"Deployment … would be a real step in the right direction," he said. "It sounds like they are getting near there."

However, deploying the aircraft in support of counter-Islamic State operations would be unwise, he said. "It's not what it's meant to do. No high-end combat aircraft is ideal for counterinsurgency," he said.

F-35Bs during exercise Red Flag 16-3 at Nellis Air Force Base, Nevada.

The reason the F-35B hasn't been deployed in combat yet is likely because the combatant commanders haven't asked for a platform with its capabilities, said Air Force Gen. Herbert "Hawk" Carlisle, commander of Air Combat Command. The military faced a similar situation with the F-22, he said.

"For a long time the F-22 was operational but it hadn't been deployed in combat," he said. "Probably with respect to the Marines today … the combatant commanders are not calling for the attributes that the F-35B has."

Carlisle, speaking at the Pentagon during the announcement of the A-variant reaching initial operating capability in July, said he was worried about the aircraft's rate of production.

"My concern is buy rate," he said. "I need more [F-35s] faster to replace aging aircraft, to get to more economic order quantity. If you buy more, it drives the cost down."

Based on LRIP lot seven, F-35As currently cost $98 million per plane, F-35Bs cost $104 million and the F-35C costs $116 million, according to Lockheed. The figures did not include the price of the aircraft's engine.

Carlisle said he would like to see the number of F-35s purchased by the Air Force per year rise to at least 60, and optimally 80. "But given the fiscal constraints that we're in today, 80 would be very, very hard to get to," he said.

A total of 2,457 F-35s are planned for purchase by the military, according to the CRS report. The Marine Corps intends to buy 340 F-35Bs and 80 F-35Cs. The Air Force plans to acquire 1,763 F-35As.

In the president's proposed fiscal year 2017 budget request, the government reduced its F-35 buy by five F-35As, added two B variants and kept the same number of C-variants, according to the CRS report.

As long the government gives the company enough time, a few delayed F-35s shouldn't make a big difference in cost per plane, Tomassetti said.

"When we have time to take those changes to the program of record into account there are obviously things we can do inside the production process" to mitigate the negative impacts, he said. "We all talk about this thing called ramp rate and say, 'Today we are going to build so many airplanes this year and then so many airplanes next year,' and this ever increasing profile until you get to max rate production. Well, if you know in advance that something is going to change two years from now or three years from now, you can plan to that and you can structure it so that that change to the ramp isn't as impactful."

One major component of the F-35 is its Automatic Logistics Information System, which is known as ALIS. The system is critical to the aircraft's ability to track maintenance and supply-chain management. However, the system still requires "extensive software development and testing," said the CRS report. It noted that a recent Government Accountability Office report found that the system may not be deployable and also required robust infrastructure to operate, something that may not be available in austere locations.

Tomassetti said that was not the case. "Obviously it's deployable because people are deploying with it, right? So we've got airplanes that are moving from one base in the U.S. to another base that isn't an F-35 base and operating ALIS there," he said. "The Marines last year went out to an austere site in Southern California and operated … their deployable ALIS unit out there. Obviously we went and operated out from the Netherlands this year and from the U.K., so it's deployable."

Lockheed has been making improvements to the system, he said. It is getting ready to deploy ALIS version 2.02 by the end of 2016. "It brings additional capability. Just like every software release with the airplane, it fixes things from the past that were deemed deficient and brings new capability. ALIS is doing the same thing," he said.

There have been some discussions within the company that instead of releasing a major block upgrade yearly, it may issue periodic patches.

"Maybe it's better to … release a patch every two months that fixes the things we know right then and we'll just keep incrementally updating it rather than waiting for these big year-at-a-time" steps, he said. "We're having those discussions with the JPO [joint program office] and with the services getting their input on what they think is best." ND

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Air Force F-35 Proponents Strike Back at Critics

By Stew Magnuson

For close to two decades, critics have taken shots at the F-35 joint strike fighter — and they had plenty of ammunition.

Cost overruns and schedule delays piled up as it became known as the most expensive weapon system ever fielded. There were those who wondered if the Defense Department would ever see any results from its massive investment. The plan to fly it as it was developed, known as concurrency, was at one point called "acquisition malpractice" by the Defense Department's Undersecretary of Acquisition, Technology and Logistics Frank Kendall.

