MARCH 2016

National DEFENSE

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March 2016

NDIA'S BUSINESS AND TECHNOLOGY MAGAZINE
VOLUME C, NUMBER 748
WWW.NATIONALDEFENSEMAGAZINE.ORG

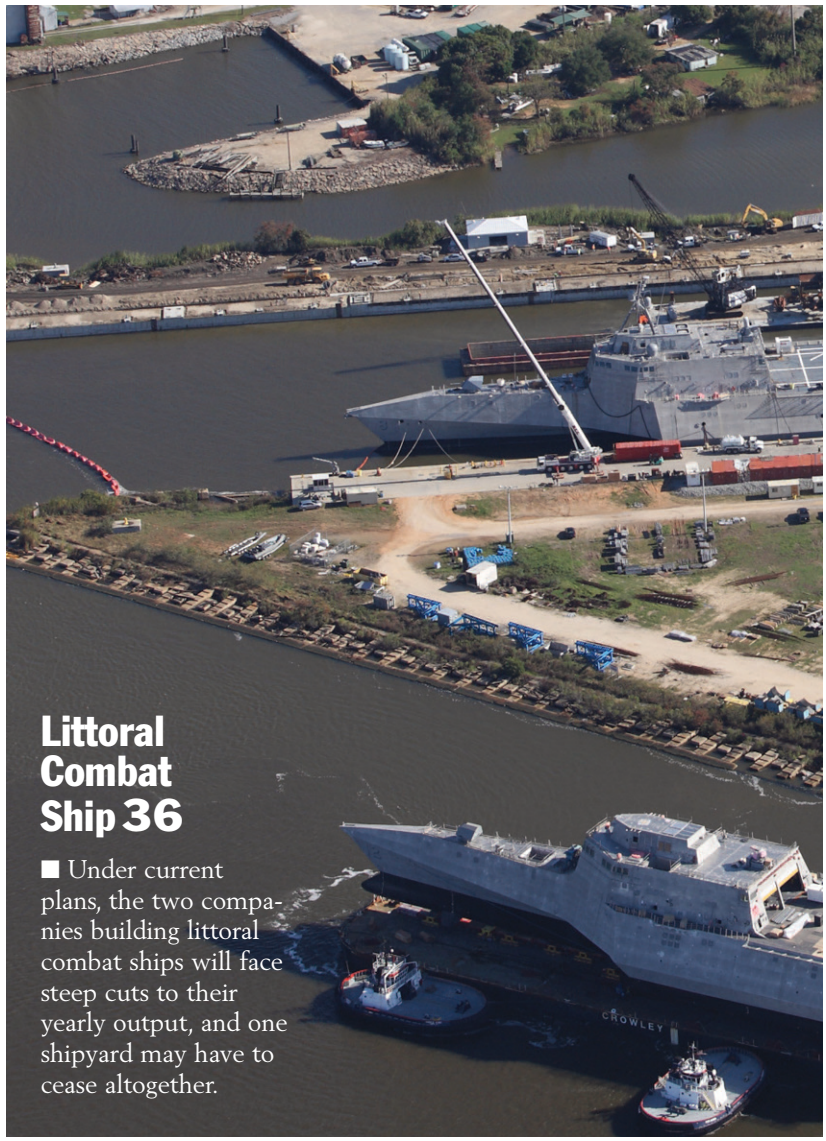
Lasers 28

■ The time is right to finally deploy a laser weapon aboard an aircraft and Special Operations Command says it has the best platform for the job.

Cover Story 22

■ The Air Force Research Laboratory wants "thinking" unmanned aerial vehicles that can fly in a pack, search for targets and possibly destroy them. Just don't call them "swarms."

Cover: Photo-illustration based on DARPA concept art.



Littoral Combat Ship 36

■ Under current plans, the two companies building littoral combat ships will face steep cuts to their yearly output, and one shipyard may have to cease altogether.

