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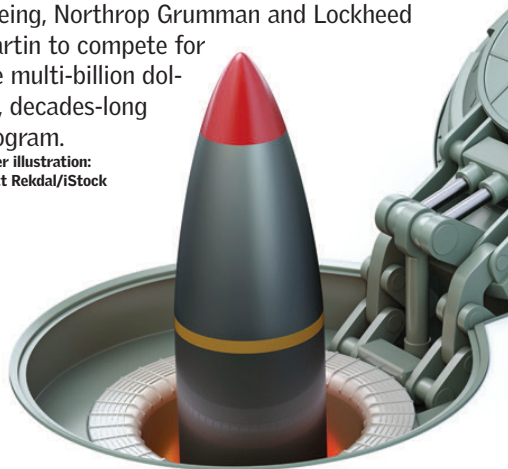
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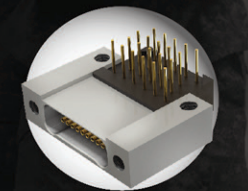
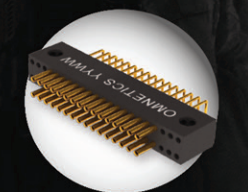
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True Costs of Brexit Remain Unknown

As it pertains to national security and the defense industrial base, there has been no larger story over the past month than the surprise vote in the United Kingdom to exit — or to begin the process of exiting — the 28 nation European Union.

Dubbed by the media as “Brexit,” meaning a “British Exit” from the EU, the polls preceding the June 23 vote indicated a close vote between those wanting to “leave” the union and those wishing to “remain.” The conventional wisdom was that “remain” would prevail, but regrettably the conventional wisdom was wrong.

The final Brexit result took nearly everyone by surprise. Placed before the citizens of the United Kingdom as a national referendum, 52 percent voted to leave the EU compared to 48 percent voting to remain. When asked to explain how the polls and the U.K. political establishment were so wrong, former British Prime Minister Tony Blair commented that, “If I could answer that I would still be running for office.”

The impact on the financial markets was immediate and negative. On the day following the vote, markets around the world dropped sharply. The Dow-Jones Industrial Average went down over 600 points on its way to dropping 4.8 percent before bottoming out the following week. For the S&P, a broader index, the drop was even more pronounced as it fell by 5.3 percent before leveling off and starting to climb back as the realization settled in that nothing immediate would actually happen following the vote, which was reinforced by the confusion that quickly engulfed the British governmental process.

During this turmoil, the leading U.S. defense stocks did relatively well, once again showing their quality as a stable investment even in moments of great uncertainty of the type that financial markets deplore. As National Defense Industrial Association board member Jim McAleese, president of McAleese Associates wrote, investors should expect, “further investor rotation out of commercial aerospace, [and] into pure defense stocks because of longer visibility, strong cash flow, and aggressive return of cash to investors (share repurchases and dividends). Expect broader commercial investors to park funds temporarily in defense stocks as defensive measure.”

McAleese has, as usual, proven to be prophetic. During the period between June 23 and the July 4th holiday break, only The Boeing Company, whose commercial aircraft sales account for nearly two-thirds of its annual revenue, finished with a lower stock price. The other major defense firms were either higher or essentially unchanged. There is, however, one caution to be observed: the S&P Defense Index remained slightly down, reflecting the relatively greater sensitivity that smaller firms have to market mayhem.

There is another important dimension to Brexit that must be kept in mind. For a variety of reasons this is an era where there are tremendous centripetal forces at work within major nation-states and within the institutions of international order that developed in the post-World War II era. It may be that older generations see current circumstances unfavorably compared to

a past they feel was more comfortable and stable, a condition suggested by the fact that in the Brexit referendum the young voted overwhelmingly to remain while older voters preferred to leave, a rather stark difference in generational perspectives. But the major question is what other forces might surface?

Having lost the vote that he had vigorously supported, Prime Minister David Cameron announced his resignation, a step that has led to an unusual scramble to replace him as the potential conservative party successors are seemingly reluctant to actually initiate the two-year process of EU withdrawal by evoking Article 50 of the 1993 Treaty on European Union, more commonly known as the Maastricht Treaty. Indeed, in both the British Conservative and Labor party members, many who championed the “leave” movement, now seem reluctant to actually “leave.” Many have quietly resigned from their posts, while others have initiated calls for another referendum to reconsider the earlier vote, or to delay the formal steps of the actual implementation of the unprecedented British vote until it is more fully understood.

Meanwhile, Scotland and Northern Ireland, both of which voted strongly to remain in the EU, are now making noise about either leaving the United Kingdom itself, or negotiating their own separate membership arrangements with the EU. In short, in addition to the financial uncertainty that may result from the Brexit vote, a large amount of political uncertainty may linger for some time confusing the future role of the world’s fifth largest economy and the United States’ most trusted ally.

All of this is occurring during a period of great strategic stress. We have witnessed an increase in terrorist attacks from Bangladesh to Istanbul seemingly supported by ISIS. As the territory ISIS actually controls compresses, its resort to external terrorism seems to be growing. In addition, Europe faces the threat of continuing Russian aggressiveness, behavior some western leaders have called “reckless,” and which President Vladimir Putin shows no signs of abandoning.

Although Brexit has no immediate impact on NATO, there are inevitable consequences to its efforts to increase defense spending and expand cooperative developmental programs such as the joint strike fighter and other important modernization efforts. As Anne Applebaum of the Washington Post noted about Brexit, “the real damage will be done by things that will now not happen.” Hopefully efforts over the past decade intended to expand, integrate, and further modernize NATO will not be among those things that “will now not happen.”

We are obviously in a period where voting publics, certainly in the United Kingdom and possibly in the United States, are more concerned about perceptions of independence and sovereignty rather than influence and importance. Certainly a diminished Great Britain is not in America’s economic and security interests, but it will be unclear for at least two more years whether others, particularly the citizens of the United Kingdom, agree with that proposition.

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Volatile Election Not Fazing Defense Sector

Pundits and professional soothsayers see the presidential election swinging in favor of Democratic nominee Hillary Clinton. The Senate remains too close to call as Republicans gear up to defend 24 seats, while Democrats try to hold onto 10 seats and eye a possible path to retake the majority.

The American public is said to be disappointed and appalled by the tone of the campaign and the daily torrents of personal attacks. Political incivility aside, the defense industry and national security insiders appear relatively content with what they are seeing.

No matter who wins in November, the defense sector can rest assured that the anti-spending wave that swept Washington six years ago is receding faster than anyone had predicted. Both Clinton and Trump want to spend more money, and both candidates appear poised to support a deal to get rid of sequester caps.

"Next year you are going to have folks doing things to increase growth, and that includes defense spending increases," says Steve Bell, senior director of economic policy at the Bipartisan Policy Center.

A slow economic recovery, layoffs in the defense industry, congressional outrage about troop cuts and aging aircraft fleets — all amid a growing recognition that the world is less safe — have shifted the mood in favor of larger military budgets and more spending overall.

Bell, an erstwhile Senate staffer who worked with former Republican Sen. Pete Domenici, fought for 40 years in the political trenches to reduce the federal deficit. In 2012 he served on the Domenici-Rivlin debt-reduction panel.

The winds have changed and the bloom is off the deficit rose, he says. "That's just the truth." The political world has concluded that the deficit no longer moves votes. Bell adds: "I think that things like growth are much more powerful and more motivating than debt."

As of this writing, House, Senate and administration leaders continue to bicker over defense hawks' tactics to boost defense spending by \$18 billion in 2017. But that is all for show, as the Pentagon is almost certain to get the additional funding, and nondefense agencies should see a comparable increase, Bell says. "I think that's all baked in the cake no matter who wins the election, who wins the Senate, whether it's Trump or Clinton in the White House."

Defense spending over the past eight years was nearly a trillion dollars less than what the Pentagon had projected before the Budget Control Act. Top defense contractors with lots of cash reserves weathered the storm by buying up their stock and paying out dividends. Most lower-tier contractors, however, have taken a financial beating from the defense downturn, eroding economic growth in the Washington, D.C., area and other parts of the country.

Economists at JPMorgan put it best in a recent blog post: Government spending cuts are "not making voters happy; they are clamoring for better. Monetary policy has done a

heroic job keeping the world economy afloat, but it does not have much left to give. It is probably time to pass on the baton to fiscal policy, as governments can borrow at historic low costs."

The sequester mechanism that Congress enacted in 2011 to cut government spending is now regarded as pure insanity, Bell says. Minor budget deals negotiated in 2014 and 2015 didn't make much of a dent, at least for the Pentagon. The cost of personnel, including payroll and benefits, is growing faster than inflation and eating into readiness and weapons modernization accounts.

There is still considerable trepidation in national security circles about the possibility of a Trump presidency. "Serious people I talk to both in the executive branch and on Capitol Hill believe that Hillary Clinton would be a better commander in chief," he says. "She knows the players, has dealt with them. And she probably understands the nuances of what is happening" around the world.

Trump causes watchers to shake their heads. On the defense budget he first railed at the Pentagon for spending too much. Then he changed his mind and said the budget should be increased. "I think he has no idea of what the federal budget looks like, no conception

"The mood has shifted in favor of larger defense budgets."

of what has happened over the past 10 years in defense spending," says Bell. "He talks about taking care of troops and increasing their compensation not recognizing that compensation costs have gone up."

There are still pockets of insiders who would prefer a Trump administration because they worry about Clinton continuing Obama's tepid approach to handling foreign crises and managing the defense bureaucracy, Bell observes. "There is tension between people in the industry who want more spending and programs accelerated, and people who say no matter how much money there is, there has to be a commander in chief with experience," he says. "Given the unstable global situation, many would rather have Clinton in charge than someone who would have to learn defense from the ground up."

In this uncertain political climate, some defense industry lobbyists are warning clients to stay on the sidelines and focus on what they might do to create a more beneficial business climate under a new administration, regardless of who wins in November. "It's time to throw out the old playbook," says Dan Hill, a long-time lobbyist and founder of Hill Impact.

He has advised his clients to not spend a dime on major party conventions or even contribute to campaigns.

"D.C. used to be 100 percent a relationship town and today it's so much more than that," he says. "Relationships still matter, but there's more to it than there used to be."

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Contemplating Life After the Warthog

■ Air Force Chief of Staff Gen. Mark Welsh shortly before his retirement laid out his vision for an aircraft that could replace the A-10 Thunderbolt II, better known as the Warthog.

He likened it to a “flying Coke machine.” But instead of dispensing sodas based on the purchaser’s taste, the pilot would call forth different weapons depending on what the situation called for: perhaps its famous 30mm GAU-8 Gatling gun for a strafing run, or a Hellfire missile to take out a high value target.

The National Defense Magazine story with Welsh’s thoughts, to the surprise of no one on the staff, shot up to the most read story online and garnered a slew of comments. Writing about the A-10 is guaranteed to get tons of page views and to be circulated widely on social media. The aircraft has passionate and knowledgeable followers and they leave detailed and — in most cases — insightful comments. And they’re not big fans of Air Force leadership, to put it mildly.

“Welsh seems to be giving the future CAS concept lip service so that he can kill the A-10 by saying a replacement is in the pipeline — a replacement with no program and no funding,” Aaron, a reader said in reaction to the “flying Coke machine” story.

The second part of that comment is verifiable. There is no program or funding for an A-10 replacement, and with a long list of much needed modernization programs such as the T-X jet trainer, the Joint Surveillance Target Attack Radar System (JSTARS) and the wildly expensive proposition of building up the F-35 fleet, it’s unlikely to make it on an acquisition priorities list any time soon. But contemplating next-generation weapon systems is something all the services do even if Congress isn’t forthcoming with the funding. They have personnel who are paid to think about what comes next, and the reports they generate can drive early research and development.

And there will come a day when the A-10 will retire. When that day arrives, is anyone’s guess. The Air Force says the current reprieve is only until 2021. But that certainly could change. Once T-X and JSTARS development are off the Air Force’s plate, an A-10 replacement is a candidate to take a spot on the acquisitions priority list.

The cynicism displayed by Warthog fans is understandable considering the mixed messages that have come from Air Force leadership since the idea to retire the aircraft was first proposed during the 2013 budget crunch.

The first message was that the Air Force’s F-35A would simply take over the close-air support missions that the A-10 previously performed. The Warthog would soon be a white elephant, they argued. That elicited scorn from both the A-10 fans and F-35 critics. When exactly was the F-35 going to be fully fielded and able to replace the Warthogs?

And they intended to fly a \$110 million high-tech jet fighter low and slow enough to be exposed to hostile fire?

This idea of the A-10 being outdated for modern combat was reiterated by then-Air Combat Command commander

Gen. Michael Hostage, who said: “I can’t send an A-10 to Syria. It would never come back.” The Air Force needs to make room for aircraft that are newer, more capable and survivable, he added.

Within four months of this statement, A-10s were stationed in Turkey and regularly flying missions into Syria. A video posted on YouTube seen by nearly a half million viewers showed footage of the aircraft obliterating Islamic State fuel trucks.

The A-10s certainly have a lot of life left in them and modernization and sustainment programs could keep them flying for years to come. But there could be something better.

“We don’t think this would take that long to do and we don’t think it’s that complicated of a design problem,” Welsh said. “The technology is available to us. We can develop it.”

Hope, of course, springs eternal when it comes to new-start acquisition programs. But there are two competing trends in the Defense Department now. One is the cautious approach that calls for only mature and trusted technologies to be integrated onto platforms. Keep requirements stable, even if the world changes during the course of the program development. No risky “unobtainium” should be included in the platform.

The other is the “third offset” touted by senior Defense Department leadership. This calls for leap-ahead next generation weapon systems that are going to be miles better than anything potential foes may have and that can operate in anti-access/area denial scenarios.

Welsh indicated the new CAS aircraft would be the former.

To control requirements and keep costs down, the aircraft would need to be designed to operate in a low- to medium-threat environment similar to Iraq and Afghanistan, he said.

Currently, the A-10 is somewhat one-dimensional and is routinely described as a “flying cannon.” It has a secondary role in combat search and rescue. Its pilots can coordinate the recovery of those caught behind enemy lines and escort helicopters out of danger zones.

Integrating several different weapon systems and their targeting pods onto one platform would probably be more challenging than Welsh believes. To wit, the F-35’s Gatling gun is four years behind schedule. The terms “open architecture” and “plug and play” look good on PowerPoints but in reality, they have their own challenges.

Still, a new close-air support aircraft could serve as a “flying Coke machine” — perhaps a “flying Swiss Army knife” would be a better analogy — that included a Gatling gun, a couple different missiles and a laser that could be attenuated from lethal to nonlethal scenarios. There might be times, for example, when it is advantageous to fry a vehicle’s electronics instead of destroying it so the occupants could be captured alive. Lasers are being tested aboard Predator drones this summer.

This new aircraft might even be something that the loyal A-10 community could eventually embrace.

Email your comments to smagnuson@ndia.org



New Initiatives for Ethics Committee

The National Defense Industrial Association is proud to have long been a proponent of ethics in the defense industry.

In 2004, NDIA launched its members' "Statement of Defense Industry Ethics," which appears on the NDIA Ethics Source webpage (www.ndia.org/resources/pages/theethics-source.aspx). The statement, including a list of NDIA "Common Ethical Principles and Practices," articulates ethical business standards to which member companies aspire. It also recommends key practices that contractors should implement to adhere to those principles.

Much has changed in the business environment and in the defense industry ethics arena since 2004. Ethics programs are no longer optional for contractors. Since 2008, the Federal Acquisition Regulation has contained specific requirements for ethics and compliance programs. We have seen a proliferation of other new regulations requiring greater effort by contractors to remain current and compliant. Enforcement efforts by the government have also intensified. There are many new laws affecting those of us whose operations extend beyond U.S. borders. All these developments contribute to a complex and demanding business ethics and compliance environment. What has not changed is that ethical business conduct is essential to the relationship of trust between the defense industry and our government customers.

In March, Bill Birkhofer of Jacobs Engineering assumed the role of chair of the Ethics Committee. Other Committee members include: Glenn D. Baer, ARINC; J. Kelly Brown, Template Software Inc.; Dale W. Church, Ventures and Solutions LLC; Vincent J. Ciccone, Rasco Inc.; Margaret DiVirgilio, Concurrent Technologies Corp.; R. Andrew Hove, AM General; John D. Illgen, Northrop Grumman; Stephen E. Kelly, Battelle; James McAleese, McAleese & Associates; Richard D. McConn, M International; Brig. Gen. Graham E. Shirley, USAF (Ret), The Pegasus Group Inc.; and Capt. Debra A. Thurman, USAF (Ret), DT Business Solutions LLC.