But at the beginning of August, the aircraft's largest customer, the U.S. Air Force, declared that it had reached initial operating capability, or IOC, which means battlefield commanders can call on at least one fully equipped and trained squadron to drop precision–guided weapons on enemy air defenses in contested environments.

"It's a major milestone in the sense that it has grown up a bit. It has still got a lot of growing to do. There is still a lot of work with the avionics and interfaces as well as the software, and those go hand in hand," said John Venable, a former F-16 pilot with more than 3,000 hours of flying time, who is now a senior research fellow at the Heritage Foundation.

There are key components that have yet to be integrated, including parts of the helmet's display system, a Gatling gun and the ability to shoot Sidewinder missiles. Much of that will be part of the next block of software due in August 2017.

Meanwhile, the aircraft's defenders such as Venable are beginning to talk about what it can do as opposed to what it can't yet do. Pilots and tacticians are just scratching the surface when it comes to understanding the aircraft and its fifth-generation capabilities.

"When people talk about situational awareness, it is exponentially higher in this airplane than it has been in any airplane up to this point. And that is a godsend for the guys in the fighter cockpits," he said in an interview.

Venable penned an Aug. 4 backgrounder report for the foundation in which he interviewed 31 F-35A pilots and asked them to compare their new aircraft with their previous fighters in terms of maneuverability, stealth and tactics.

He noted that fighter pilots were well known for blunt opinions and a lack of tact. As an outsider he was met with a good deal of skepticism.

"When I walked out of these [interviews] I got the gospel on what each man genuinely believed about both of his jets," he said. Their first aircraft is the love of their life and the F-35A is "the mistress" they are unsure about. The pilots had F-15C, F-16C, F-15E and A-10 backgrounds, but none came from the F-22 community.

Maneuverability in a dogfight has been a big question mark since a leaked report in 2015 called into question the F-35A's air-to-air performance over a fourth-generation aircraft.

Venable noted at the time of that test F-35A pilots were governed by software control laws, known as CLAWS, that limited them to three to five Gs during turns. There have been big strides since then and they are now limited to seven Gs. Ultimately, they will be allowed nine Gs. For the purpose of the survey, he asked the pilots to consider only what the aircraft can do now at seven Gs and to not speculate on how it would perform when the software no longer restricted them.

All but two of the pilots thought the F-35A outperformed his previous airplane in air-to-air combat engagements. The two who didn't favored their old F-15Cs in the 9,000-foot perch setup, a high-altitude combat scenario.

In beyond-visual-range scenarios, they all chose the F-35. For setups where energy and maneuverability are critical to success, they chose it 80 percent of the time.

"The F-35A was not designed to be an air superiority fighter, but the pilots interviewed conveyed the picture of a jet that will more than hold its own in that environment — even with its current G and maneuver restrictions," Venable wrote.

All of the pilots ended up saying that they would choose the F-35 over their previous jet, although Venable said that question wasn't included in the survey. "I decided to let the numbers speak for themselves," he said.

Two former F-22 pilots, Maj. Gen. Jeff Harrigian and Col. Max Marosko III, recently published a paper with the Mitchell Institute about the F-35A that they hoped would "demystify things that have been written in publications," said Harrigian, who directs the F-35A integration office.

The F-35A "allows you to understand where you need to be in the next three to five minutes, where you need to move assets, and to have that battlefield situational awareness to make decisions quicker and better than we could in any other legacy airplane. And that is fundamental to the platform and what it brings to the fight," he said at a

A pilot secures his helmet before an F-35A test flight.

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panel discussion where he presented the report, "Fifth Generation Air Combat: Maintaining the Joint Force Advantage."

The integrated avionics and sensors autonomously fuse and prioritize data for the pilot to reduce his workload "allowing him to focus more on the mission as opposed to managing sensors," he said.

He also lauded the aircraft's stealth. "There is nothing like running an intercept and then at the end of the day realizing that no one ever saw you."

Venable said he walked on an F-35A wings in his street shoes, and it didn't harm the protective coating that helps provide the plane's stealth. He could never do that on an F-22, which is known for its sensitive coating. The tougher stealth layer will allow it to be stationed in more austere settings in harsher environments.