DEPARTMENTS

BPA WORLDWIDE **National Defense** (ISSN 0092–1491) is published monthly by the National Defense Industrial Association (NDIA), 2111 Wilson Blvd., Suite 400, Arlington, VA 22201–3061. TEL (703) 522–1820; FAX (703) 522–1885. **Advertising Sales:** Dino K. Pignotti, 2111 Wilson Blvd., Suite 400, Arlington, VA 22201–3061. TEL (703) 247–2541; FAX (703) 522–1885. The views expressed are those of the authors and do not necessarily reflect those of NDIA. **Membership rates** in the association are $40 annually; $15.00 is allocated to National Defense for a one-year association basic subscription and is non-deductible from dues. Annual rates for NDIA members: $40 U.S. and possessions; District of Columbia add 6 percent sales tax; $45 foreign. A six-week notice is required for change of address. Periodical postage paid at Arlington, VA and at additional mailing office. **POSTMASTER:** Send address changes to National DEFENSE, 2111 Wilson Blvd, Suite 400, Arlington, VA 22201–3061. The title National Defense is registered with the Library of Congress.

National DEFENSE MARCH 2016
VOLUME C
NUMBER 748

EDITOR
Sandra I. Erwin
(703) 247-2543
SErwin@ndia.org

MANAGING EDITOR
Stew Magnuson
(703) 247-2545
SMagnuson@ndia.org

SENIOR WRITER
Jon Harper
(703) 247-2542
JHarper@ndia.org

STAFF WRITER
Yasmin Tadjdeh
(703) 247-2585
YTadjdeh@ndia.org

DESIGN DIRECTOR
Brian Taylor
(703) 247-2546
BTaylor@ndia.org

EDITORIAL ASSISTANT
Allyson Versprille
(703) 247-9469
AVersprille@ndia.org

ADVERTISING
Dino Pignotti
(703) 247-2541
DPignotti@ndia.org

For additional advertising information, go to the Index of Advertisers on the last page.

National Defense Magazine
2111 Wilson Blvd., Suite 400
Arlington, VA 22201

CHANGE OF ADDRESS:
http://eweb.ndia.org

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Deferred Maintenance Could Swamp Budgets

Nearly everyone is familiar with the old adage, "An ounce of prevention is worth a pound of cure." It is one of those universal and enduring truths that millions of us implicitly acknowledge when we get an annual physical, take our car in for its scheduled service or repair the roof on our house after a few shingles fall off after a storm.

But, for a multitude of reasons — none of them convincing or persuasive — we don't practice this logical and simple concept when managing our defense infrastructure.

A report came out recently revealing that when it comes to facility and infrastructure management, the Air Force has had to accept a "patch and mend" strategy for the numerous installations it operates around the world. What could that mean? In essence, it means that the Air Force can't apply preventative procedures to key facilities and infrastructure. Instead, it defers needed and predicted maintenance and repairs until things actually break or otherwise become unusable.

Why has the Air Force adopted this approach? I can assure you it is not because its leaders are unfamiliar with the concept of scheduled, preventative maintenance and repair. And it is not because they are unfamiliar with concepts such as performance-based logistics and predicted failure rates. It is simply because they do not have the funding needed to execute a preferred alternative approach. The result has been excess costs incurred when making repairs, and a decrease in availability while awaiting them.

A few examples have recently been reported in the defense media. At Malmstrom Air Force Base, Montana, a building floor collapsed forcing a six-month stoppage in the repair of important nuclear components. At Tinker Air Force Base, Oklahoma, an obsolete electrical sub-station exploded cutting off power to numerous depot buildings, and resulting in millions of dollars in repairs and lost productivity. In this business, "lost productivity" is a soft way of describing "lost operational capability."

In simple terms, although the Air Force received all the money it asked for in the fiscal year 2016 budget for infrastructure and facilities maintenance, it did not have a sufficient topline allocation. As a group, the military services only requested about 80 percent of the funding they actually needed to perform necessary sustainment and infrastructure maintenance. This means that some 20 percent of needed maintenance is being deferred, which creates two interconnected problems.

First, such deferrals have a compounding effect, meaning the eventual costs of a repair, upgrade or replacement will be significantly more costly than had the problem been addressed according to a systematic schedule.

Second, this compounding effect ultimately means that a huge backlog develops across the entire inventory. For the Air Force, that backlog, by some estimates, has now reached $23 billion, a figure nearly 20 percent of the Air Force's base budget and approaching the size of its annual procurement budget. For the Army, there are more than 5,000 facilities work orders that are unfulfilled because of insufficient funding.