Under Birkhofer's leadership, the Ethics Committee is working to identify opportunities to expand NDIA's role as a leader of ethics advocacy in the defense industry. In its first meeting in June, the group agreed to undertake a variety of initiatives to benefit the NDIA membership. The committee intends to

create a forum for education, information and best practice sharing. It also plans to serve as an advocate when needed and enhance NDIA's visibility as a force for ethics in the defense community. With this column, the committee wants to inform members of its plans and also solicit assistance from members in meeting its goals.

In order to serve the membership best, the committee will strive to incorporate members representing the wide range of companies that make up NDIA, to include large, medium and small businesses, primes and subs, suppliers, women-owned, veteran-owned and every type of contractor.

The Ethics Committee has identified a number of initiatives it plans to undertake over the next year. For starters, it intends to increase the ethics program resources and best practices available to members on the Ethics Source page, including additional links to member companies' codes of conduct and other existing online resources such as policies and training.

It will also provide additional resources specifically focused on small- and medium-sized contractors. Smaller contractors are usually so intensely focused on execution, with thinly spread resources, that they may not always be aware of some of the evolving regulatory requirements. They will benefit from easy access to information and resources to help them implement cost-effective ethics and compliance programs.

Another goal is to conduct outreach to other organizations that share an interest in fostering defense industry ethics such as the DII, the Defense Industry Initiative on Business Ethics and Conduct, to explore opportunities to collaborate and share resources and best practices.

It will also explore regular interface meetings with the Department of Defense to raise awareness of the constructive efforts going on in the industry.

The "Ethics Corner" column in National Defense Magazine will be used to write about current hot topics and best practices, focusing on sharing practical information members can use every day.

In addition, the committee will review the existing online NDIA Statement of Defense Industry Ethics and determine if it needs to be updated.

Finally, it will share information and updates regarding trends and best practices in ethics and compliance programs by providing speakers at chapter and division meetings.

The Ethics Committee wishes to issue to all members an invitation to contact Bill Birkhofer at 571-218-1459 / bill.birkhofer@jacobs.com or Anne Harris at 571-599-0417 / anne.harris@ethicsworks.com to contribute ethics training materials, share access to a company's ethics statements and compliance resources, or to suggest additional initiatives to benefit NDIA members.

It is in all of our interests to proactively support continued high ethical standards in the defense industry.

Anne R. Harris, principal of Ethics Works LLC, provides pro bono support to the NDIA Board of Directors Ethics Committee.

Help Raise the Tide for NDIA Members

The NDIA Ethics Committee plans to expand access to ethics and compliance resources for members. NDIA members are invited to add a link to their company's Code of Conduct and Ethics and Business Conduct web page to the virtual library of best practices on the NDIA Ethics Source.

Contact Bill Birkhofer 571-218-1459 / bill.birkhofer@jacobs.com or Anne Harris 571-599-0417 / anne.harris@ethicsworks.com



Bid Protests: If It Ain't Broke, Don't Fix It

The Government Accountability Office's bid protest system is one of the most efficient and effective ways this nation has of protecting itself from wasteful spending. It ensures that agencies make rational, informed decisions about what really constitutes "best value."

In recent years, the Department of Defense has complained that there are too many protests overall, and that the system is awash in "frivolous" protests. But the facts don't support those complaints.

The system includes key elements that discourage and prevent frivolous protests. Nonetheless, DoD's complaints seem to have gained some traction in the Senate. Three provisions in the Senate version of the 2017 National Defense Authorization Act would limit GAO's jurisdiction and otherwise curtail protests.

We believe the provisions as written would significantly reduce GAO's oversight function, producing unintended and undesirable consequences.

Protests have been increasing over the last number of years. But the number of protests is not high by historical standards. In fiscal year 2015, GAO received 2,639 protests, for an average of just 6.0 protests per billion dollars in procurement spending. In contrast, in 1993, GAO received 3,377 protests, for an average of 11.1 protests per billion, adjusted for inflation.

Also, after significant increases from 2008 through 2011, the growth in protests has begun leveling off. The steepest increases coincided with the implementation of GAO's jurisdiction over task and delivery order competitions valued at more than \$10 million. In fiscal year 2014, 21 percent of all contracting dollars — \$94 billion — was awarded via multiple award, "fair opportunity" contracts.

The use of task and delivery order competitions is exploding, making GAO's continued oversight of such procurements critical.

Each year, GAO tracks the "effectiveness rate" of protests, which is the percentage of protests in which GAO sustains, or the procuring agency voluntarily agrees to take corrective action. In fiscal year 2015, the effectiveness rate was 45 percent. So in almost half of all cases, the protester identified a problem that either GAO, or the procuring agency itself, agreed needed to be fixed. Nor was 2015 an outlier: In each year from 2008 to 2015, the effectiveness rate was 42 percent or higher. These numbers show that protesters are doing a good job of identifying when there's a problem that needs to be fixed.

The high effectiveness rate is striking, considering how difficult it is to win a protest. A protester must show either that the agency violated procurement law, or that its exercise of judgment was irrational. It's not enough for a protester to show that an agency's judgment was wrong; the judgment must be so wrong that no reasonable person could reach the same conclusion.

In short, the protest process puts a heavy thumb on the scale in favor of the agency, yet protesters still win 45 percent of the time. And when protesters lose, that doesn't mean that the protest was frivolous.

The system already prevents frivolous protests in formal and informal ways. GAO's bid protest regulations have long barred protests that are legally or factually baseless. So companies avoid filing baseless protests, which are subject to summary dismissal, often within 30 days after the protest is filed.

An equally powerful protection is that companies don't like suing their customers. Companies decline to bring even meritorious protests for fear of damaging their customer relationships. Even for an incumbent contractor, getting three more months of performance by filing a protest pales in comparison to the risk of poisoning the well with a valued customer.

The Senate version of the NDAA contains three provisions that would limit protests and GAO's oversight function. First, the language would eliminate GAO's jurisdiction over task and delivery order awards valued over \$10 million, in favor of review by a DoD ombudsman. The ombudsman process has been in place for years, and no one views it as a meaningful oversight mechanism: It doesn't catch mistakes, and doesn't provide critical feedback to an increasingly junior acquisition workforce. If this provision passes, a huge and rapidly growing portion of DoD procurement spending will have no effective oversight.

The language would also require contractors over a certain size to pay GAO's costs if they lose; and incumbent contractors that protest to forfeit their profit from any resulting bridge contract, unless GAO sustains the protest or the procuring agency cancels the solicitation.

These provisions go far beyond discouraging frivolous protests. The first would penalize a company that files a perfectly legitimate protest, but loses because of the high burden of proof and deference given the agency. The second is even worse: The protest might be a slam-dunk, and cause the agency to take immediate corrective action. But if the agency doesn't cancel the solicitation (which wouldn't make sense in most cases) the protester loses its profit. Both provisions would severely chill valid protests, all in the name of fending off DoD's fictional wave of frivolous protests.

GAO's bid protest process performs a critical oversight function. One example may serve to drive the point home: Whenever an agency awards a cost reimbursement contract, it must evaluate whether the offeror's estimated cost is realistic. If it isn't, the agency must adjust the estimate, so it knows what it's really likely to pay if it awards a contract to that offeror. Agencies often make mistakes in this area — which can then be caught and corrected only through a protest.

The House version of the NDAA contains none of the Senate's three provisions. Instead, it includes a provision calling for further study of the protest process and potential improvements to it. That's a wise approach: Congress should take great care before passing measures that would constrain or impair GAO's important oversight function.

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B-21 concept

Questions Loom About Air Force Nuclear Funding

■ The Air Force plans to upgrade its arsenal of intercontinental ballistic missiles and strategic bombers, but it's unclear where the money will come from.

In the 2020s the Pentagon will be facing large bills for nuclear modernization. The annual cost is expected to be \$12 billion to \$18 billion higher than the amount spent on strategic forces in recent years, according to the Defense Department's cost assessment and program evaluation office.

Congress has created a special national sea-based deterrence fund outside of the Navy's regular shipbuilding budget to pay for research and development and advanced procurement of the Ohio-class replacement ballistic missile submarine. Construction of the lead ship in the class is slated to begin in fiscal year 2021. The Government Accountability Office estimated that the overall program would cost \$96 billion.

Air Force leaders have suggested that the service might want a similar fund to help pay for its nuclear modernization programs.

"If you have funding that's set aside for one piece it makes sense to have funding set aside for the entire [nuclear] enterprise," said then-Air Force Chief of Staff Gen. Mark Welsh during a breakfast with reporters shortly before he retired in June.

"Whether it's ... an Air Force fund or one [joint] nuclear fund or no extra funds at all, I don't think it really matters. But we just need to have a fulsome debate about where are we going and prioritizing of resources," he added.

The service is pursuing a new long-range

bomber, the B-21, and has plans to procure a replacement for the aging Minuteman III missile system. A top congressional staffer said the Air Force might not benefit as much from a separate deterrence fund to help foot the bill.

"The cost of the Ohio replacement is so disproportionate to the [Navy shipbuilding] account that just buying the submarine basically shoves all the rest of the procurement out," said Bob Simmons, staff director for the House Armed Services Committee, during a meeting with reporters.

"It's not quite the same problem in the Air Force," he said. "I don't know that it needs something to pull it out so that there's breathing room for the rest of aircraft procurement. We'll have to see."

The new bomber fleet, which is also geared toward non-nuclear missions, was estimated to cost about \$80 billion if 100 aircraft are procured. The Minuteman III successor, known as the ground-based strategic deterrent program, was projected to cost about \$62 billion.

Some analysts have argued that the ICBM arsenal should be scrapped to save money. But Welsh said that leg of the triad is a relatively economical option in some respects.

The ground-based missile force is "really cheap compared to ... operating a submarine or operating a bomber fleet," he said.

The annual operating cost of the Air Force's strategic deterrent is about five percent of the service's budget, he noted. "It's just not as expensive as everybody seems to think it is."



Minuteman III missile test launch

Spending on Third Offset Tech Growing Rapidly

■ The Defense Department is pumping money into so-called third offset technologies intended to help the U.S. military maintain its technological edge.

Between fiscal years 2011 and 2015, the Pentagon spent \$27.8 billion on the portfolio, according to a recent report by analytics firm Govini. The Defense Department estimates that it will spend about \$18 billion on the initiative over the next five years.

The third offset “constitutes a massive overhaul in U.S. military operating concepts and technological investments,” the report said.

There is no official third offset spending account in the Defense Department budget, so classifying particular items as such can be a subjective exercise.

Govini grouped the technologies into five categories: target tracking; navigation and guidance systems; conventional long-range missiles; directed energy; and hypersonics.

Between fiscal years 2011 and 2015, spending on hypersonic technologies saw the largest relative growth, increasing by a whopping 98 percent to a total of about \$200 million, the report said.

Hypervelocity projectiles (HVP) can travel at a speed of Mach 3 or faster. They can be fired from an electromagnetic rail gun or conventional 5-inch guns on combat ships.

“One advantage of the HVP/5-inch gun concept is that the 5-inch guns are already installed on Navy cruisers and destroyers, creating a potential for rapidly proliferating” hypersonic weapons across the force, naval analyst Ronald O’Rourke said in a recent Congressional Research Service report.

Pentagon leaders have identified hypersonics as a promising area for future investment.

“The spending trends ... will continue their steep climb, especially as the technology continues to be used for strategic signaling between the U.S. and China,” the Govini report said.

According to the report, spending on directed energy technology, which the authors called the “flagship initiative” of the third offset, grew by 23 percent in fiscal year 2015 relative to the previous four-year average — reaching a total of approximately \$600 million.

Key congressional staffers have applauded the way the Defense Department is pursuing the third offset.

“You can have transformational outcomes through an incremental process where you fund a lot of ... investments — some of which pan out, some of which don’t,” said Chris Brose, staff director for the Senate Armed Services Committee, during a recent press conference.

He praised Pentagon leaders for reaching out to different innovation centers that are conducting “game-changing research” instead of deciding to “place sort of a huge bet and put all your eggs in one basket.”

Bob Simmons, staff director for the House Armed Services Committee, noted that the initiative isn’t tied to a large program of record.

“It’s a whole bunch of little independent programs that all fit” into the strategy of pursuing a wide range of cutting-edge technologies, he said.



Cost Makes Army Chief Wary of Adding Soldiers

■ Army leaders are voicing concerns about the dwindling number of soldiers in the force. But the service’s top officer and other U.S. officials are worried about congressional efforts to beef up the number of troops.

The fiscal year 2017 House defense appropriations bill calls for more than 20,000 service members above the level requested by the Pentagon, most of which would be added to the active duty Army, Guard and Reserve. Lawmakers have said more troops are needed to handle potential contingencies and meet existing requirements.

The additional end strength provided in the House bill would cost about \$30 billion above the currently programmed levels once military pay and allowances, operation and maintenance support, and Defense Health Program requirements are factored in, according to the Pentagon comptroller’s office.

During a recent conference, Army Chief of Staff Gen. Mark Milley said he would like to have a bigger force but he’s concerned that it wouldn’t be fully funded.

“I would welcome more troops,” he said. “That would be a good thing if and only if there was sufficient money to maintain those troops’ readiness.”

Increasing the number of soldiers without providing additional money to keep them well-trained and equipped “would actually have the opposite of the desired effect,” Milley said. “It would actually decrease readiness and it would begin to hollow out the force. And that is not a direction we want to go.”

The Army has been shrinking due to budget constraints and the withdrawal of most ground forces from Iraq and Afghanistan. Just a few years ago, during the height of counterinsurgency fighting, the active duty Army had 570,000 soldiers. It has since declined to about 475,000 and is on a path to be reduced even further. The House legislation would reverse that trend.

The White House objected to lawmakers’ efforts to boost end-strength beyond what was requested, arguing that it would divert money from other priorities.

“The bill would force the department to take additional risk in the training and readiness of the current force, as well as investment in and procurement of future capabilities,” the Office of Management and Budget said in a statement.

The Obama administration has threatened to veto any legislation that included such a provision.

The Senate defense appropriations bill does not call for the larger force proposed by the House. The differences in the respective legislation are slated to be ironed out during conference in the coming months.

Email comments to jharper@ndia.org



Brexit Could Hurt British Defense Budget

After a nationwide referendum, the United Kingdom voted to leave the European Union in late June. While having numerous effects on trade and immigration, it could also trigger cuts to defense, one report said.

"The United Kingdom's decision to leave the European Union will have consequences for the country's defense market that are likely to include reduced military funding and foreign direct investment but potentially greater latitude regarding procurement decision-making," said a report by IHS Jane's.

The U.K. defense budget was projected to reach nearly \$63 billion by 2020 under plans laid out in the country's 2015 spending review, according to IHS. The organization now estimates the budget will only reach \$59.8 billion, the report said.

Additionally, if the value of the British pound sterling continues to fall, that could lead to defense imports becoming more expensive, which would "erode the effective purchasing power of the U.K.'s procurement budget," the report said.

In 2015, the U.K. exported \$654 million worth of systems-level defense equipment to European Union states.

"Reduced access to the EU market would therefore be likely to have a relatively marked impact on the U.K. defense sector," the report said.

However, Brexit could be good for U.S. defense contractors, said Theodore Bromund, a senior research fellow focusing on Anglo-American relations at the Heritage Foundation, a Washington, D.C.-based think tank.

The United States and the United Kingdom already share a special relationship, especially within defense, and that could be strengthened once the United Kingdom formally leaves the EU in the next year or two, he said.

"It's likely that the U.K., once it is fully outside of the EU, is going to be less interested in European defense cooperation and more in American ones," he said. "It's a marginal advantage for U.S. contractors."

Brexit also has implications for the United Kingdom's nuclear forces. Trident is the nation's sole nuclear deterrent, consisting of Vanguard-class submarines, Trident II D5 ballistic missiles and nuclear warheads based in Scotland. Scots have historically been against the program, and during the country's independence referendum in 2014, political leaders made it clear that Scotland would not keep Trident if it achieved independence.

During the EU referendum, a majority of Scots voted to remain while a majority of English voters opted to leave. Leaders of the Scottish National Party, which overwhelmingly controls parliamentary seats in Scotland, have already called for a second Scottish independence referendum in the wake of the "leave" vote.