"You can park them out in the sun in the open. … Now you're starting to talk about a real fighter that has the real potential to do what you need to do in a real-world environment," Venable said.

Harrigian said: "As we look at operations in highly contested environments with modern long-range [surface-to-air missiles], increased air-to-air threats and the capability the threat has these days to move targets and make them mobile … the only aircraft that can get there are modern, fifth-generation aircraft."

In a fourth-gen fighter, "you might get in there and release the bomb, but the odds of escaping are not high," he said. "In our minds, it comes down to the ability to kill and survive." The F-35A has robust defenses against electronic warfare and cyber attacks, but he could not go into details.

The helmet with its internal displays as opposed to a heads-up cockpit display is a real-game changer, both Harrigian and Venable said.

There is still a lot of complex work to be done on the helmet, which is expected to be finished in time for the next software upgrade. Meanwhile, the current display that fuses the aircraft's three main sensors — the radar warning receiver, distributed aperture infrared search and track system, and the passive coherent location system — finds and identifies friendly and enemy aircraft and provides unparalleled situational awareness, Venable said.

Harrigian said: "The F-35 [helmet's] tremendous capability is really a first step toward providing that asymmetric advantage to the pilot with that situational awareness it provides for communications, navigation and identification capabilities."

In air combat mode, when the "world is swirling around the pilot," who may be turning 15 to 30 degrees per second with many aircraft flying around in different directions, keeping track of just the friendly jets is a big challenge, Venable said.

"What this aircraft does is to look in any direction and see who is there and you'll be able to tell who is a good guy and who is a bad guy," he said.

Harrigian added that the ability to allow F-35A pilots to be mission commanders will be unmatched.

Air Force tacticians such as Harrigian and Marosko, who is serving as deputy director of air and cyberspace operations at Headquarters Pacific Air Forces in Hawaii, are just beginning to look at not only what the F-35A can do, but what it will be able to accomplish flying in teams with fourth-gen aircraft as well as joint forces and allies.

F-35A Lightning II aircrafts

The F-35A will have to address threats covering an entire spectrum from relatively permissive environments found in Central Command's area of operations to more contested scenarios found in the Pacific Command, Marosko said.

For example, the F-35A could be used to destroy enemy air defenses to create pockets of permissive airspace in which fourth-generation aircraft can operate, he said.

Venable said most of the current F-35A pilots have only 100 to 300 hours of flight time on the aircraft, which isn't much. "These guys aren't getting out and standing their airplane on its tail. They're not understanding the nuances and they really need to be given that opportunity with a lot of flying time to go out there and max fly the airplane."

Harrigian said: "There is more work that needs to be done with this. … When you give this stuff to airmen: get out of the way. They've got it."

Venable said: "This airplane is not out of the woods. It still has some growing to do and the growing pains are still going to be with us for awhile."

When the Defense Department decided to do concurrent development, it chose a path of greater risk, he said. He pushed back at the notion that concurrency was acquisition malpractice, although there were lessons to be learned from the program's mistakes.

The years between when the F-35 was conceived and today were ones of rapid technological advancement. To have frozen the requirements in place in 2001 would have resulted in a fighter that was outdated as soon as it was fielded, he argued in his report. The Royal Air Force's Tornado F-3 is one example. The technology that went into it was mature, there were no technological risks, and therefore no technological leaps. It was virtually obsolete as soon as it was fielded. The Defense Department had that program in mind when it chose concurrency.

"The risks of developmental delays and cost overruns were accepted to mitigate an even bigger risk: that the United States would field its own version of the Tornado F-3," he wrote.

That "riskier acquisition strategy had to pay off dividends … and what the payoff is — from what the pilots told me — is an extraordinary fighter," he said.

One lesson to takeaway is leadership. The program's first 18 years saw nine directors. The military's habit of swapping out program managers every three years to accommodate officer career paths just doesn't work with a long, complex acquisition process, he added.

After the Defense Department recognized this, it installed Lt. Gen. Christopher Bogdan as the director, and has kept him in the position.