A July 2015 Government Accountability Office report, "Facilities Modernization: DoD Guidance and Processes Reflect Leading Practices for Capital Planning," took a deep dive into how such projects are funded. The department maintains a global real-property portfolio of more than 561,000 facilities valued at more than $879 billion, the report said. Getting a handle on what maintenance is needed to cover such a vast amount of holdings has been a problem for budget planners.

The office of the secretary of defense seems to have little visibility over the services' needs. The Army, Air Force and Navy have their own methods and schedules to assess facility conditions that results "in facility-condition index data that lacked credibility as a measure of the quality of DoD's facilities," the report stated. The office of the undersecretary of defense for acquisition, technology and logistics issued a memorandum in September 2013 directing the adoption of a standardized process to assess the condition of each Defense Department facility by September 2018.

And insufficient funding is the indisputable source of the problem. In order to meet its current challenges and fund the existing force, the armed forces have to address certain expenses such as paying personnel costs, health care and funding the growing costs of ongoing operations. If the base sustainment and maintenance backlog grows, and further deferrals become unacceptable because of readiness implications, this inevitably means that funds will have to be diverted from the modernization accounts — procurement plus research and development — which are the only "discretionary" accounts a military service actually has. This creates a true dilemma: the more costly the deferred maintenance, the greater the fund diversion.

What this means, in actuality, is that the ability of the future force will be diminished because we have inadequately resourced the present force and recent past. And the culprit here is obvious: an inadequate defense topline that has been suppressed by sequestration and other resource limitations imposed by the budget agreements of the past four years.

This should stop. We simply must come to grips — across the nation and within the government — with the reality that we cannot continue to ask our military to be more places, accept more missions and assume greater risks, while their budgets are either flat or moving in the opposite direction. And if necessary facilities funds are not to be committed, then Congress needs to authorize a new Base Realignment and Closure round so that infrastructure that can't be adequately funded is eliminated.

Short-changing the facilities account, and inviting a growing maintenance backlog that will be even more expensive to address two congressional terms from now, is truly shortsighted and self defeating. Many have spoken in the past of a growing disconnect between military resources and missions. This particular area may be the most pernicious example. Not only does it limit capabilities in one area, but its compounding impact inevitably limits capabilities in others.

Email your comments to cmckinley@ndia.org

Defense Watch By Sandra I. Erwin

Another Stab at Reinventing the Pentagon

There is no denying that, on the subject of Defense Department efficiency or lack thereof, Congress is at its wits' end.

Over dozens of House and Senate hearings, lawmakers and witnesses have catalogued a long list of grievances, including excessive overhead spending, wasteful procurement programs, glacial slowness in technological innovation and ineffective methods of recruiting fresh talent.

So in a bold legislative move aimed at lighting a fire under the Pentagon's top leadership, Congress ordered a major shakeup of the department's upper ranks.

The National Defense Authorization Act for Fiscal Year 2015 creates a new senior position — undersecretary of defense for business management and information — that would be next in line after the secretary and deputy secretary. This post would absorb two current offices, the deputy chief management officer and the chief information officer. Perhaps the more consequential impact would be a disruption to the pecking order, bumping the undersecretary for acquisition and logistics down one notch.

To ease the disruption, Congress set a Feb. 1, 2017 deadline, to coincide with the start of a new administration.

As expected, there are ongoing talks at the Pentagon about asking Congress to rethink this.

Whereas the law was intended to make the Pentagon run more efficiently, in accordance with corporate America business practices, the mandate has revived a perennial debate on why the government can't operate like the private sector.

Defense Secretary Ashton Carter turned to a group of advisers, known as the Defense Business Board, for answers on how to tackle the NDAA mandate to reshuffle the department's org chart.

A group of DBB members led by management consultant Mark H. Ronald, a former CEO of BAE Systems, has been studying the issue, interviewed more than a dozen former Pentagon officials and is expected to submit a plan to Carter in the coming months.

During a recent meeting of the DBB, Ronald suggested that Congress might have underestimated how difficult it is to change the status quo at the Defense Department.

"The secretary and the deputy secretary have asked us: 'How should we implement this? Should we go back to the Congress and suggest modifications?'" Ronald said. Lawmakers are clearly frustrated and want the department to be more agile, but it is at best idealistic to think the Pentagon can behave like a Fortune 500 corporation.