The United Kingdom's nuclear fleet is based along the River Clyde, which offers the subs a deep-water port and multiple canals to enter and exit. There are a few alternative locations available in England, Wales and Northern Ireland but none are as advantageous as Scotland, Bromund said.

The future of Trident is a serious question should Scotland vote for independence, but that is years away, he noted. A referendum vote could happen as early as 2018 or 2019, he said.

"Scotland is on a long-term trajectory toward having another very close referendum vote about independence regardless of Brexit," Bromund said. "While Brexit may end up being the trigger, I wouldn't say it is the cause."

The day after the Brexit vote, Vice Adm. Terry Benedict, the U.S. Navy's director of strategic systems programs, said Great Britain leaving the European Union would not change the U.S.-U.K. nuclear relationship.

"I have no concerns about that," he said. "I see ... yesterday's vote in the United Kingdom having no effect on our relationship in the nuclear world."

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FirstNet Faces Coverage, Funding Challenges

■ Four years into the planning of a high-speed nationwide public safety wireless broadband network, state and federal government representatives remain at odds over financial details of the program, officials said during a recent Senate hearing.

FirstNet was established in 2012 as an independent authority within the Department of Commerce's National Telecommunications and Information Administration, and was tasked with constructing a nationwide emergency communications network.

Officials conducted one-on-one sessions with interested telecommunication companies to discuss commercial offerings and major program objectives and to learn more about industry capabilities to meet those objectives. The contract winner will have use of the extra broadband space when not in use by public safety operators.

"Based on what we've seen in the past, the financial incentive isn't enough for the commercial community to do this on their own," said Michael Poth, chief executive officer of FirstNet, during a hearing of the Senate subcommittee on communications, technology, innovation and the internet. "We know taxpayer funds are simply not there to do this by ourselves."

The \$7 billion start-up budget for the program won't sustain FirstNet indefinitely. In order to leverage costs, FirstNet will make use of existing infrastructure to provide its coverage, according to officials. FirstNet must also remain a self-sustaining program, which is where its partnership with commercial enterprises comes in.

"FirstNet must offer public safety-grade services at a cost that is competitive to all users," Poth said. "We expect our commercial partner to be successful in monetizing the excess spectrum so we can use the fees and revenue from their end to keep cost down for public safety users."

Since its initial inception, state representatives have also remained concerned over FirstNet's ability to provide coverage for the nation's rural areas, witnesses said.

"We all have generally the same issues — we [states]



have major metropolitan areas but the rest are substantially rural," said National Guard Maj. Gen. Arthur J. Logan, Hawaii's adjutant general and

director of Hawaii's Emergency Management Agency. "So how do we guarantee coverage? If it's good for the city cop it has to be good for the rural cop. Just because you live in the city doesn't mean you get first priority."

Poth said 100 percent coverage was unrealistic. "We expect industry and technology to give us the tools — like deployables and satellites — to help reach those areas." FirstNet aims to award a contract by Nov. 1, although the exact timing is dependent on the amount of time it takes to complete the evaluation and award process in accordance with the Federal Acquisition Regulation.

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Army Releases Disaster Response Video Game

■ A new Army video game is taking soldiers into the heart of foreign disaster zones and delivering real-world training from their laptop or tablet.

A joint task force — including U.S. Army South, the Army Research Laboratory, the office of foreign disaster assistance and the Army games for training program — has put Disaster Sim into the hands of soldiers after two years of research and development.

Disaster Sim was created by the Army Research Laboratory and programmers from the Institute for Creative Technologies at the University of Southern California as a cost-effective training tool for company grade officers and mid to junior non-commissioned officers engaged in foreign disaster relief, said Maj. Timothy Migliore, chief of the Army's games for training program.

"The more ways you can involve actually doing the task or the job at hand, the faster you learn," he said.

Hour-long vignettes based on real-world events familiarize users with operational environments they could encounter on the ground, and teach them how to work with the office of foreign disaster assistance, non-governmental agencies and the host country. The initial scenario challenges a soldier to respond to needs in Guatemala after an earthquake.

Although it was developed for Army South, the game's editor authoring tools allow it to be tweaked by developers to assist other organizations at a minimal development cost, said Col. Michael Panko, U.S. Army South chief of training and exercises.

"If you're Army Pacific, you can make it look like their area," he said.

Migliore noted the cost-saving benefits of the game.

"If I can develop my own scenario and not have to go outside [the services], we're saving the user money and saving the taxpayer money," he said. Service members across the globe can download Disaster Sim and the authoring tools through an online portal at no charge. It cost approximately \$700,000 to create the training application and the authoring tools, according to the Army Combined Arms Center – Training.

There used to be "a cultural resistance" to using video games as a training tool among the services, Migliore said.

But within the last 10 years, the military has shifted away from that mindset and embraced the virtual training possibilities that offer a more realistic experience at a lower cost, he said. "We've got a ton of what we've liked to call niche games that get to training requirements, and there's nothing remotely that relates to Disaster Sim."

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Underwater Drone Nears Production Phase

■ A new lightweight autonomous underwater vehicle that can be kept in a rucksack is nearly ready for the production line, according to General Dynamics executives.

The company's SandShark weighs 15 pounds and can be outfitted with a number of sensors, said Rand LeBouvier, senior manager of General Dynamics' autonomous undersea systems portfolio.

"You could call it kind of the quadcopter of the undersea world," he said.

SandShark originated from a Defense Advanced Research Projects Agency program known as the adaptable sensor system, he said. The purpose was to create a low-cost, open architecture unmanned underwater vehicle that could be used for a variety of missions, he said. Bluefin Robotics, which was purchased by General Dynamics earlier this year, won that contract in 2013 and the program ended in 2015.

SandShark is "designed to enable people to take a basic vehicle design and then expand upon it to increase capabilities, to test out new sensors," LeBouvier said.

The system is an affordable option for the Navy and other customers, said Tracy Howard, director of undersea programs at General Dynamics.

"For the Navy, there are many applications we see for expendable micro-UUVs to replace or expand on current capabilities," he said. The system could be used for mine countermeasures or for anti-submarine warfare training missions, he said.

General Dynamics is currently in the final stages of refining the design of SandShark to improve upon the DARPA version, LeBouvier said. General Dynamics expects it will begin taking orders toward the end of 2016 and delivering vehicles at the beginning of 2017.

The company currently has interest from military, commercial and academic customers, he said.

In August, General Dynamics will test out a prototype version of SandShark in concert with a 21-inch heavy-weight underwater drone as a payload delivery vehicle, Howard said. The test is part of the Navy's annual naval technology exercise.

"There's a lot of interest in this area, a lot of potential applications," he said. "The Navy sponsors that we're working with on this demonstration exercise ... are anxious to demonstrate a lot of concepts" such as swarming and coordination between multiple UUVs, he added.

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New Tower-Based Fire Detection System Tested

■ Logos Technologies' hostile fire detection system, Serenity, which has until now been fastened on aerostats, has been adapted for mounted stationary use on towers.

The company moved forward with the new version of the system after a customer request, said Douglas Rombough, vice president of business development at Logos, a Fairfax, Virginia-based defense and technology company.

"The original concept was to have Serenity on aerostats, but the Army Research Lab requested mounted modifications so we segued into this new version," he said.

Serenity works off a dual-sensor system. It relies on visuals and acoustics to locate the point of origin of enemy fire. It also reduces false alarms, such as a beam of sunlight reflecting off a car window.

Serenity "picks up the flash of a weapon system and automatically knows how soon it should hear a subsequent bang based on the speed of sound," Rombough said. If the machine doesn't register a sound after it picks up a flash of light, it recognizes it as a false alarm.

The system's range is tied to the height of the sensor, so the mounted tower versions of Serenity will have a lower detection range compared to an aerostat that has a coverage of 2,000 to 3,000 feet, said Frank Plew, Serenity project manager.

The adaptation to a stationary dual-sensor was relatively simple, he said.

"Physically, we developed new mounting kits," Plew said. "The architecture of the camera and acoustics detection didn't change. We found it actually works better at a lower altitude," he added, referencing Serenity's improved acoustic and light pick-up capabilities at such altitudes.

Logos isn't phasing out the aerostat version of Serenity. According to Plew, the mounted system can easily be installed on an aerostat without any modifications.

"You can have them set up on alternate platforms within a few hours," he said.

Preliminary work has also begun on mounting Serenity on a moving platform, such as an unmanned aerial vehicle, he said.

Recently, the mounted version of the sensor passed preliminary testing in Huntsville, Alabama. The intent is to be able to use the mounted sensor on any U.S. base or combat zone, Plew said.

"We've primarily been working with the Army to develop the sensor, but our hope is that Serenity will be used within other military branch sites overseas," Rombough said.



— Kristen Torres ■ serwin@ndia.org

International Missile Defense Market Heats Up

■ As NATO celebrates the operability of its first land-based Aegis Ashore missile defense system in Romania, nations around the globe are seeking their own missile defenses.

Countries in Europe, the Asia-Pacific and the Middle East are considering lower-tier air and missile defense capabilities to protect themselves against rising threats from Russia, Iran and North Korea.

NATO allies including Poland, Germany and Denmark “are exploring options for new air and short-range missile defense capabilities in the face of what appears to be a changing Russian posture,” said Thomas Karako, a missile defense analyst at the Center for Strategic and International Studies, a Washington, D.C.-based think tank.

Danish Maj. Gen. Henrik Dam, the defense, military, naval and air attaché for the Embassy of Denmark, echoed this thought at a recent Missile Defense Advocacy Alliance roundtable in Washington, D.C.

“It’s time to re-establish a credible air defense,” he said. “You cannot win a war from the air, but if you don’t master the air, you lose the war.”

Karako said there is a “land rush” by companies to fill this gap in the near term. Germany is developing Lockheed Martin’s



The Aegis Ashore missile defense system in Romania

medium extended air defense system to replace its Patriot surface-to-air missile systems, and Poland has expressed interest in Raytheon’s next-generation Patriot system. Suppliers in France and elsewhere are also in the competition, Karako said.

“What we’re seeing is increased demand and a diversity of suppliers in an air and missile defense market that’s heating up,” he said.

South Korea and Japan are also thinking more seriously about the suite of capabilities they need, as are Middle Eastern countries such as Saudi Arabia, Kuwait, Qatar and the

United Arab Emirates.

“There’s increased global supply and demand for missile-based strike and the means to counter them,” Karako said.

The Aegis Ashore system in Romania, declared operational in May, completes phase two of the European phased adaptive approach missile defense system, the United States’ contribution to NATO’s ballistic missile defense. The first phase involved the deployment of four Aegis-equipped guided-missile destroyers to Naval Station Rota, Spain, between 2014 and 2015. A second Aegis Ashore system to be installed in Poland by 2018 will complete phase three. NATO established missile defense as a core alliance mission in 2010.

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Defense Innovation Initiatives Out of Sync

Commentary

By Scott Chandler

In the first of four trips to Silicon Valley over the last year to advance his innovation agenda, Defense Secretary Ashton Carter assured his Stanford audience that DoD is a strong proponent of protecting intellectual property rights. However, this statement does not reflect actual policy on intellectual property, a reality widely understood, and the disconnect suggests this innovation outreach is likely in vain.

Defense acquisition policy is defined in statute, in regulation, in published guidelines, in training and in defense media — and most if not all of it is public. DoD's competition guidelines include a large section on intellectual property strategy which instructs government contracting officers to establish an IP strategy for the "full spectrum of IP and related issues," which it deems as a "critical mechanism to remove barriers to competition." In the month following Carter's first visit to Silicon Valley, then-chief acquisition officer for the Air Force Bill LaPlante wrote: "We cannot achieve our goals of developing, procuring and fielding adaptable and agile capabilities without our government program offices 'owning the technical baseline.'"

At the Reagan National Defense Forum, defense procurement chief Frank Kendall expressed the view that "industry uses IP as a weapon to gain competitive advantage."

Carter recognized in that first Silicon Valley speech that "IP is often the most important and valuable asset a company holds." Company valuation by investment bankers, stock market analysts and venture capitalists is in large part based on the company's intellectual property portfolio, and its ability to monetize it through new products and financial returns. DoD's own guidebook on intellectual property, written in 2001 understood that "a company's interest in protecting its IP from uncompensated exploitation is as important as a farmer's interest in protecting his or her seed corn."

The 2012 National Defense Authorization Act awarded the government new rights to data generated or used in performance of a contract and data required for segregation and reintegration of items into major programs — even for commercial items — plus other new rights. These new rights already in statute have been dormant since then subject to rulemaking which was finally introduced June 16. The prospect of these powerful new government rights going into effect has been unsettling in the defense industrial base and a warning to the non-traditional defense industrial base. However, the House version of the 2017 NDAA would walk back much of the potential threat of the 2012 statute, obviating the new proposed rule if it survives the legislative process. In the meantime, the "813 government industry advisory panel" created by the 2016 NDAA, is reviewing all DoD policy on intellectual property and data rights for potential legislative action.

The government reasons that control of intellectual property provides the ability to "level" the playing field and enable competition by removing the competitive advantage of the innovator. A closely related objective is government strategy to avoid sole-source

suppliers or "vendor lock." Both of these strategies require the intellectual property of the innovator to be distributed to third parties in order to create competition and alternate sources of procurement. The logic of such policy, considering these two issues, is understandable given a process confined to contracting alone. But it is a strategy that fails to understand the chilling effect such policies have on potential innovators considering a business case on where to invest and on whose problems to solve. The Defense Business Board captured the disconnect between objective and policy by concluding that "current IP rules crush industry upside potential" and that DoD process "destroys competitive advantage that should result from investment in innovation."

Other risks potential innovators must allow for in their decision making are government strategies to reverse engineer parts, components and software, and partnerships with the government that can result in their technology being classified under the International Traffic in Arms Regulation. The Air Force has promoted reverse engineering and 3D strategies at multiple "innovation centers" and touted emerging abilities to 3D print engine parts and electronics. Last year, DoD quietly implemented a rule that would by default classify any electronics developed with DoD funding as defense articles, regardless of intended application, whether military, commercial, or dual use, a problem that would severely compromise commercial potential.

Clearly, DoD must ensure it has the needed data rights to operate and perform routine servicing of equipment it buys, and it must have access to sources of more extensive repair. But this is no different from commercial buyers of any technology product such as vehicles and commercial aircraft, yet these buyers do not demand design and manufacturing specs, duplicate analytical design and manufacturing departments, or provide such specs to third parties to compete against the OEM who sold them the equipment. Nor do commercial buyers subject suppliers to 180,000 pages of defense acquisition regulations.

Certainly, some aspects of military acquisition and operation are unique, but it is not clear that such differences represent a need for the kind of legislated overreach that current IP policy represents. But what is clear is that current IP policy is increasingly isolating DoD from the raging innovation happening outside of defense. Competition guidelines warn that demanding excessive data rights "may have significant negative consequences" and Kendall speaking at Brookings last year said, "technology poses a particular challenge, because the DoD's structure does not make it attractive to many American technology companies."

Ultimately, the adequacy of DoD's intellectual policy should be judged on its effectiveness in achieving its purpose. The United States, long badly outnumbered by potential peer combatants, has instead relied on overwhelming technical dominance. The United States never wants to send its soldiers into a fair fight. But Cold War dominance is rapidly eroding

"Industry uses intellectual property as a weapon to gain competitive advantage."

FRANK KENDALL, UNDERSECRETARY OF DEFENSE FOR ACQUISITION, TECHNOLOGY AND LOGISTICS





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and DoD has engaged a broad new strategy to counter that loss.

The current strategy assumes access to innovation is a matter of outreach or education or proximity, but it is unaccompanied by real change in policy or culture. So while the Defense Department seeks to achieve “dominant capabilities through technical excellence and innovation,” the prospect for greater access to cutting-edge innovators and resurgent technical dominance seems remote.

Former defense industrial policy director Brett Lambert observed, “when it comes to acquisition, the department continues to assume it is the dog, not the tail of a market. Increasingly that is the wrong assumption.” If defense technological leadership is the goal, then DoD must rebalance its policy on intellectual property and be a better customer as well as a better buyer.

Outreach to the private sector is a positive step. Compliments to Carter, Kendall and other leaders for the energy and resources they have applied to this effort. However, a more comprehensive solution is needed to regain the technical dominance our defense is based on. DoD must become a desirable customer. The military has no access to cutting-edge innovation outside the willing supplier pool. In addition to revising IP policy, it must also reform rules on the purchase of commercial items, and rethink laborious, expensive bureaucracy.