"The single biggest requirement [for a program like the F-35] becomes competent, long-tenured leadership," Venable wrote. ND

Email comments to smagnuson@ndia.org

AIR FORCE

Space Division Presents Teets Award to Raymond, Faga

The National Defense Industrial Association's space division Aug. 1 presented the Honorable Peter B. Teets Award to Lt. Gen. John W. "Jay" Raymond, Air Force deputy chief of staff for operations, and Martin C. Faga, retired president and chief executive officer of the MITRE Corp.

The award is the space division's highest honor and recognizes public and private sector leadership or achievement that results in significant contributions to the development, introduction, operational contribution or support of space systems. The award dinner took place during the division's annual Space Policy and Architecture Symposium in Chantilly, Virginia.

Raymond has distinguished himself as a leader in space and missile operations for over 30 years and has an extensive record of success, innovation and contributions to national security space, particularly in the integration of space with other domains of warfare in the joint environment. In his current role, he is responsible to the secretary of the Air Force and the chief of staff for formulating policy supporting air, space, cyber, irregular warfare, counter-proliferation, homeland security and weather operations.

Faga has more than 40 years of distinguished and devoted service as a leader in the national security space community. He was the 10th director of the National Reconnaissance Office where he revolutionized NRO support to the military, downgraded the classification of NRO products, and appointed a deputy director for military support. He also served from 1989 to 1993 as assistant secretary of the Air Force for space while also director of the NRO. He joined MITRE Corp. in 1993, retiring as the president and CEO in 2006. He remains active on numerous government and industry panels and boards continuing to shape the future of national security space.

NDIA Space Division Chair John Williams (left) and NDIA Executive Vice President Barry Bates (right) present Lt. Gen. John W. "Jay" Raymond with the Peter B. Teets Award.

NDIA Calendar

SEPTEMBER

1 S&ET Executive Breakfast Featuring Dr. Jason Matheny, Director, IARPA
Washington, DC
www.ndia.org/meetings/672D

9 Rocky Mountain Chapter 33rd Annual Ball
Colorado Springs, CO
www.ndiarmc.org

12-15 Insensitive Munitions and Energetic Materials Technology Symposium
Nashville, TN
www.ndia.org/meetings/6550
See our ad on p. 46

12-16 2016 SIW (Simulation Innovation Workshop)
Orlando, FL
www.trainingsystems.org

13 NDIA Washington, DC Chapter Breakfast
Arlington, VA
www.ndia.org/washdc

19-21 Joint Undersea Warfare Technology Fall Conference
Groton, CT
www.ndia.org/meetings/6240
See our ad on p. 46

20-21 Mastering Business Development Workshop
Herndon, VA
www.ndia.org/meetings/607E

27-28 Insider Threat Workshop
Washington, DC
www.ndia.org/meetings/680B

OCTOBER

6 U.S.-UK-Australia-Canada Quadrilateral Conference
Arlington, VA
www.ndia.org/meetings/7570
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11-13 21st Annual Expeditionary Warfare Conference
Portsmouth, VA
www.ndia.org/meetings/7700
See our ad on p. 45

12 TRIAD
Chantilly, VA
www.ndia.org/meetings/714T

17-18 Supply Chain Workshop
Washington, DC
www.ndia.org/meetings/7040

18-19 NDIA Great Lakes Chapter Annual Meeting
Oshkosh, WI
www.ndia-greatlakes.org

19 S&ET Executive Breakfast Featuring Major General Robert McMurry, Commander, AFRL
Washington, DC
http://www.ndia.org/meetings/772A

19-20 Manufacturing Division Meeting
Washington, DC
http://www.ndia.org/meetings/719A

21 Health Affairs Biodefense Summit
Washington, DC

DETAILS COMING SOON

21 NDIA Washington, DC Chapter ROTC Scholarship Lunch
Arlington, VA
www.ndia.org/washdc

24-27 19th Annual Systems Engineering Conference
Springfield, VA
www.ndia.org/meetings/7870
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25-26 San Diego Chapter Fall Defense and Industry Forum
San Diego, CA