"There are complex companies out there, but nothing comes close to the scale or complexity or, for that matter, the mission of the Department of Defense," Ronald said. "There is no question in our minds that there are opportunities for improvement. But as we all know, this is very much a complex issue."

The installation of new leaders next year with the change of administration alone is a monumental disruption. And inserting a major reorganization of a vast bureaucracy into the mix would exacerbate the chaos.

Turnover in the top ranks is a fact of life that sets the Pentagon apart, compared to private corporations. "Every time there's a new administration there's massive change in leadership," Ronald said. "That level of change generally doesn't happen in the private sector, at least not to that degree."

So it remains to be seen how the DBB comes down on this. One of its members, retired Marine Corps Maj. Gen. Arnold Punaro, already is on record opposing the creation of a new undersecretary for business management. "I testified and have been working against it," Punaro told National Defense. "It would create new bureaucracy that we don't need." Instead, Punaro would favor beefing up the CIO office and other, less sweeping, reforms to improve the acquisitions of advanced technology.

A less controversial task given to the DBB was to find ways to spur innovation at the Pentagon and become a workplace that encourages disruptive thinking.

One proposal that takes a page from the private sector is to create "virtual consultancies," or online collaboration within the vast network of civilian and military organizations. The issue is, "How do you leverage the workforce to solve problems?" said Atul Vashistha, DBB member and an internationally recognized expert on globalization, emerging markets and outsourcing. "How do we capitalize on the people we have? How do we link ideas?"

This is part of a growing trend in corporations to adopt "lean startup" cultures that are less hierarchical and more collaborative. It also would give the Pentagon much needed millennial outreach. "With a huge uniformed workforce under the age of 25 committed, engaged and excited to contribute, its raw material is uniquely well suited to mirroring that model," Vashistha said.

Creating these virtual consultancies, however, could be an uphill battle in an organization as inflexible and set in its ways as the Pentagon. "The department faces real challenges in doing so … primarily in the form of its massive, rigid bureaucracy," the DBB task force noted. Corporate executives wonder whether the Defense Department will provide the "leadership commitment, sustained effort and resources" that are needed to build an innovative culture. The group suggested defense leaders should designate "innovation from within a core behavior" of the department. These cultural changes are important to ensure the Pentagon can recruit the next generation of technologists and leaders, the panel said. "The task group is confident that the Defense Department workforce is poised to contribute from the 'bottom up' if it's supported from the 'top down.'"

The DBB is just getting started on its ambitious agenda to reinvent the Pentagon. On tap for the coming year: Examine the structure and overhead of the defense test and evaluation office, study reasons why the Pentagon has difficulties recruiting private sector executives, de-conflict the acquisitions oversight process, and probe the cost and benefits of Pentagon-funded schools.

Good luck and Godspeed.

Email your comments to serwin@ndia.org

Achieving the Holy Grail of Low-Cost Launch

If there were one dollar for every time a government official at an industry conference said: "We have to reduce the cost of space launch," then there would be enough money to — well — send a small bag of flour to the international space station — or maybe a jar of Tang.

Lofting objects into orbit is wildly expensive. Estimates are anywhere from $5,000 to $15,000 per pound depending how far up the payload is going. Government officials once stated that lowering that figure to under $1,000 per pound would be ideal.

That was back in the beginning of the 2000s, when a newly made millionaire named Elon Musk had just sold his stake in PayPal. Only 31 years old, he could have taken his big pot of money and lived comfortably off it for the rest of his life on a private beach. Instead, he jumped into the highly risky business of building rockets.

Musk is a dreamer. And he dreamed of a day when mankind would colonize Mars. To make it there, the cost of space launch had to be reduced.

He founded SpaceX, and quickly began producing rockets that were indeed less expensive than the big competitors. He did so by building almost all the subcomponents in his Hawthorne, California, factory and cutting out the subcontractors.

That was more of a unique business plan than a technological breakthrough. What was needed were reusable rockets, he believed.

That was the original vision for the space shuttle: a space plane that would take off and land, then be ready to be used again after a short amount of time. The boosters that lofted the shuttle during its first two minutes parachuted into the ocean where they were recovered by NASA ships, then refurbished. The original vision for the program never came to pass. It took months to ready them for a follow-on mission and the cost of launching them skyrocketed.

The space launch business has undergone major disruption since the end of the shuttle program.