Above all, there must be a transformation not just in the acquisition community, but also in the American public — a transformation that recognizes that the Defense Department cannot succeed alone, that many weapons and services essential to deterrence and warfighting are provided by private industry, and that industry partners are patriots as well as businessmen.

The newly established Government-Industry Panel was cre-

ated by Congress to review data rights statutes and regulations to ensure that they are “best structured to serve the interests of the taxpayers and the national defense.” As it meets to consider changes to IP policy, it should heed the advice of DoD’s guidance on IP “Intellectual Property: Navigating Through Commercial Waters.”

As the government participates more and more in the commercial community and tries to act more like a commercial entity in its dealings with the civilian marketplace, the government will have to assume a more commercial mindset when acquiring IP rights.

When the panel is done, its recommendations should mean fewer pages of acquisition regulations, not more. Contracting officers should have more discretion accordingly, enabled by the increased attention to acquisition tradecraft and professionalism, key principles in DoD’s Better Buying Power, and through Carter’s DoD/industry exchange program. Panel recommendations should include making acquisition of commercial items for defense resemble commercial transactions in the private sector. IP should be retained by the innovator for all inventions and technology he funds except that required for operations and field repair. Mixed funding should be addressed by negotiation. Modular open systems architecture is a good idea, but it too should be used as a management tool, and not legislated.

In the more flexible acquisition environment described here, given that DoD often uses its equipment and services longer than typical of commercial users, it is fair to ask what provisions should be made for cases when the OEM moves on or becomes insolvent. This situation is rare for military equipment, more common for commercial equipment or software, which are typically under continuous improvement, and developers at some point end support of older versions. DoD’s first instinct should be to upgrade selectively to remain current and take advantage of new capabilities. If that is not possible, then some negotiation with the OEM for the needed IP must be made. In unusual circumstances, the IP would be compelled from the OEM but this should be intentionally difficult to do.

John Luddy, of the Aerospace Industries Association, is concerned about the creation of “fast lanes” for non-traditional contractors while traditional companies remain bogged down complying with the burden of the full acquisition process. He asks: “If the goal is streamlining, competition and speed, why not eliminate burdensome regulations for all contractors?” While DoD courts non-traditional contractors in a quest for innovation and relieves them of much of the bureaucracy of defense acquisition — at least temporarily — one might speculate that given similar relief for traditional contractors, the Pentagon might discover that the most innovative minds and companies already work for it.

Acquisition reform has been going on for decades. Progress has been elusive.

Thomas Paine in “Common Sense” said it is true that “nothing but heaven is impregnable to vice,” but it is equally true we cannot “paperwork away all risk” as Rep. Mac Thornberry, R-Texas, observed. To address the many and troubling threats today, the creative power of this country’s entire private sector should be put to work. For this, government must be more than a better buyer, it must be a better customer as well. **ND**

Scott Chandler is a former Marine Corps officer and worked in the commercial and military aerospace industry for 35 years.

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Military Must Prepare for Unmanned Aircraft Threat

Analysis

By Jeffrey Lamport and Anthony Scotto

Low-cost unmanned aerial vehicles are equipped with cameras, laser designators, radio frequency collection devices or weapons. The size and composite materials used in UAV production make them difficult to defeat with traditional force protection measures and short-range air defense systems commonly employed by maneuver forces.

In Ukraine, both Ukrainians and Russian-backed separatists are operating UAVs in relatively large numbers. They are reportedly operating more than a dozen variants including fixed- and rotary-wing configurations, each functioning at different altitudes with various sensor packages.

For nearly three decades, U.S. and allied forces have had the luxury of conducting ground and air operations in

potential gaps in air defense coverage. And soldiers are “numb” to UAVs. Recent combat experience in Iraq and Afghanistan indicates troops may be highly accustomed to friendly UAVs and, therefore, less likely to be concerned about them flying overhead and less inclined to actively search for UAVs operating in their battle space.

Many soldiers lack UAV recognition training. This issue is compounded by the ever-increasing proliferation of new UAV designs and off-the-shelf systems sold to multiple countries. U.S. Army and joint doctrine have not kept pace with the threat.

UAVs provide the enemy critical intelligence such as a unit’s precise location, composition and activity. They may also provide laser designation for indirect fires or direct attacks using missiles; rockets; small “kamikaze” munitions; or

soldier can understand. They also must ensure all joint data link contributors utilize a common set of track amplification data — air type, air platform and air activity — to categorize the UAV target.

Critical assets within the continental U.S. have already been “attacked” by nefarious UAVs. It is only a matter of time before these systems are directly or indirectly responsible for loss of life or interference with critical infrastructure. In some circumstances, Title 10 military personnel and equipment may be required to operate subordinate to civil-military organizations.

Per Department of Defense Directive (DODD) 3025.18, DoD resources may be used in an immediate response to prevent loss of life, mitigate damage to infrastructure, or in support of mutual aid agreements (Title 42 USC).

It is unlikely that most organic communications systems will be compatible with the civil organizations being supported, thereby increasing reliance on knowledgeable liaison officers. Missions may include air defense coverage for the National Capital Region, key power/

communications infrastructure, national borders, sporting arenas, political conventions and presidential inaugurations.

Technology used to counter UAV threats within our own borders must be in compliance with Federal Aviation Administration and Federal Communications Commission regulations.

Military planners cannot assume they are exempt from fines or prosecution for violating civil airspace or spectrum management policies in the interest of thwarting a potential hazard.

It must be assumed targets of vital interest are being watched and targeted. UAS operations are not limited to the battlefield; they have already been used to disrupt our daily routines at home and violate traditional security measures surrounding our borders, prisons, nuclear facilities and sporting venues.

Leaders across the board must take an active role in educating themselves and training their units to defeat this threat.

ND

Jeffrey Lamport and Anthony Scotto are unmanned aircraft experts at the joint deployable analysis team, part of the Joint Staff J6, located at Eglin Air Force Base, Florida.

“UAVs can create serious problems for maneuvering or static forces.”



a virtually uncontested airspace environment. Development and fielding of air-defense systems has declined and passive air defense skills have atrophied across the force. Leaders at all levels cannot be lulled into a false sense of security because of the small size of these UAVs. They are as effective, if not more effective, than traditional manned aircraft (or even stealth aircraft) in reconnaissance, surveillance, and target acquisition precision attack and indirect fire support.

UAVs can create serious problems for maneuvering or static forces. Conventional air-defense systems often “filter” out tracks to avoid confusion with clutter, large birds and aerostats. Systems optimized for this threat often forfeit effectiveness against other target sets (manned aircraft, cruise missiles, rockets and mortars, and ballistic missiles).

A reduction of dedicated air-defense units to maneuver brigades creates

chemical, biological, radiological and nuclear weapons. Some payload configurations can contain radar and communications jamming or other cyber attack technology.

UAVs are the air threat of the next fight. Technology development and employment around the world demonstrates a relevant and viable air threat. Air defense artillery liaison officers cannot be lulled into a false sense of security because of the relatively small size of these platforms.

Air defense artillery liaison officers — when working with or within an integrated air defense system — should take an active role to address threats to the maneuver force, suggest UAV-specific rules of engagement when there is a reliable ability to distinguish unmanned platforms, ensure criteria for “hostile act” and “hostile intent” specifically address UAVs and are written in terms any

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Basic Research Key to Invigorating Innovation

Viewpoint

By Richard G. Ames

Basic research provides the foundation for the technologies that have the broadest and most significant impact on military capability. In recent decades, the Defense Department's research policy has threatened to distance basic research from the broader innovation enterprise and hinder its ability to develop truly revolutionary new capabilities.

Given increases in foreign economic strength and commitment to military technology, this is an issue that cannot be addressed with spending alone. DoD must ensure that it is making efficient use of its investments. A critical element is ensuring that the basic research activity is integrated into the rest of the enterprise.

The Department of Defense Instructions (DODIs) are a collection of documents that define policy for a number of activities. Among these is DODI 3210.1, where basic research is defined as, "systematic study directed toward greater knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications towards processes or products in mind."

The latter phrase lies at the heart of the separation between the basic research community and the rest of the innovation enterprise. Furthermore, the history of science calls into question whether the definition is valid: many breakthroughs in fundamental understanding came as a result of addressing specific applications. For example, aerodynamics was born of a desire to build better aircraft; microbiology was born of a desire to increase the shelf life of milk; surface physics came from efforts to improve yields at semiconductor manufacturers.

Many basic research endeavors are driven purely by curiosity, not application. The Higgs boson and gravity waves are prime examples. So there certainly is basic research that has no links to applications at the time it is conducted — though history shows that applications will follow — but the notion that basic research cannot be directed toward an application, specific or otherwise, is at odds with the history of science.

The application phrase in DODI 3210.1 was added, of course, to protect

DoD research funding from misuse on non-research activities. But the best way to achieve that protection is to simply move all Defense Department basic research funding to the National Science Foundation.

So why not do that? The answer is that the Pentagon has application-specific basic research needs that are not well addressed elsewhere, a direct contradiction to DoD's own DODI 3210.1.

This dilemma was noted in a 2005 National Academies report on defense basic research. In that report, the National Academies recommended that the definition be changed to explicitly require "the potential for broad, rather than specific, application," presumably to acknowledge that DoD basic research should be application-focused while also preventing misuse of non-research activities.

The Office of Management and Budget builds on this idea with the hedge that basic research "may include activities with broad applications in mind" but still excludes specific applications. In common practice, the current definitions are taken to mean that basic research can have zero applications or many applications, but not one or a few, thereby continuing the attempt to protect basic research funding from misuse within the department. From the basic research standpoint, there is no way to come to logical closure on this definition. Given that new applications for basic research regularly emerge after the research is conducted, why are zero initial applications acceptable but one is not? In both cases, there is the potential for many more. Again, this is not a scientific rationale; it is a rationale built on the desire to protect funding. Though it achieves that goal, the common-use definition also creates a culture that is wary of ties between basic research and the rest of the Defense Department.

With three actions, we can protect basic research funding while ensuring ties to the rest of the department.

First we have to accept that defense-specific basic research is necessary. Second, to enforce that acceptance through policy, we need to remove the DODI 3210.1 language that mentions applications. Third, we need to move away

from the research model that separates the basic research activity from the rest of the technology development process.

DoD and Congress have moved toward a funding model that prescribes a sequential path from basic research to applied research to development programs. This model emerged in the 1980s and has since been discounted because it is not an accurate model of how technology development works. Basic and applied research interact in complex ways not represented by a simple progression from basic to applied. It was adopted because it provides an efficient means to administer funding.

More to the point, the sequential model assumes that the groups conducting the basic research, applied research and development programs can be administered separately, further encouraging a fragmented approach to technology development.

The DoD Basic Research Office is poised to address this fragmentation problem with a new pilot program: the Defense Enterprise Science Initiative.

DESI will reinvigorate the links between basic researchers, applied researchers and DoD development programs by funding teams to work together on basic research problems that are directly linked to established knowledge gaps. This approach is in contrast to the current model that separates the basic and applied efforts.

DESI will blur the lines between basic and applied research by funding all members of the team — including industry — to work the basic research elements in support of existing applied research and/or development efforts.

Such a model does exist in pockets within the department but not to the extent necessary to ensure a robust innovation enterprise.

The benefits will be far reaching: moving knowledge transfer back to an organic team activity will enable faster development cycle times and make more efficient use of basic research investments. **ND**

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Air Force Seeks Path Forward For Troubled GPS III Program

 **By Stew Magnuson**

The Air Force is being forced to restructure or cancel the troubled ground control segment of its GPS III program, putting the next generation timing and navigation system at risk.

The program to develop the next generation operational control system, better known as OCX, began with a contract award to Raytheon Co. in 2010.

Six years later, it has failed to deliver the first two software blocks, and the rising costs of the program has triggered a Nunn-McCurdy breach, which requires the Defense Department to either sign off on continuing the program or restarting it.

"Factors that led to the critical Nunn-McCurdy breach include inadequate systems engineering at program inception, Block 0 software with high defect rates, and Block 1 designs requiring significant rework," the Air Force said in a press statement.

Before the Nunn-McCurdy breach was announced, members of Congress were already expressing their ire with the program. The Senate Appropriations Committee in its 2017 defense spending package called for \$260 million to be cut from the \$393 million the administration requested.

The contract was worth some \$1.5 billion when awarded in 2010. The Air Force now estimates that it needs an additional \$3.7 billion to complete the project, the 2017 budget request revealed.

GPS III has three components — the spacecraft, the ground control system, and GPS enabled equipment. All are on different development timelines, which is made all the more complicated by the OCX delay, according to the latest Government Accountability office report on the program, which was released September 2015.

The current GPS network is functioning fine and is expected to do so for a number of years. A minimum of 24 spacecraft are needed, but because some of the older models have exceeded their life expectancy and new ones continue to be launched, there are now 40 in orbit, with eight of them being spares,

it said.

GPS III is expected to provide capability beyond the current system, and the OCX system is essential if the GPS III satellites are to deliver new capabilities. Those include: advanced cybersecurity; signal boosting and spot beams capabilities that can power through enemy jamming; and use of the M-code, which provides encrypted and more precise navigation data exclusive to the military and government users.

The M-code will not be available until the Block 0 and Block 1 software are functioning. There is a Block 2, which will deliver further improvements, but it is not essential for the operation of the new satellites.

Lt. Gen. John "Jay" Raymond, deputy chief of staff for operations, is among the Air Force leaders who believe that there is little choice, but to somehow move forward on the program.

"I'm not in the acquisition business so what I would say from an operator's perspective, OCX is absolutely critical to us. You have to have the ability to command and control future GPS satellites in orbit and it remains a vital program," he told National Defense.

The GAO report said there was plenty of blame to go around. It faulted both Raytheon and the Air Force for the delays.

The service did not follow best acquisition practices, it said. For example, it skipped a preliminary design review. Key cybersecurity requirements were not well understood by either party and they were poorly communicated to the contractor. The program experienced significant development delays from the beginning, but the Air Force continued to deliver optimistic reports on its progress, it said.

"OCX issues appear to be persistent and systemic, raising doubts whether all root causes have been adequately identified, let alone addressed," the GAO report said.

Undersecretary of Defense for Acquisition, Technology and Logistics Frank Kendall and Secretary of the Air Force Deborah James personally traveled to Raytheon's campus in Aurora, Colorado,

to conduct the second in a series of quarterly reviews of the OCX program, a statement from the Air Force provided to National Defense said.

Raytheon briefed its progress on implementing process improvements, which included increased automation in software development, platform deployment, as well as an improvement in their software approach, the statement said.

The pair, along with Lt. Gen. Samuel Greaves, Space and Missile Systems Center commander and Air Force program executive officer for space, "concluded that Raytheon has made progress implementing these critical changes," the statement said.

Loren Thompson, chief operating officer of the Lexington Institute, said the irony of the OCX situation is that the program was once intended to serve as a model for a new way to do space acquisitions. After many failed and delayed programs in the 1990s, GPS III was supposed to serve as a pathfinder and a "return to basics" where the Air Force would not delegate too much decision-making power to the contractor. It would also ensure that all cybersecurity requirements were met instead of issuing waivers, which had been a long-time practice.

"Both the contractor and the government simply didn't grasp how complicated OCX was going to be," Thompson said.

Ground systems are far more vulnerable to cyber intrusions than spacecraft. GAO identified some 250 portals where a hacker could penetrate the system.

"Raytheon literally worked for years on this thing before they realized the full extent of the information assurance requirements," he said.

The Air Force will have no choice but to restructure the program and move forward, Thompson said.

"It's not too big to fail, it's too critical to fail," he said in an interview.

Without the ground system, GPS III will not function as advertised. The legacy system will continue to be vulnerable to hacking, the signal susceptible to jamming and the M-code a white elephant, he noted. Today, there are GPS II satellites in orbit with M-code capabilities, but they are not being used to their full potential because OCX is not in place, he added.

Thompson said the Air Force and Raytheon have made progress fixing some

of the problems, which were first recognized in 2013.

Raytheon, a week prior to the Nunn-McCurdy announcement, said the company had passed an electromagnetic interference qualification test for its monitor station receiver element and critical design review for its hardware.

Raytheon spokeswoman Michelle Lammers said the company could not provide further comment.

Thompson said there has been a series of press releases indicating that the program is back on track.

The Air Force has asked Congress for \$39 million to help resolve some outstanding issues and “replan” the program. Thompson said legislators should approve it. It’s a small amount to pay in a program that will cost billions.

“The indication is that some tweaks are sufficient to get it on track,” Thompson said.