25-27 Precision Strike Technology Symposium (PSTS-16)
SECRET//NOFORN Classification Level
Laurel, MD
www.precisionstrike.org
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31-Nov 2 28th Annual Integrated Program Management Workshop
Bethesda, MD
www.ndia.org/meetings/7IPM
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NOVEMBER

1-2 Gulf Coast Chapter 42nd Air Armament Symposium
Fort Walton Beach, FL

2-3 How Washington Works® – Navigating the DOD
Reston, VA
www.ndia.org/meetings/743A

3 Picatinny Chapter Annual 36th Firepower Awards Luncheon
Randolph, NJ

8-10 Aircraft Survivability Symposium 2016
Monterey, CA
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10 CyberForwardDC
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14-16 2016 Joint Annual NDIA/AIA Fall Industrial Security Committee Conference
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www.ndia.org/meetings/7ISF

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www.iitsec.org

DECEMBER

1 S&ET Executive Breakfast Featuring Dr. Melissa Flagg, Deputy Assistant Secretary of Defense for Research
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6 Combating Terrorism Technical Support Office (CTTSO) APBI
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This conference is classified Secret U.S. Only.

Groton, CT ▪ September 19-21, 2016
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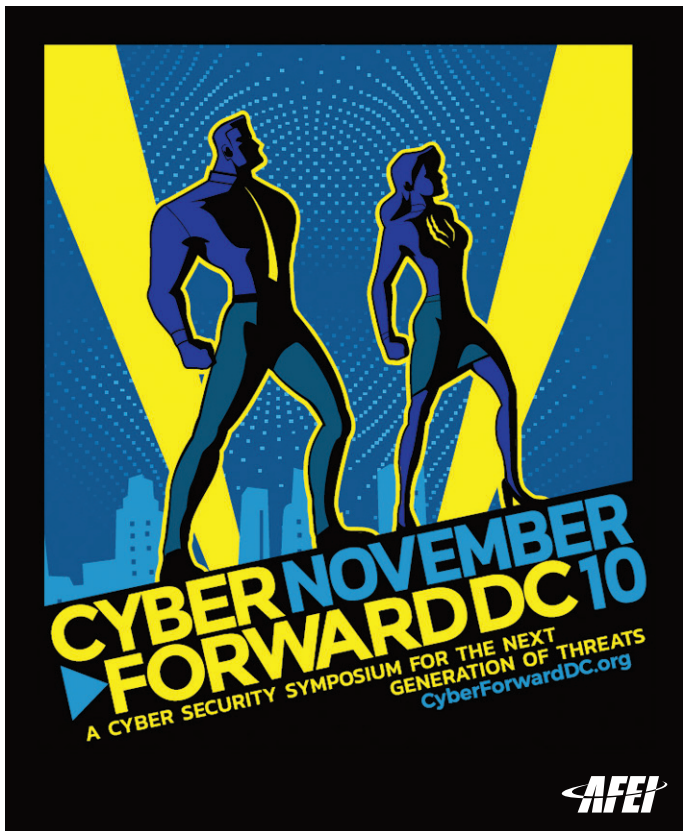

Next Month

Ground Vehicle Technology

■ The Army and Marine Corps are looking to enhance the survivability of their ground vehicles without adding additional armor and weight. To accomplish this, the services are seeking new technologies such as active protection systems, signature reduction, and increased speed and mobility. DARPA's Ground X-Vehicle Technology program is tapping industry to develop solutions.

Soldier-Focused Innovation

■ The Warrior Web program, spearheaded by the Defense Advanced Research Projects Agency, aims to give dismounted infantrymen greater endurance by outfitting them with robotic exosuits to air their movements and reduce the weight burden of their gear. The effort to advance the technology is moving forward at military and academic laboratories around the country.

Chemical-Biological Defense

■ It's time for the joint program office for chemical and biological protection to replace 100s of thousands of ensembles worn by service members when such weapons of mass destruction are employed. Users want more flexibility to don different layers of protection depending on the circumstances. But to do this, they also need better sensors to tell them what kinds of threats are coming their way.

Body Armor Technology

■ For the past several years, the weight of soldiers' body armor has remained a costly issue across the U.S. military. We explore the current state of personal protective gear in the field, and what new trends may provide the lighter, but no less effective, coverage officials are seeking.

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