SpaceX and its rival Blue Origin, owned by Amazon.com billionaire Jeff Bezos, emerged from the private sector to develop their own engines. The space tourism industry spearheaded by Virgin Galactic is developing spacecraft as well. Composite materials and additive manufacturing promise to help reduce rocket manufacturing costs further.

Rather than operate another fleet of space planes, NASA has decided to turn this task over to the private sector, which is competing for launch services to the international space station with multi-stage rockets.

Meanwhile, the Air Force is doling out a series of contracts to companies large and small to develop a replacement for the Russian-made RD-180 rocket engine. An examination of the contracts finds an overarching theme: reducing the cost of manufacturing the subcomponents.

Both SpaceX and Blue Origin have taken a page from the space shuttle program to develop reusable boosters. But instead of landing them in the sea, they are both trying to land them on platforms.

The last two months have seen several breakthroughs. The first came when Blue Origin launched its New Shepard booster 62 miles above Earth, then landed it on the ground.

Then SpaceX, after incremental testing and some failures on an ocean-based platform, landed the first stage of its Falcon 9 rocket on the ground in December during a test at Kennedy Space Center. It will continue to launch payloads and land the boosters on a platform at sea.

While rivals, both companies firmly believe that reusable rockets are the path to affordability and — by extension — the means to colonize Mars.

> "As for U.S. development of a single-stage-to-orbit vehicle, one wonders how large of technological leap it would be now that 15 years has passed."

There is another way, though. The next logical step after the space shuttle was single-stage to orbit — in other words, no boosters or stages at all. The rocket engine and spacecraft are one. Lockheed Martin and NASA in the 1990s set out to build the X-33 space plane and spent some $1.3 billion between them to develop it.

They had made a lot of progress when the project was canceled in 2001. Technical problems arose with the liquid hydrogen tank, which had to be lighter than standard tanks in order to reduce the weight enough to reach orbit. The composite material and honeycomb design failed in a 1999 test. Three years after the X-33 was canceled, Northrop Grumman and NASA announced that they had achieved a breakthrough in composite liquid hydrogen fuel tank design.

Other single-stage-to-orbit concepts involved bypassing the denser, harder to breakthrough, lower atmosphere by giving rockets carrying small satellites a boost to the upper altitudes. AirLaunch had an idea to drop payloads out of the back of a C-17. The Defense Advanced Research Projects Agency paid the company for some successful demonstrations, but the idea never made it across the so-called Valley of Death, where ideas don't find customers.

There were concepts for balloon launches and there are some still advocating for a space elevator, a tether strung between Earth and geo-stationary orbit.

But the single-stage-to-orbit trail has gone cold in the United States.

There is one active program in Great Britain. Reaction Engine Ltd. has garnered some European Space Agency funding to develop its space plane concept but needs a whole lot more capital to finish its work. British defense giant BAE Systems is clearly a believer. In November, it bought a 20 percent stake in the company and injected some 20 million pounds into the company.

As for U.S. development of a single-stage-to-orbit vehicle, one wonders how large of a technological leap it would be now that 15 years has passed.

Email your comments to smagnuson@ndia.org

Ethics Corner By Anne R. Harris

Evaluating Ethics, Compliance Programs

Last fall, the Department of Justice hired Hui Chen as its first full-time compliance counsel. Chen came to the DoJ with experience as both a prosecutor and a corporate compliance officer. This new role is designed to enhance the department's approach to evaluating companies' compliance programs.

The creation of this new position sends a powerful message about the current focus on compliance across industry. Indeed, Assistant Attorney General Leslie R. Caldwell has stated that the establishment of this new role "should be an indication to companies about just how seriously we take compliance."

It should also serve as a healthy reminder to contractors to evaluate their own ethics and compliance programs. The policy for federal contractors on "Contractor Code of Business Ethics and Conduct" can be found at Federal Acquisition Regulation (FAR) Subpart 3.10. In addition, there are specific contractual requirements at FAR 52.203-13 for contracts valued at over $5.5 million and with a period of performance of 120 days or more — subject to certain exceptions for small businesses and commercial item contracts.

These prescribe program elements comprising a written code of conduct, communications and training, an internal reporting mechanism such as a hotline, and more, including a specific requirement to conduct periodic evaluations of the effectiveness of the program.