Meanwhile, Lockheed Martin, which won the \$3.6 billion contract in 2008 to develop and build the first batch of GPS III satellites, may be delivering spacecraft that can’t be used to their full potential. A May press release from the company said its production line was in “full swing” and that there were eight spacecraft in various stages of production.

This may turn out to be another example of military space satellites that are not synchronized with the ground control systems or terminals, Thompson said.

Winston Beauchamp, deputy under secretary of the Air Force for space, said there are two main options: modifying the existing GPS system or recompeting the contract, the trade publication Defense News reported.

Restarting the program would be challenging, he said. “But it would be challenging in either case. Both of them have challenges.”

The broad requirement to detect and refuse access to all potential intrusions has turned out to be the program’s downfall, he said. It is in some ways a moving target, he said, as hackers are always discovering new exploits.

“That’s a lot to have to do, and hardening the software from a cyber perspective and closing off these hundreds of entry points to the internet has proven to be extremely challenging, as you could imagine,” he said.

If the program is restructured, it will have to include more flexibility in the

requirements, he said.

The Air Force statement said the decision on how to move forward will be made by October. Kendall, who will make the ultimate decision, told Defense News, “To be blunt, it’s a mixed bag. I’m seeing some evidence of progress, but I’m still seeing some problems,” Kendall said. “I think Raytheon is putting additional resources into the program and I do see some signs of improvement. We also have had a couple of hiccups, I’ll say.”

Kendall reiterated the belief that starting over could create its own set of problems and indicated the best option would be for Raytheon to fix the issues.

“It’s a critical system. It would be very

disruptive to stop where we are and start over,” Kendall said. “That’s not a preferred alternative. But on the other hand I need to see adequate progress or we’ll have to consider that sort of alternative.”

Kendall also said threats from lawmakers to cut off funding for the program are counterproductive.

“My biggest concern right now is some of the things Congress is doing to the program would make it impossible to execute successfully, so we’re going to be having conversations with the relevant committees,” he said. **ND**

Additional reporting by Kristen Torres.

Email comments to smagnuson@ndia.org

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Government Officials Conflicted About Encryption

 **By Yasmin Tadjdeh**

Encryption — which prevents unauthorized users from accessing devices and data — is a double-edged sword, experts have said. While U.S. citizens use the technology to protect personal information, bad actors such as terrorists are employing it to hide illicit activity.

Encryption services are also vitally important to the government, said a panel of department heads in May.

“We know we need it,” said Secretary of Defense Ashton Carter during a joint press conference at Intel’s corporate headquarters in Santa Clara, California. “We know that strong encryption is part of the solution for the future.”

Carter called on companies around the country, including those in Silicon Valley, to keep investing in such technology.

“I think it’s fair to say that ... globally the market for cybersecurity that should exist doesn’t yet exist,” he said. “But what that says is that there will be a big market for those innovators that get here first.”

Secretary of Commerce Penny Pritzker said encryption is critical to protecting the nation’s digital infrastructure.

“Today our entire economy rests on the back of the digital infrastructure,” she said. “It’s extremely important that we have strong encryption.”

But such technology can make it harder for law enforcement to detect criminal activity, said Secretary of Homeland Security Jeh Johnson.

The government and the private sector are “interested in finding the right solution that accommodates both strong encryption and enables us to track crime and to track potential terrorist plots for reasons of law enforcement, public safety and national security,” he said.

A cooperative agreement is possible and officials are “working very hard on this issue,” he said.

Encryption became a hot topic in the United States following a high-profile dispute between the FBI and Apple earlier this year.

Following a deadly shooting rampage in San Bernardino, California, last year the FBI acquired an iPhone 5C that was used by one of the shooters, Syed Farook. The phone — which was owned by Farook’s employer — was encrypted and 10 wrong attempts at inputting the passcode would clear the smartphone of its contents.

In February, a federal judge ordered Apple to help the FBI get around this feature and create a backdoor into the device. The company refused, claiming that could set a dangerous precedent. In the end, the FBI was able to break into the phone on its own.

The litigation in San Bernardino was not about trying to send a message or impugning Apple, said James Comey, director of the FBI.

“I don’t think anybody should be demonized in this conversation,” he said. “It was about trying to confidently investigate a terrorist attack that slaughtered innocent people at an office gathering. That’s all it was about.”

The FBI had consent from the owner of the phone, a search warrant and, according to a Justice Department lawyer, a valid basis for asking the court to force Apple to help the FBI gain access to the phone, he said.

There needs to be greater dialogue in the United States about the balance between public safety and privacy, Comey said.

“I love strong encryption,” he said. “Encryption is a very, very good thing. I also love public safety.”

Currently, the two ideas are “crashing into each other,” he said in May during an industry conference hosted by the National Defense Industrial Association.

Encryption also became a major issue in 2013 following the revelation that the National Security Agency collected enormous amounts of information about U.S. citizens via its bulk phone metadata collection program. Since then, there has been a major push for encryption on mobile phones, Comey said.

This has had major ramifications for the FBI, he said. Even with court orders, many times agents are not able to access data on encrypted phones.

“We are increasingly finding devices ... that we can’t open,” he said. During the first six months of fiscal year 2016, FBI agents received about 4,000 devices it wanted to investigate. Five hundred of them couldn’t be opened. That number will only grow, Comey said.

Encryption has made it harder for the FBI to track Islamic State supporters, he said. ISIL uses social media platforms, such as Twitter, to reach out to potential sympathizers around the globe. “[For] 24 hours a day that terrorist is in your pocket,” he said.

Once ISIL finds a potential supporter through a social media platform like Twitter, they quickly move them to a mobile messaging app that is end-to-end encrypted, he said.

This model breaks the old one that the FBI used for years with al-Qaida supporters, he said. “Our task in those days was to find those watering holes on the internet where people would go to consume the poison of al-Qaida and talk to each other,” he said. “If we found that watering hole, everybody drinking out of it was of interest to us.”

Investments in encryption technology are on the rise, said Brad Curran, a senior industry analyst focusing on aerospace and defense at Frost & Sullivan.

The burgeoning market is currently valued at about \$1 billion per year, he said.

“If you take the whole cybersecurity market together ... it’s a good size chunk,” he said. “It’s definitely got everyone’s attention. It will continue to grow for the next few years.”

However, as the encryption debate rages in the public policy arena, such disputes could cause businesses to be wary of investing in encryption, Curran said.

“It hinders the market,” he said. “It’s something that’s going to go through the courts. It’s going to be muddy and ugly for years to come ... and in the meantime it will hinder the development and sales of some products.”

“It’s not going to stop it but it’s certainly a restraint,” he said.

There are companies in Silicon Valley that refuse to work with government agencies at all, he noted.

In a report by the House Homeland Security Committee’s majority staff titled “Going Dark, Going Forward: A Primer on the Encryption Debate,” the authors said if the United States placed burdensome regulations on encryption — which has now become ubiquitous — it could hurt businesses.

“Studies suggest that two-thirds of the entities selling or

providing encrypted products are outside of the United States," the report said. "Legislation might have little impact on bad actors that can obtain encryption tools outside of the United States, while irreparably harming U.S. commercial interests by driving customers to foreign competitors."

House Homeland Security Chairman Rep. Michael McCaul, R-Texas, and Sen. Mark Warner, D-Va., have called for the creation of a national commission on security and technology challenges to study encryption, the report said.

"The best way for Congress and the nation to proceed at this critical juncture is to formally convene a commission of experts to thoughtfully examine ... the matter of encryption and law enforcement's future in a world of rapidly evolving digital technology," the report said.

The purpose is to bring together experts "to engage one another directly and, over the course of a year, develop policy and legislative recommendations to present to Congress," the report said. These experts would include those who work in cryptology, global commerce, federal law enforcement, the intelligence community and privacy and civil liberties activists.

Despite presenting law enforcement and intelligence officials with new challenges, it would be a mistake to say that government does not value encryption, the report said. "The FBI, the Department of Homeland Security and the wider intelligence community use strong encryption to secure their own information."

In a closed hearing in July, Adm. Michael Rogers, commander of U.S. Cyber Command and the director of the National Security Agency, testified before the Senate on encryption challenges.

"I was testifying before the Senate Armed Services Committee predominantly in my role as U.S. Cyber Command," Rogers said days later during remarks at the National Press Club in Washington, D.C. "One of the things the committee wanted to talk about was, 'So what are your views of encryption? What are some of the challenges that you are working your way through?' And I always start out by telling people, 'Look, I don't know what the answer is.'"

There needs to be a nationwide dialogue on the proper and legal uses of encryption. The solution cannot come from the intelligence community, he added.

"You don't want the intelligence world telling you what the answer is here. Likewise, I don't want a company necessarily telling me what the answer is here. I don't want a government agency necessarily telling me that," he said. "Can we engender a broader dialogue as a society about what are we comfortable with here? And what makes sense for us?"

The NSA is watching a world where many terrorists or other bad actors are harnessing the same technology that most U.S. citizens rely on to ensure that their personal information is not compromised, he said.

"They are using that same capability, that same technology to generate money, to coordinate attacks and to generate violence against us and other nations around the world. We got to ask ourselves, how are we going to deal with this?"

Despite the technology sometimes being used for nefarious purposes, it is critical to the nation, he said.

"Encryption is a positive thing. It's fundamental to the future," he said. "I don't see a solution where we go, 'Well, we don't need encryption. It's bad.' I reject that idea."

More and more government agencies are moving toward

commercial encryption technology, said Chris Burchett, executive director of client security software at Dell.

"There are a lot of people who are going to want to use commercial products," he said.

With an in-house system "you are stuck with the need to continue to evolve your products, to maintain them, to support them," he said. "The benefit of going with a commercial vendor is they do that for a living ... so they are going to keep up with it and give you ongoing maintenance."

Dell — which has a number of customers in the government, including the military — offers encryption services for classified information, Burchett said. It participates in a NSA project known as commercial solutions for classified program.

The program was "established to enable commercial products to be used in layered solutions protecting classified NSS [national security systems] data," according to the NSA. "This will provide the ability to securely communicate based on commercial standards in a solution that can be fielded in months, not years."

Under guidance from the program, users of commercial encryption must employ a dual-cryptology system when transmitting top-secret classified data, Burchett said. There are two systems in the market, including "Dell Data Protection | Encryption" enterprise edition product and Microsoft's BitLocker system, which Dell manages, he said.

"If you're pulling your products from the CSfC [commercial solutions for classified program] list right now you basically need to use both of those products if you deal with top secret material," he said. **ND**

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Wearable Technology Could Change How Special Operations Forces Fight

 **By Jon Harper**

Special Operations Command is looking for cutting-edge, wearable technology to help its troops maintain the upper hand against future foes. From clothing to armor to sensors, officials are counting on industry, academia and military research labs to equip commandos from head to toe with the best gear.

After years of battling in the desert and mountain climates of the greater Middle East, U.S. commandos are turning their attention to other environments such as the Arctic and the jungle.

"We haven't been fighting in those areas," said Adam Fields, SOCOM's program manager for survival, support and equipment systems. "There are going to be different things that we need."

New cold weather uniforms must enable operators to tolerate temperatures 50 degrees below zero, he said. "We want to reduce bulk as much as possible so the guys aren't simply surviving in the Arctic, but they're actually able to do their job."

The command is looking for heated gloves with similar qualities, he noted.

In the jungle, uniforms need to counteract heavy rainfall and high humidity, Fields said. "We want to be able to get the moisture off of the operator [and] we also don't want the uniforms to get soaked after five minutes."

Additionally, they must be durable in heavy brush, which can tear materials when troops are on the move, he noted.

Commando uniforms consist of multiple layers and a single company doesn't have to produce the entire outfit, Fields said during a briefing at the Special Operations Forces Industry Conference in Tampa, Florida, in May.

Oftentimes "the layers are all made by different manufacturers," he said. "We tie them all together with multiple contracts. If you have got a piece [of technology] that may apply to one layer, that's great."

SOCOM could hold an industry competition for new protective combat uniforms as early as fiscal year 2017, he said.

The Department of Defense is pursu-

ing other advanced materials for special operators and conventional troops. It is partnering with the Advanced Functional Fabrics of America Alliance — a consortium of universities, companies, nonprofits and research organizations across the country — and funding a new manufacturing innovation institute focused on revolutionary fibers and textiles. The institute will be headquartered in Cambridge, Massachusetts.

"This is a pioneering field, combining fibers and yarns with things like flexible integrated circuits, LEDs, solar cells, electronic sensors and other capabilities to create fabrics and cloths that can see, hear, sense, communicate, store energy, regulate temperature, monitor health, change color and much more," Secretary of Defense Ashton Carter said in April at MIT when the new initiative was announced. The Pentagon is making a \$75 million initial investment in the project with more than \$240 million in contributions coming from public and private partners.

"Revolutionary fibers and textiles have enormous potential for our defense mission," Carter said.

Lightweight sensors woven into the nylon of parachutes could catch small tears that might otherwise expand in mid-air and put paratroopers' lives at risk. Electronics embedded in uniform fibers could detect potential chemical and radiological agents, or help power network devices that soldiers carry into the field, Carter said.

Special operators training and assisting Iraqi forces would benefit from this technology during the hot summer months, he noted.

"A number of these fabrics are much more lightweight and shed heat better, and that's not an insignificant matter when you're a soldier and you're carrying around a lot of weight," he said.

In addition to being protected from the environment, commandos need body armor to shield them against enemy fire.

SOCOM will have a recompete for a ballistic plate contract in fiscal year 2019, Fields said. The command is also

looking for new helmets that offer ballistic and impact protection. A solicitation is expected to go out to industry in the first quarter of fiscal year 2017, with a contract award anticipated in the third quarter.

Another item on SOCOM's wish list is better eyewear.

"What I'm really looking for here is one of the ones that does it all — day, night, laser protection, perhaps something that does some active transitioning," Fields said.

"It has to do it really fast," he added. "We need to go from inside to outside, outside from inside, [and] the operators need to be able to not wait for their glasses to catch up with them."

Officials are conducting market research to see what types of protection technologies are available, he said.

Perhaps the ultimate form of wearable armor is the tactical light operator suit, or TALOS. Nicknamed "the Iron Man suit" in reference to the fictional superhero, the aim of TALOS is to make special operators who kick in the door during raids essentially bulletproof. The powered exoskeleton is to be equipped with a communications suite and other enabling technologies.

SOCOM hopes to have a prototype ready by 2018, and officials have said the program is on track.

To push the technology forward, the command is promoting SOFWERX, its new rapid prototyping office. SOFWERX has already been put to use on the TALOS project to develop a base layer.

"Everybody thinks of the Iron Man suit exoskeleton," said James "Hondo" Geurts, SOCOM's acquisition executive, at the SOFIC conference. "What most people don't think about is ... what's between that [metal suit] and human skin?"

Industry partners and different user groups recently teamed up to develop a solution.

"In 60 days we were able to turn full-up designs and prototypes so that we can start figuring out how are we going to solve this for the end suit," Geurts said.

Wearable technology can help solve situational awareness problems.

Army Gen. Raymond Thomas III, the commander of SOCOM, was inspired by watching the movie "Minority Report" during a deployment to Afghanistan.

"I'm watching Tom Cruise do all his gizmo stuff, understanding everything in

the world and I thought, "That's what I want at the touch of a fingertip," he said. "I want to be able to bring everything we know ... to the appropriate operator level."

Even better would be a heads-up display system.

At some point "we're going to interface artificial intelligence with our operators so they are literally hands free," Thomas said. "At the voice prompt they're going to be able to say, 'Siri or Son of Siri or whoever, give me this [situational awareness information].' And it's going to drop down to a heads-up display and they're going to have everything they need because it will all be in some file."

Down the road, the SOCOM chief wants to integrate voice prompt technology into TALOS, noting that the first iteration of the suit will rely on button-enabled capabilities.

"I'm thinking, 'OK, I can't see buttons'" without looking down and taking eyes off the battlefield, he said. "I ... want the next best version and so will our operators."

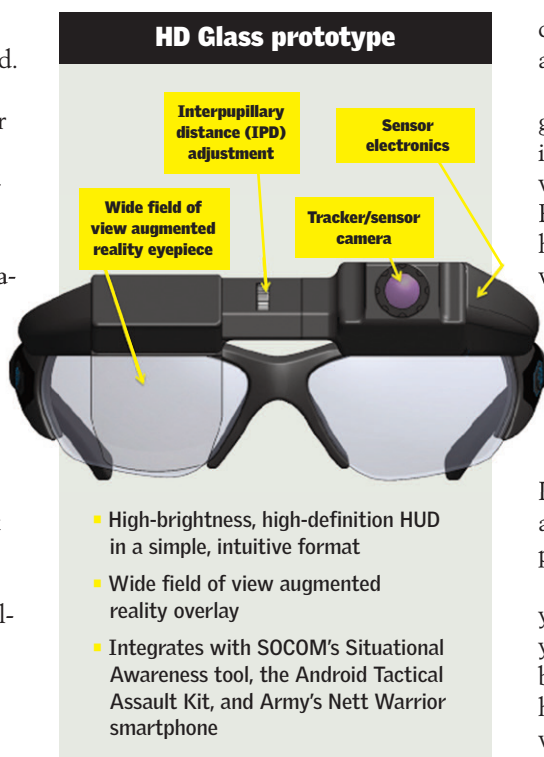
Thomas' dream might be on the path to coming true. The Defense Department's rapid reaction technology office and the Army's night vision and electronic sensors directorate have collaborated on an emerging capability prototyping project called HD Glass. SOCOM is slated to receive the new heads-up display equipment in September.

"The prevalence of smartphone applications for geolocation and information services has demonstrated how information can be a force multiplier for warfighters," said an HD Glass project description published by the Defense Department.

But "increased battlefield awareness through smartphones, tablets and laptops comes at a cost of reduced awareness of immediate surroundings," it said. "Heads-up displays provide an alternative human-technology interface that leverages the full capability of a smartphone, while maintaining 'eyes out' tactical awareness."

Existing heads-up displays designed for aircraft pilots have insufficient field of view and contrast to meet the operational challenges of ground forces, according to the Pentagon's acquisition office. HD Glass is intended to solve that problem.

The system consists of a high-defini-



tion, high-brightness, organic light-emitting diode see-through display mounted on a set of ballistic eyewear. The display will be integrated with a camera, sensors and electronics in a small, lightweight package that enables continuous all-day use, according to the project description.

It is designed to work with computing platforms such as Android operating systems, to provide an augmented reality overlay.

In this case, augmented reality refers to a live view of an environment with added situational awareness displays.

The phase one prototype, completed in April, demonstrated "an operational fit and function." The phase two prototype, slated to transition to SOCOM and undergo an Army user assessment in September, includes "a versatile augmented reality interface."

The system is intended to integrate with SOCOM's Android tactical assault kit and the Army's Nett Warrior system.

"It won't be long, I guarantee you, before our combat infantrymen and women are using wearable electronics with uploadable combat apps and heads-up displays of their own," Deputy Secretary of Defense Bob Work said at a conference last fall.

Beyond protecting and enabling special operators in combat, wearables could also help monitor their health and fitness. The Air Force Research Laboratory has tested out a range of devices

designed to measure physical condition and performance.

"There are some devices that are really good and I think we have confidence in the data that we're getting back and we find that data is actionable," said Rajesh Naik, chief scientist for the 711th human performance wing at the lab. "I would say the majority of them don't work well."

Naik and his colleagues want devices that can accurately measure the physical condition of troops such as hydration levels and heart rate variability, a key indicator of fatigue.

Identifying biomarkers in sweat could also be useful for force management purposes.

"There are certain markers that tell you when are you fatigued, when are you stressed," he said. "But those sensors, because they are biological, it's a little harder to build. That is why now we're working with industry and academia saying, 'What are the right platforms? What are the right sensors? What are the ... recognition elements?'"

The lab has been working with special operators during their training exercises to learn more about the implications of wearables for measuring human performance.

Being able to collect, analyze and act upon information gleaned from wearable sensors — such as signs that a commando is about to suffer from heat exhaustion — could help prevent injuries or other health problems during training or in other settings.

"Can you intervene when you see his biometric signatures go off the charts?" Naik said. "Is there some signal that tells you that this guy is going to go into a state that is going to impact his physical performance?"

AFRL is working with a variety of partners through cooperative research-and-development agreements and other mechanisms to push the technology forward. Collaborators include traditional defense contractors, academia, research consortiums and non-traditional companies.

"There are some unusual folks who have gotten into this business of wearable sensors," Naik said. "I'm not saying it's a bad thing. It's actually a good thing because they bring a completely different mindset." **ND**

Email comments to jharper@ndia.org

How Technology Could Create 'Super Soldiers'

By Jon Harper

Popular culture has long been fascinated by the idea of enhancing human beings. From the 1970s TV show "The Six Million Dollar Man" to this year's latest "Captain America" film, sci-fi writers have imagined what it would be like to give individuals extraordinary powers.

In the real world, scientists and engineers are working on a number of cutting-edge technologies to make U.S. troops faster, smarter and more resilient than their normal selves.

Paul Scharre, a former Army Ranger and the director of the 20YY Future of Warfare Initiative at the Center for a New American Security, said performance-enhancers that are being explored could offer tremendous operational advantages for warfighters.

"What if we had an 'on' switch right before pilots were about to go into a dogfight and we could turn that switch on? Or right before infantry soldiers were about to go into combat we could turn that switch on? That would have profound ... implications for warfare," he said.

Sometimes referred to as human enhancement or human augmentation, the effort to create what observers have called "super soldiers" is progressing on many fronts.

In one example, the Defense Advanced Research Projects Agency has launched 4MM, a project to develop a device that could enable dismounted troops to run a four-minute mile, a benchmark normally reserved for the world's most elite runners.

"The underlying theory there is if you can provide some forward push to ... the wearer, can you make it so they can run faster," said Mike LaFiandra, chief of the dismounted warrior branch in the human research and engineering directorate at the Army Research Laboratory, where 4MM prototypes have been tested. "There are different concepts for how that forward push comes."

With DARPA funding, researchers at Arizona State University developed a

system called Air Legs.

"We built an exoskeleton ... where we used air cylinders that would move back and forth very quickly to allow people to run fast," said Tom Sugar, a professor in ASU's department of engineering. "We had people running as fast as 5.5 meters per second or 12 miles an hour."

Sustained running at that speed would enable a soldier to clock a five-minute mile. A runner would need to reach speeds of 15 miles per hour or greater to achieve a four-minute mile.

LaFiandra said the project is "progressing" and additional prototype evaluations will be conducted this fall.

To enable troops to essentially be

smarter, scientists at the Air Force Research Laboratory are exploring the implications of transcranial direct current stimulation, or TDCS. The process entails attaching electrodes to a person's head and passing a low-intensity electrical current to the brain.

"We are seeing slight increases in attention and in learning," said Rajesh Naik, chief scientist at AFRL's 711th human performance

wing.

Researchers need to learn more about cause and effect when it comes to brain stimulation and response, he said at a recent conference.

"We have work that's going on from the study of neurobiology [of] what pathways are you exciting? What pathways are turned on/turned off to enhance specific cross-cognitive processes in individuals?" he said.

DARPA has a new program called targeted neuroplasticity training, which aims to speed up the learning process for service members and other defense officials.

"We're focusing on fully non-invasive, non-implantable devices that can stimulate peripheral nerves superficially," TNT program manager Doug Weber told National Defense.

The goal is to stimulate nerves that play a role in regulating brain functions.

"When you're training for an exam or learning a new skill your brain is being essentially rewired to acquire that knowledge and to perform those new skills," he explained. "There are molecules, or you can think of them like drugs, that are naturally produced by your brain that affect those learning processes. And by accessing the nerves that regulate production of those neuro-molecules we believe that it's possible to boost learning or to accelerate the rate at which your brain takes on or acquires those new skills."

Targeted neuroplasticity technology could prove useful in expediting foreign language and intelligence analysis training, Weber noted.

"People that are trained to study satellite imagery and other surveillance signals, they spend a long time trying to find that needle in the haystack and learning how to develop the trained eye and the trained ear to be able to recognize specific targets," he said.

Having the ability to increase the rate at which analysts learn to distinguish them is one of the goals of the program, he said.

DARPA is in the process of reviewing solicitation responses from industry and academia. The program is slated to get off the ground this year after the source selection process is completed.

The effort is expected to run for four years before the work is handed off to other Defense Department organizations. By 2020, program officials hope to have demonstrated the proof of concept.

"I don't want to speculate what form that device will take at this point, but I think what we're aiming for is something that can be worn and will be not obstructive and can be adaptive to almost any training scenario," Weber said. "Commercializing it will be fairly straight forward because ultimately the technology I think will be fairly simple to deploy."

To improve cognitive function, researchers at AFRL see promise in microbiology. Naik is particularly interested in the potential of probiotics.

"There's a lot of things you could do ... in helping improve the gut or the microflora in the gut," he said. "That can influence neurological processes because there are bugs that can help induce neurotransmitters that can impact mood ...



ASU developed the Air Legs system.

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so there might be easy fixes for enabling the warfighter [to improve his performance] without having to put on all these different devices."

DARPA researchers are also aiming to make service members more resilient to disease and combat stress.

Last year the agency launched the electrical prescriptions program, known as ElectRx, and selected partners from academia and industry to participate in the first phase of the project, with the goal of improving biological responses for treating illnesses and injury.

"Ultimately our vision is that this is a device that would be implanted and provide continuous monitoring of someone's health status and then responds in a sort of on-demand fashion to deliver the therapy," said Weber, who is managing the program.

The therapy would not be a drug or a surgical procedure, he noted. "It's simply stimulating the specific nerve targets of the body to affect ... some change in immune system function."

The technology could eventually provide opportunities for regulating troops' physiological and psychological condition in combat.

"Many of those same chemicals affect your cardiovascular system as well, so your blood pressure rises and falls depending on your level of arousal and your level of perceived stress," he said. "You could envision [the technology] sort of up-and-down regulating your brain and body's response to those stressful environments."

Controlling these functions could enable soldiers to reach an optimal state for performing tasks under pressure.

"Sports psychologists talk about this all the time," Weber said. "If we had a better ability to sort of keep our personnel 'in the zone' then we would expect a performance benefit absolutely."

The program, which kicked off in October, is still in its early stages. Much of the work that has been done so far is aimed at understanding the physiology involved and the body's response to these types of devices, Weber said.

The ElectRx program will last four years.

Another way to enhance performance is with pharmaceuticals. Some Air Force pilots already take amphetamines, nicknamed "go pills," to keep them energized and alert during long missions. Now military researchers are interested in

medication to ward off high altitude sickness.

"There are some companies that say they have certain drugs that can help you enhance hemoglobin uptick of oxygen, for example," Naik told National Defense. "We are looking at the science" behind that.

Naik said a lack of understanding of the long-term effects of certain pharmaceuticals inhibits their use. "We have to be a little bit careful."

The proliferation of advanced wearable technologies could help researchers monitor individuals and learn more about the effects of various drugs, he noted.

Scharre said the Defense Department is being overly cautious when it comes to withholding these types of performance enhancers.

"We're certainly raising almost a generation of young folks today on study drugs for ADHD," he said. "How is Ritalin scary? If we could give a low, safe dose ... to a fighter pilot or an intel analyst or a sniper to improve their concentration and performance, why would we not want to do that?"

"These ethical concerns have to be balanced against the ethical responsibility that the military has to give soldiers a game-changing technology if it will save their lives on the battlefield," he added.

Potential adversaries are unlikely to have the same wariness about giving their troops performance-enhancing drugs, Scharre said.

"If the Soviet Union was happily doping its athletes for the Olympics, why would Russia not want to dope its service members if they had the technology to win in a war, which is a lot more important?" he said.

U.S. troops are already taking off-the-shelf performance enhancers that they can buy at GNC stores on or nearby military bases, he noted.

"Soldiers and other service members are pumping themselves full of supplements but they're things that aren't regulated and they're not necessarily safe or even effective," Scharre said.

One road that the Defense Department isn't heading down to create better warfighters is genetic manipulation of humans. There are multiple reasons for that, according to Naik.

"Ethics clearly, but also the science," he said. "We don't really understand it. It is much more complex" than people

imagine.

The Defense Department isn't looking to permanently enhance individuals in order to create super soldiers, Naik said. When it comes to understanding U.S. military efforts to improve troops' performance, think of Iron Man, not Captain America, he said.

"Captain America is [still] enhanced when he pulls off his suit," he said. "He is still Captain America. When Iron Man gets out of his suit he's a normal arrogant individual. ... He sort of remains the same" as he was before he donned his gear.

Scharre thinks it will be a long time before Pentagon leaders would consider approving genetic enhancement.

"There's just so much uneasiness within the U.S. military about anything that modifies people that it won't be until this is something that is really well understood and widely used in American society as a whole before the U.S. military adopts it," he said.

Meanwhile, potential foes could forge ahead with these types of technologies including those that could enable troops to control artificial limbs or other appendages with their brains. That possibility creates difficult dilemmas for the United States, noted Air Force Gen. Paul Selva, the vice chairman of the Joint Chiefs of Staff.

"How far will we go with biological augmentation? I would argue that's a legal and ethical question that we're going to have to" answer, he said at a conference earlier this year. "What might our adversaries do with that technology is something that we need to be able to understand. It's not just do we want to do it, but if somebody else does it, how do we or can we counter it?"

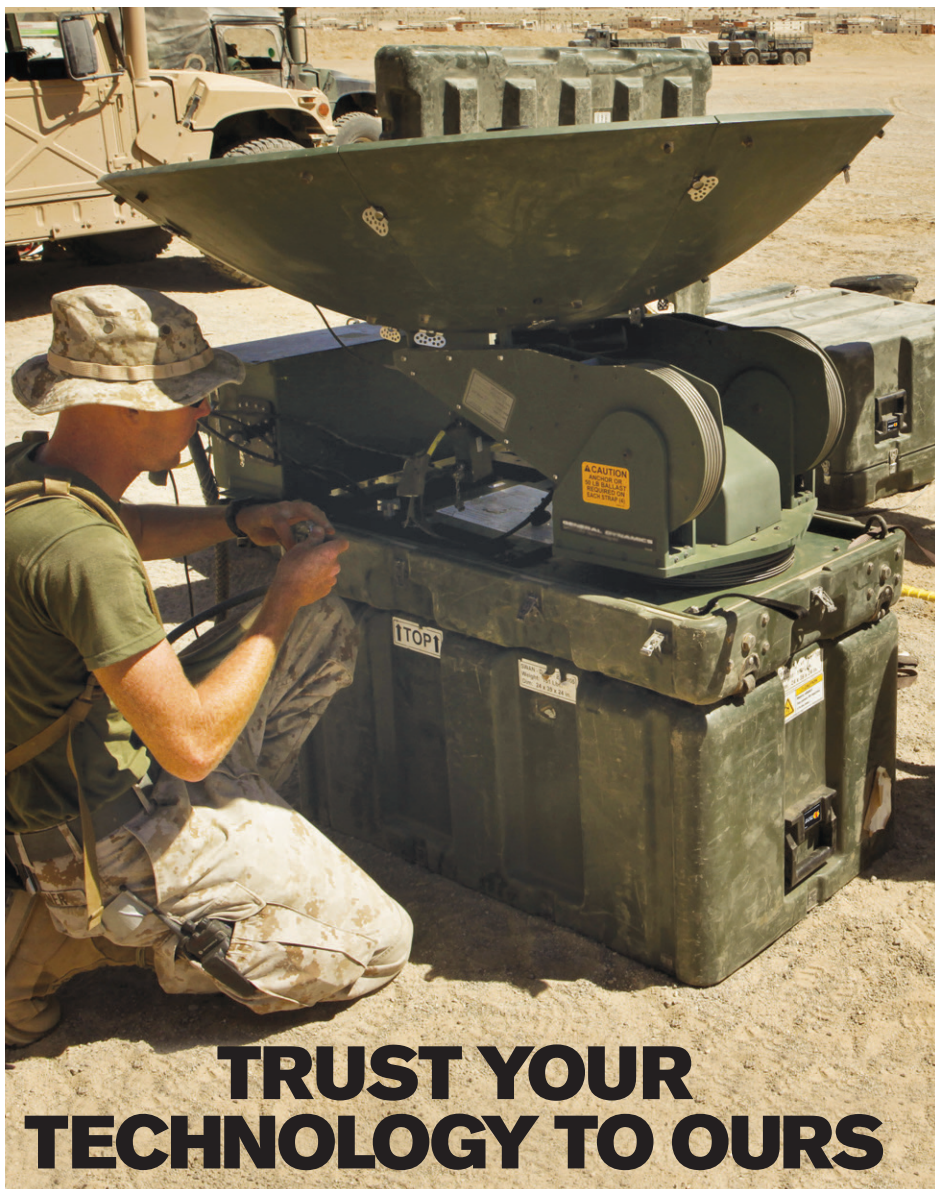
International conventions regarding how such technology can or cannot be used might be necessary, he said.

"I think we are a long way from actually being in the middle of that debate," he added.

Scharre said it would be foolish for U.S. defense leaders to keep kicking the can down the road on these issues.

"I would really be fearful of waiting until an adversary has demonstrated some advantage for us to even begin talking about this," he said. "That's a terrible way to go about military innovation." **ND**

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Stealth Bikes May Fill Troops' Need For Lighter, Faster Transportation

By Vivienne Machi

A couple of never-before seen militarized motorcycles grabbed headlines at this year's Special Operations Command's trade show in Tampa, Florida.

The hybrid-electric, off-road bikes appear to be more than curiosities, however. Because of their stealth-like features and flexible fueling options, there is a chance that they could one day be part of the military inventory.

Hybrid-electric motorcycles — that can be powered by either heavy fuels like diesel and jet fuel or by a lithium ion battery — offer a longer range and a quieter ride than other motorized vehicles, said Christopher Orlowski, a program manager at the Defense Advanced Research Projects Agency, who is leading the motorcycle research.

"Raids can require infiltration into an area, and if you can do it more quietly, then that can add benefits into the operation," he said.

The two prototypes — Logos Technologies' SilentHawk and LSA Autonomy's NightMare — were unveiled at the 2016 Special Operations Forces Industry Conference. They can each run for at least 120 miles on combined electric and heavy fuel sources, reach a top speed of 80 miles per hour and maneuver in and out of areas at about the noise level of a normal conversation. They can also charge portable electronics, saving precious space in soldiers' rucksacks, Orlowski said.

The program was funded in 2014 through small business innovation research grants, which provide funds to smaller companies to demonstrate the feasibility of a product or technology.

For the hybrid off-road motorcycles the objective was "to demonstrate a lightweight two-wheel drive hybrid-electric off-road motorcycle [...] powered by heavy fuels, capable of short periods [of] electric-only propulsion,

and usable as a portable electric power source for soldiers in the field," according to documents.

The stealth motorcycle effort is "not a traditional DARPA program," Orlowski said in an interview, "but it was in line with our mission to create disruptive programs for national security."

Hybrid-electric propulsion in a ground vehicle could be a benefit to special operators, although a motorcycle may not be the ideal vehicle, said James Hasik, a military vehicle expert and senior fellow at the Atlantic Council's Brent Scowcroft Center on International Security.

"In the late 1930s, everyone had a motorcycle unit, which was the reconnaissance team, similar to a cavalry on horseback," he said. But the same issues that rendered horseback cavalry obsolete — namely, that the riders were exposed to machine-gun fire and roadside bombs — also made a motorcycle infantry "not particularly survivable" in the modern era, Hasik said.

"The technology has perhaps a broader

application because the forces don't have a whole lot of need for dispatch riders" in the age of radio communications, he said.

"But if you're on the other

side of a really nasty electronic warfare campaign, a dispatch rider on a motorcycle may make more sense," he said.

Hybrid motorcycles have been difficult to develop until recently, said Jean-Marc Henriette, co-founder and chief hardware engineer for LSA Autonomy, the Westminster, Maryland, robotics and autonomous platform company behind the NightMare.

"You're trying to create a lot of power on a compact frame so that it won't be too sluggish or too slow, and it needs to be able to support a rider," he said.

LSA Autonomy decided that the only way it could make that amount of power work on a small frame was by building a motorcycle chassis from scratch around its hybrid engine.

The NightMare is intended to be a workhorse vehicle, he said. "It has agility, it can go fast and it has some meat to it. And we've taken extra measures like using a belt instead of a chain to limit those engine noises," he said.

Logos, a diversified science and technology company based in Fairfax, Virginia, opted to work with Alta Motors, an electric motorcycle company based out of San Francisco, and placed its own hybrid engine into Alta's Redshift MX electric dirt bike.

"It has the capability of running as long as you need to, as long as you can find fuel," said Alex Dzwill, lead Logos engineer for the SilentHawk program. That fuel can be conventional fuel, diesel fuel, jet fuel, propane or even bio-fuel if need be, he said.

Although the motorcycles don't meet the full criteria of stealth technology — there is nothing they can do to reduce radar or infrared signatures, for example — Hasik said that the term could apply because "stealthiness is a matter of observability, and in this case we're trying to limit the noise signature," he said.

Orlowski considers them to be stealthy "in the sense that



Alta Motors' Redshift MX (above) was used to develop Logos' SilentHawk



LSA Autonomy's custom-built NightMare

you don't have engine noise," he said. The noise level is dependent upon the type of terrain the rider is traveling, but the goal of the program was to keep the noise level to less than 55 decibels in the "quiet" electric mode, he said.

"But we didn't tie that number to any type of operational or military utility analysis," he said.

Fifty-five decibels is about the level of a normal conversation, Dzwill said. The SilentHawk can run in quiet mode for up to two hours on a single charge. Once the electric battery has been depleted, the multi-fuel generator can be turned on to travel a combined distance of 170 miles with the generator and battery, he said. "With the generator on, you're looking at the sound level of a vacuum cleaner, about 75 decibels," he said. The noise level for a typical motorcycle varies between 80 and 100 decibels, according to a study of motorcycle noise levels by Purdue University's department of chemistry.

The SilentHawk and NightMare also each feature a dual-wheel drive system, as opposed to conventional motorcycles that only feature rear-wheel drive.

"For the extreme off-road situations like this motorcycle is likely to see, if you only have rear-wheel drive it's not going to cut it," Dzwill said. "By combining front-wheel and rear-wheel drive, you can get anywhere on the planet with the right driver." The fact that they can each charge portable electronics while in use or while stationary means that special operators may not have to carry as many batteries or chargers with them on missions, he added.

Commandos have already used electric — although not hybrid — motorcycles while on missions. Zero Motorcycles' military MMX model was developed in coordination with the Navy in 2012. "We've been evolving that model and making it better every year," said Zero Motorcycles chief technology officer Abe Askenazi.

The Navy was interested in the low auditory and heat signatures that the MMX model provided, and its unique rapid charging capabilities, Askenazi said. Zero's patented battery system allows a rider to easily swipe a depleted battery out for a fully charged one in less than a minute, and then recharge the first battery on the vehicle, he said.

Zero, a Scotts Valley, California-based motorcycle company, started developing

electric motorcycle technology in 2007, a year after the company was established, Askenazi said.

"We had done a lot of off-road and racing motorcycles, and for those, you want to get into the racing pit and [be able to] swipe a battery out and continue," he said. "It just so happened very coincidentally that the Navy and special operations forces approached us then." They sold eight MMX units and 32 batteries — four batteries per vehicle — to the Navy in 2013, he said.

It has also been sold to U.S. allies around the world and to several California police agencies, including the Los Angeles Police Department's off-road enforcement unit and 84 other law enforcement agencies, Askenazi said.

"There's a vast stretch of land that's undeveloped that they [the LAPD] need to patrol, and they were looking for a silent vehicle that could be used for enforcement patrolling," he said. "They don't make a racket while they're policing beach paths, city streets or college campuses, so they're not a nuisance."

The viability of electric motorcycles has been limited by their battery range, although Askenazi noted that the technology is becoming more efficient and powerful. It's easy to forget that electric cars like the Tesla or the Nissan Leaf have only been developed over the past 10 years, he added. "The energy density just wasn't there. But every year, it improves," he said.

In the meantime, the SilentHawk and NightMares' fuel tanks can serve as a gapfiller as electric battery technology progresses. Once the SilentHawk's electric battery is dead, or close to dead, the system will switch to the multi-fuel engine to allow the battery time to recharge, Dzwill said. The NightMare's system works in a similar manner, Henriette said.

As the SilentHawk and the NightMare have each completed the second phase of the development process and the companies plan to finish testing their prototypes by the end of 2016, DARPA will keep the services informed of their progress, Orlowski said.

SOCOM spokesman Navy Lt. Cmdr. Matt Allen confirmed that electric motorcycles have been purchased by some of the special operations components in the past "for increased ground mobility capabilities when the mission required them," he said.

It's not a given that the technology will find a customer at SOCOM, he suggested.

"While this technology is not something we are specifically seeking at this time, we are always interested in the advancement of technology to enhance or increase mobility for the SOF operator," he said.

The services could also find another use for the motorcycles that DARPA had not previously considered, Orlowski said.

"Anytime you put equipment into a soldier's hand, they think of new and novel ways to use it," he said.

As LSA moves out of the development phase, the NightMare's power generation feature alone could foster customer interest, even if the full prototype does not, Henriette said. "Although we would love to continue to work on the motorcycle," he said.

The broader lesson that Hasik sees here is that "the idea of a hybrid or electric motorcycle for the services has been taking root," he said. "I was hoping 10 years back it would take root, because diesel engines are loud, and that's a signature on the battlefield." **ND**

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Directed Energy Weapons Gaining Acceptance Across U.S. Military

 **By Yasmin Tadjdeh**

No longer the stuff of science fiction, laser technology is progressing rapidly. Throughout the services, officials are banking on new directed energy weapon systems, which promise to offer the military precision strike at a low cost for both defensive and offensive missions.

At Special Operations Command, its program executive office for rotary wing is working alongside the Army's program manager for Apache attack helicopters to test a directed energy weapon on an Apache this summer.

"There is absolutely a niche I believe for use of directed energy weapons," said Col. John Vannoy, SOCOM's program manager for rotary wing. "The lens we are looking at this through right now is: 'Is it feasible to do this?' We're not at the point where we've laid out a business case to advance it."

The command envisions using a laser weapon to destroy vehicles or generators versus sending in a missile that could cost hundreds of thousands of dollars, he said during an industry conference hosted by the National Defense Industrial Association in Tampa, Florida.

Vannoy's office and the Army's Apache office have entered into a cooperative research and development agreement with Raytheon to put a podded laser on the aircraft, he said.

"We really want to understand the environment on the wing, the beam quality we can get off the wing and the ability to beam steer and keep power on a target," he said.

Environmental factors such as dust could affect beam quality. In addition, the vibrations on an Apache's wing could affect steering, he said.

Vannoy did not disclose a specific timeframe for the test or when results would be made public.

The effort to equip an Apache with a laser is still in its infancy, he said. "I wouldn't say that we're at the tipping point and you're going to see a Star Wars-like effect or a Death Star laser hanging off the side of a rotary wing aircraft," he said.

A directed energy weapon could also be mounted on an MH-60 Black Hawk,

he noted.

Mark Gunzinger, a senior fellow at the Center for Strategic and Budgetary Assessments, a Washington, D.C.-based think tank, said based on the relatively small size of a helicopter the laser would likely have between 15 and 30 kilowatts of power.

"That would pack a pretty good punch" at short ranges against a soft target, he said.

If SOCOM decides to move forward with the effort to equip a laser on a helicopter, PEO rotary wing would work closely with its fixed-wing counterparts in the command, Vannoy said.

Currently, PEO fixed wing is working to outfit an AC-130J Ghost Rider gunship with a directed energy weapon.

"We communicate between the two offices daily," Vannoy said. "There will be limited redundancy. We'll be working together to advance that. But their requirement, I would expect ... [it] would be different. They've got a larger capacity on a C-130 than we do."

AFSOC has been planning to put a laser on the gunship for years. Officials recently said the command is on track to equip the aircraft with a laser weapon by the end of the decade.

Working alongside Naval Surface Warfare Center Dahlgren in Virginia, the service recently wrapped up the first phase of a two-part study that will give the command greater clarity on the maturity of commercially available systems and potential design concepts, said Lt. Col. John DiSebastian, director of fixed-wing tech insertion at SOCOM.

AFSOC plans to use commercially available technology to develop different parts of the laser — such as the power source or beam director — but the command will be the lead integrator of the system, he said.

"We're not looking for a single company to come in and take the lead. We're looking for individual components where the government will control the interfaces," he said. Similar to "our previous gunships, we would put one capability on and then grow it and then add another and build upon it."

Lt. Gen. Bradley A. Heithold, AFSOC

commander, has made the development of the laser his pet project. During an industry conference hosted by CSBA in June, he noted that the system is often called the "Heithold

laser" because he talks about it so often.

When developed, the weapon will be a game changer, but for now it is critical that the command can begin development and testing, he said.

"It's going to be a little sloppy. It's not going to be real, real precise at first. But you know what? If you give industry partners a challenge they'll take it ... and they'll make it better," he said. "But you got to start."

The goal is to kick off the program in fiscal year 2017, with a flight test in 2020, DiSebastian said.

AFSOC is still determining how powerful it wants the laser to be, he said. The system will range from 60 kilowatts to 150 kilowatts and will be outfitted in the Ghost Rider's 30mm gunport, he said.

SOCOM is currently waiting for the results of phase two of the Dahlgren study, which is slated for completion in August, he said. That will give officials more information on cost, schedule and capability.

While the program hasn't had any hiccups, the biggest hurdle will be drafting an appropriate funding strategy, he said.

"We're on a path. It's just whether or not the department agrees that we are at the proper maturity. So we don't want to get ahead of ourselves and try to push too far beyond the bounds of what is currently available," he said.

Following the release of an official acquisition strategy, AFSOC will solicit a request for proposals from industry, he said.

In its fiscal year 2017 unfunded requirements priority list, AFSOC asked Congress to allocate \$120 million for the effort, Gunzinger said.

"I hope the Congress does find the resources to fund it because this could be the first high-powered operational directed energy weapon system DoD fields," he said.

Laser technology is mature enough for such an endeavor, he said.

"The current state of the art of laser technology considering the power, the cooling, the size, the weight of lasers, is frankly a good fit for an AC-130 gunship-sized aircraft," he said.

While there might be some techni-



AH-64 Apache

cal challenges when SOCOM begins integrating components, it will be more a matter of engineering than science, he said. Funding is the biggest uncertainty.

"The problem is more a question of obtaining adequate funding than it is the technology itself unlike 10 years ago where there was a lot of basic science yet to be done," Gunzinger said.

The Marine Corps is also developing directed energy weapons, said Lt. Gen. Robert Walsh, commanding general of Marine Corps Combat Development Command.

"From an aircraft side, we're looking at putting lasers on anything we can get" them on, he said.

The service is already using the technology on its CH-53 aircraft, which is equipped with a directed infrared countermeasures system, he said. It has "the ability to defeat weapons coming at our aircraft. ... We plan on putting that on all our assault aircraft and that to me is a tremendous capability, much better than we've ever had in the past to be able to defeat those threats."

The Marine Corps would also like to equip its inventory of KC-130 aircraft with directed energy weapons, he said.

Northrop Grumman, Boeing, General Atomics, Raytheon and Lockheed Martin are the leaders in laser technology, according to a study by Govini, an analytics firm with offices in Arlington, Virginia, and San Francisco. Investments in directed energy grew by 23 percent in fiscal year 2015 compared to the previous four-year average, reaching a total of approximately \$600 million, the report said.

The report called directed energy weapons the "flagship initiative" of the Pentagon's third offset strategy, which is intended to maintain the United States' military superiority through investments in emerging technology.

It is also meant to develop technology that can lead to cost advantages for the United States while imposing a cost burden on the enemy, Gunzinger said.

Directed energy weapons "could help counter enemy air and missile salvos at much less cost than if we simply continue to use very expensive kinetic interceptors only," he said.

Lasers have long been in development and a system may soon become a program of record, he said.

"There is generally an acknowledgment that we are right on the cusp of seeing these technologies leap over what's called the 'Valley of Death' which exists between science and technology projects and actual acquisition programs," Gunzinger said. "I think the gunship laser in particular is going to be the first one."

Gen. Ellen M. Pawlikowski, commander of Air Force Materiel Command, urged laser developers to not repeat mistakes that plagued previous development efforts, such as the airborne laser program, which Pawlikowski once oversaw. The megawatt laser program, which was canceled in 2009, faced major cost overruns and schedule slippages.

"I want to make sure that we don't have another five- or eight-year development program that we told everybody we were going to do in three to four," she said. "It's so vitally important that we continue this path of expectation management and we target for something that is achievable within the bounds of the state of technology as we see it today."

The airborne laser program used toxic chemicals to produce the laser, which gave it enormous power but made it expensive, Gunzinger said. Additionally, it required a platform the size of a Boeing 747 to operate. While most research currently focuses on solid-state lasers

that use electricity, "never say never" that the pendulum could swing back in favor of chemical-based systems, he said.

"Technology has continued to evolve with those systems," he said. "I could see the potential applications for chemical lasers on, say, base defense, perhaps."

One of the most high-profile laser efforts in the military is the deployment of the Navy's 30-kilowatt laser on board the USS Ponce. Adm. Bill Moran, the vice chief of naval operations, said recently that the Navy will perform a shipboard test of a 150-kilowatt laser weapon system in the near future.

There are lessons that can be applied from the Navy's system to the AC-130J effort, Gunzinger said. For instance, crewmembers on the Ponce found that the laser could also be used as a sensor, he said.

"It wasn't just the question of, 'Well, it only has utility when it is acting as a defensive weapon.' They found they could use it to meet other needs as well," he said. For the AC-130J, the optics on that laser could be used as a sensor as well.

While the military is working on the development of directed energy weapons, it must begin investing in counter-laser systems, Gunzinger noted.

"We need to think about how we are going to counter enemy-directed energy weapons and not just how we could use them to our benefit in the future," he said. "Frankly, that could in the future be the harder problem. How do we defend our forces and our capabilities against directed energy weapons when they become widely proliferated?"

It is likely that other countries are at least thinking about such technology, he said. They could be developed relatively soon, he added.

"We're not talking 20 years," he said. "It could be much sooner than that."

Directed energy weapons could become as readily available as precision-guided munitions are today, he said.

"Back in the '90s ... we were just about the only kids on the block with a large inventory of PGMs," he said. "Now we're worried about how we're going to defend against salvos of PGMs. This is going to happen with directed energy weapons in the future as that technology continues to proliferate and not necessarily just to state actors." **ND**

Email comments to ytadjdeh@ndia.org

Air Force Kicks Off Program to Replace Minuteman III Missiles

By Stew Magnuson

The nation's top three military contractors will compete for a multi-billion dollar, decades-long program to replace the Air Force's fleet of Minuteman III nuclear missiles and to modernize its command-and-control systems.

The service pre-selected the three competitors — Boeing, Northrop Grumman and Lockheed Martin. A request for proposals is expected by the end of this summer. Two of those three will be selected for a technology maturation and risk reduction phase. The goal is to deliver the first batch of new missiles by 2029, according to Air Force documents.

Chief of Staff of the Air Force Gen. David Goldfein, said: "Despite numerous upgrades to Minuteman III since it was first deployed in 1970, significant obsolescence and 26 sustainment challenges require development of a follow-on ICBM capability."

The ground-based strategic deterrence (GBSD) program "will resolve [Minuteman III] sustainment and aging issues, reduce total life-cycle costs and extend the U.S.'s ICBM capability out to 2075," he said in written responses to the Senate Armed Services Committee prior to his confirmation hearing.

The program is expected to cost \$62 billion from 2015 through fiscal year 2044, the Congressional Research Service reported. That breaks down to about \$14 billion for upgrades to command-and-control systems and launch centers, and \$48.5 billion for new missiles.

All three competitors made a case for being the best contractor for the job.

John Karas, vice president of the ground-based strategic deterrent program at Lockheed Martin, said his company has a long track record of success in engineering, evolving and sustaining ballistic missile systems.

"We bring vast expertise to the design, development and fielding of the Air Force's and the Navy's next-generation strategic missile weapon systems, as well as the nation's missile defense systems. We are uniquely qualified to offer the government the most affordable, low-risk GBSD solution that meets all mission requirements," he said in an email.

Randy Belote, Northrop Grumman vice president of strategic communications, said the program aligns well with the company's core capabilities.

"Northrop Grumman has been a U.S. Air Force intercontinental ballistic missile (ICBM) mission partner for nearly 60 years. ... The company has strong systems engineering skills; a track record for developing some of the most complex and innovative systems in the world; and a highly skilled, committed and innovative workforce that includes the next generation of missileers."

Both companies declined to make executives available for interviews pending the release of the RFP.

Boeing executives, however, expanded on its qualifications for the program, in April at the Space Symposium in Colorado Springs, Colorado. The company has served as the ICBM prime contractor for more than 50 years. Craig Cooning, president of network and space systems at Boeing, said with the long-range bomber under development and recent upgrades for the sea-based Trident missile program, Minuteman III would be the oldest part of the nuclear triad.

There have been some upgrades to the missiles since the 1970s, but other components have not been touched. "If you look at the launch control centers, it's like going back in time literally 50 years," Cooning said.

The Air Force, meanwhile, is dealing with an aging fleet of Minuteman III missiles that will have to be maintained until the new system is in place. They were deployed in the 1970s with a



Minuteman III missile

10-year lifecycle expectancy, but are now in their 40th year.

Alex Lopez, vice president for global sales and marketing for Boeing's network and space systems, said the Air Force has committed to replacing the flight systems on the missiles and the ground-based command-and-control systems, as well as carrying out cybersecurity upgrades.

The Air Force wants to refresh the technologies beginning in the 2020 timeframe, Lopez said.

"Maintainability is a big deal," said Cooning. If one fix to an antiquated system costs \$1 million per missile, that begins to add up with some 450 Minuteman IIIs in the arsenal.

The Air Force in its studies has concluded that these technology refreshes will cost less than simply trying to maintain some of the 1970s subsystems, said Lopez. Cooning added: "Lowering those [operations and maintenance] costs overall is going to be vital to the future of this program."

As for the follow-on missiles, Lopez said the key will be making a new architecture that is "flexible, effective and affordable."

Lockheed's Karas agreed.

"Our grandchildren's generation will be working on GBSD. That's why this program has to be affordable throughout development and production, and it has to remain affordable through operations and sustainment for decades to come. We're putting together a proposal with the future in mind and leveraging smart technology investments over the entire GBSD lifecycle," he said.

In a report looking at outdated federal information technology programs, the Government Accountability Office in May provided a case study focusing on the aging nuclear missile command-and-control system.

Development of the Air Force's Strategic Automated Com-

mand and Control System, which is needed to send and receive emergency action messages to ICBM personnel and other nuclear forces, began in 1963. The 53-year-old system is still being used today. It runs on an IBM Series/1 Computer — a 1970s computing system — and uses 8-inch floppy disks.

"Replacement parts for the system are difficult to find because they are now obsolete," said the report, "Information Technology: Federal Agencies Need to Address Aging Legacy Systems."

The software was written in assembly language code. Programs written in this language are much more difficult to write and maintain than others, and typically run only on the make of computer for which they are originally developed, it added.

Work on replacing the system is scheduled to begin by the end of fiscal year 2017, with completion by 2020 at the cost of \$60 million, the Defense Department said in its response to the report.

Amy F. Woolf, specialist in nuclear weapons policy at the Congressional Research Service, wrote in a March report about nuclear weapon platform modernization programs that the Air Force intends to replace and upgrade rocket motors, guidance systems and other components, so that they can remain in the force through 2030.

The U.S. land-based ballistic missile force currently consists of 440 Minuteman III ICBMs, each deployed with one warhead. The fleet will decline to 400 deployed missiles, while 450 silos will be retained to meet the terms of the New START Treaty. Treaty reductions are still ongoing with work due to be completed by Feb. 5, 2018.

The U.S. Minuteman III ICBMs are located at three Air Force bases — F.E. Warren AFB in Wyoming, Malmstrom AFB in

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Montana, and Minot AFB in North Dakota. Each base houses 150 missile silos.

The Air Force deactivated the missiles attached to Malmstrom's 564th Missile Squadron, which was known as the "odd squad," the CRS report said.

It was known as such because its launch control facilities for these missiles were built and installed by General Electric, while all other Minuteman launch control facilities were built by Boeing; as a result, these missiles used a different communications and launch control system than the other Minuteman missiles.

The 50 non-deployed missiles that were taken from Malmstrom are now being used for launch tests, and must be included in any modernization programs, CRS reported.

One example of how costly it is to modernize the Minuteman III can be found in the fuze modernization program, which will replace the current MK21 fuze to "meet warfighter requirements and maintain current capability through 2030." This program is needed because the current fuzes have long exceeded their original 10-year life span and U.S. Strategic Command does not have enough of them to meet its requirements.

For this upgrade alone, the Air Force received \$58 million in fiscal year 2015 and \$142 million in 2016. It has requested \$190 million for 2017. The budget documents indicate that funding will continue to exceed \$150 million per year through 2020, with a total program cost of \$1.2 billion, CRS reported.

The Air Force has also done some preliminary work on the Minuteman III replacement missile through a demonstration-validation, research-and-development program to buy down some risk for the new missile fleet.

Technologies in this program include: ICBM guidance applications, ICBM propulsion applications, reentry vehicle applications, and command-and-control applications. In the area of guidance applications, the Air Force is seeking to "identify, develop, analyze and evaluate advanced strategic guidance technologies, such as a new solid-state guidance system, for the ICBM fleet."

This new system would increase the accuracy of the ICBM force and allow the missiles to destroy hardened targets with a single warhead, the CRS report said. Multiple warhead missiles were eliminated under New START.

Larry Dickerson, an analyst at Forecast International, said the stakes are high in the program, but all is not lost for the two companies that ultimately aren't selected as the prime contractor.

"Just because they lose this initial contract doesn't mean they are shut out forever. They can figure a way to come back in," he said.

The Air Force is pretty good at spreading the work around so everybody "stays interested," he added. "Everybody gets a piece of the pie because they don't want to lose these other players and they don't want to be too dependent on somebody else."

There will also be plenty of opportunities for subcontracting, not only for the two runners-up, but other companies as well, he said.

"With industry consolidation, there are only so many companies now who can do this kind of stuff," he said. Some firms have certain skills sets and others don't, and just because Boeing has been the incumbent for a half century, doesn't necessarily give it an advantage. "It helps to have experience in this area, but it depends on whether that institutional knowledge is able to stay around," he said.

Some companies have hurt themselves under restructuring and have lost institutional memory of these types of programs that date back decades, he said.

Boeing, on the other hand, does have a long history of working with the Air Force on strategic programs, which may help, he said.

Some members of the Senate Armed Services Committee are also keen on the idea of cost savings through cooperation with the Navy on its Trident missile modernization program.

Goldfein said he was committed to the idea of commonality between the Navy and Air Force as they both upgrade their respective nuclear missiles.

"As we field that weapon system, it is actually not just the missile. It is the missile. It is the launch. It is the command and control. It is the entire enterprise approach. The Navy does the same thing when they look at the submarine force. So I think there is synergy there between how the Navy approaches it and how we approach the enterprise that is required to be able to support this mission," he testified.

The Air Force plan has some critics.

Kingston Reif, director for disarmament and threat reduction policy at the Arms Control Association in Washington, D.C., said the decision to build a new ground based strategic deterrent missile could be postponed for up to a decade. There have been — and will be — so many upgrades to the Minuteman III that it is basically a new missile.

Upgrades to launch control centers and the command-and-control systems are separate budget items that will cost about \$7 billion each. The Air Force has invested most of its resources over the past decades into upgrading the missiles, and neglected the ground stations. The Air Force could instead proceed with these upgrades, while modernizing the Minuteman IIIs in place, he said.

The budget bow wave expected in the 2020s — when the Defense Department will be forced to pay for Ohio-class submarines, the B-21 bomber and myriad other conventional weapon modernization programs — may force a postponement decision, he said.

Todd Harrison, senior fellow and director of defense budget and analysis at the Center for Strategic and International Studies, told reporters in January that replacing the missiles was "early to need," and postponing the program by five years could save \$2 billion per year.

The Air Force argues that its stock of 50 test launch missiles will be depleted by 2030, and if there is no new missile, it will have to dip into its deployed stock of 400. The association's stance is that 400 missiles are more than what's needed, although Reif declined to give an ideal number. New START expires in 2021, he added. It could be extended by five years if the United States and Russia agrees, or it could be renegotiated with lower missile numbers.

The service has also said it wants improvements to the missile, although it has not stated publicly what it wants. If one goal is to improve accuracy, then why not modernize the Minuteman III's flight control system? Reif asked.

"Given the enormous and likely unexecutable costs of the current plan, it makes sense to think about how to sensibly reshape and rescale the current path we're on. It would still leave us with an incredibly devastating deterrent," Reif said. **ND**

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Michael Appointed Senior VP for Program Development

■ The National Defense Industrial Association has appointed Frank Michael to serve as its senior vice president for program development.

Michael will manage NDIA's relationships with industry stakeholders and government officials, and will collaborate with its members, chapters, divisions and affiliates to provide forward-thinking programming and activities that address current and future challenges in defense and national security.

"Frank is a respected thought-leader who brings with him



Frank Michael

tremendous depth in strategic decision-making and a long and proven tenure of serving in executive leadership in the military services," said NDIA President and CEO retired Air Force Gen. Craig McKinley. "With Frank's leadership, NDIA will continue to serve as a trusted source of information and collaboration."

Michael joins NDIA from the Navy, where he most recently held the position of chief of the Navy strategy branch.

WID Names Service To the Flag Awardees

■ Women In Defense, an affiliate of the National Defense Industrial Association, presented its Service to the Flag Award to Christine E. Wormuth, who recently retired as undersecretary of defense for policy, and Lisa Atherton, executive vice president, military business of Bell Helicopter at a June 15 event at the Women In Military Service For America Memorial.

The Service to the Flag Award honors women who have contributed extraordinary leadership and strategic impact in government service and the defense industry.

"This is very meaningful to me," said Wormuth. "Years ago, when I started working at the Pentagon

there were relatively few women. Now we're seeing women in the highest levels of government and I'm tremendously pleased to see additional talent, expertise and perspectives coming together to work on very difficult problems. I thank Women In Defense for recognizing me

and for the very important work you are doing for women."

"While at the Air Force Academy I had to prove to those who didn't believe in me I deserved to be there, which drove me to persevere," said Atherton. "I know every day makes a difference to the

soldiers, sailors, airmen, Marines, and that we have to work to make sure they have what they need to do their jobs. I've had an incredible support system and I'm eternally grateful for organizations that encourage women to become leaders and inspire others."

The Service to the Flag Award is bestowed annually through NDIA's "Women In Defense" organization and recognizes leaders who identify and address some of our nation's most vexing national security challenges through their work in and outside of government.



WID National President Amy Courter (left) and NDIA Board Chair Sid Ashworth (right) present the Service to the Flag Award to Christine Wormuth June 15 at the Women In Military Service For America Memorial in Arlington, Virginia.

NDIA Spotlight: Integrated Program Management Division

■ NDIA's Integrated Program Management Division (IPMD) focuses on building strong government and industry working relationships to promote and communicate integrated program management best practices using earned value management (EVM) and other related processes.

The IPMD is industry's leading advocate on the use and implementation of EVM practices and has authored and maintains the EIA-748 Standard for Earned Value Management Systems, as well as a set of related industry best practice guides.

The division has a number of working groups that focus on specific areas and work jointly with government agencies to resolve common issues or promote industry best practices for mutual benefit. Two of the working groups have recently pub-

lished new or updated industry guides.

The EVMS for Agile Development Working Group was formed to advance the understanding and use of Agile and EVM to increase the probability of program cost, schedule and technical success. The Planning and Scheduling Working Group is an effective forum for exchanging views and information between government and industry regarding planning and scheduling processes including earned value management.

The division meets three times a year for two days. For more details on the IPMD's working group activities, guides and white papers, charter, board of director's contact information, presentations and minutes from previous meetings, and schedule for upcoming meetings, visit <http://www.ndia.org/ipmd>.

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Air Force F-35

■ Air Force officials are confident that their version of the F-35 joint strike fighter will reach initial operating capability by the end of the year. Yet development of some components is lagging, meaning the vision for the aircraft is still years away from being realized. Once that comes to fruition, how will the service use this fifth-generation aircraft to its full potential?

Marine Corps F-35B

■ Last summer, the Marine Corps announced that the F-35B joint strike fighter had achieved initial operating capability. In the year since, the Marines have reached a number of milestones, including flying the aircraft for the first time in the United Kingdom. In our September issue, National Defense examines what's next for the F-35B.

A-10 Replacement

■ With the A-10 Thunderbolt II slated for retirement in 2022, the Air Force is already pondering a next-generation close-air-support plane. Shortly before he retired in June, then-Air Force Chief of Staff Gen. Mark Welsh envisioned a military version of a "flying Coke machine" — a platform that could provide a variety of attack capabilities on-demand. Questions remain as to whether the money will be there for such a project, and if the service would need to modify an existing platform or develop a brand new one.

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