While a government contractor may never have its ethics and compliance program assessed by the Justice Department, it is likely to have it reviewed by the Defense Contract Audit Agency and other agencies or customers. It behooves contractors to be prepared for such reviews, rather than having to scramble in response to the proverbial knock on the door.

An evaluation of an ethics and compliance program's effectiveness should be done vis-à-vis all applicable requirements or guidelines. The overall goals the program is designed to achieve — such as creating a culture of integrity or safeguarding the company's good reputation — should also be borne in mind. It is not a check-the-box exercise. For example, it is not enough to ask whether compliance policies exist. It is important to ask whether employees know what the policies mean in relation to their own jobs and how to use policies or other resources to help them respond in a tricky or uncomfortable situation.

In a recent interview published by Ethics and Compliance Initiative, an Arlington, Virginia-based association devoted to corporate ethics, Chen shared some of the indicators she looks for when assessing the effectiveness of a compliance program. Among these are: How empowered is the compliance officer and does the role get the resources and support it needs? Is compliance just on paper or truly embedded in daily business operations? In the event of a violation, are corrective actions real and suitable? And are cross-functional collaboration, ownership, commitment and accountability for compliance manifest throughout the organization, especially among the leadership?

These effectiveness "tests" illustrate the in-depth approach that should be taken with a program assessment.

One example of required program elements from FAR 52.203-13 centers on "effective communications and training." Periodic and practical communications and training about the ethics and compliance program, tailored to each audiences' roles and responsibilities, must be provided to company leadership or principals, employees, and, as appropriate, to others who act on behalf of the company such as agents and subcontractors.

An effectiveness evaluation needs to ask questions such as: How are resources allocated to communications and training? Are they sufficient? How does the company determine whether the communications and training are effective; for example, does it survey employees to gauge understanding or issue post-training tests to measure comprehension? Is business area leadership supportive or is there push back about incurring training costs? If that sort of discord takes place, how does it get resolved?

Another required program element is "risk assessment." Contractors need to periodically evaluate the risk of criminal conduct and then design, implement or modify their ethics and compliance program and internal controls program to mitigate any identified risks.

In evaluating this process, consider the resources allocated to it. Are they adequate to conduct a meaningful assessment? Does the company leadership support the process as one that adds value? If not, why not? Is the risk assessment broadened to take into account ethics and reputational risks? Does participation in the process extend far enough in the organization to be valid? In an area identified as high risk by the assessment process, how does the functional head respond in terms of involvement and commitment to modifying processes to mitigate the risk?

Finally, contractors should look at their "internal reporting mechanisms." The contractor must make available a communications channel, such as a hotline, which allows for confidentiality or anonymity, that employees can use to report suspected misconduct.

The contractor must also give employees instructions and encouragement to use the internal reporting mechanism. Evaluate the effectiveness of the hotline by asking, for example: Is it available to all employees worldwide in their own languages? Does the company explain to employees exactly what happens, step by step, if they choose to raise a concern using the hotline?

Are suspected violations investigated fairly and thoroughly and dispositioned promptly? Does leadership across the board support use of the hotline as one of the company's tools for preventing and detecting misconduct? Is management committed to prohibiting retaliation against employees who report concerns via the hotline?

The Ethics and Compliance Initiative interview with Chen can be found at: www.ethics.org.

Anne R. Harris is owner and principal of Ethics Works LLC, an ethics and compliance consulting practice with a particular focus on defense contractors. She formerly served as chief ethics officer for General Dynamics Corp. The opinions expressed are her own. Comments may be sent to anne.harris@ethicsworks.com.

Weapon Development Cost Sharing Must End

Periodically over the last 55 years, the Defense Department has made repeated attempts to characterize and then re-characterize the acquisition and procurement of weapons systems.

The latest series of efforts have lived under the moniker of "Better Buying Power" and now are enjoying a further rebirth under the oft-used title of "acquisition reform."

The Pentagon has approximately 90 major weapons programs in development. A fair number of these programs owe their R&D origins to classified efforts of the early and mid-1980s and were focused on countering fifth- and sixth-generation offerings of the Soviet Union. It is a reasonable assumption — with only a few exceptions — that the objective of these programs is to complete research and development, testing, engineering, low-rate production and ultimately put the systems into inventory.

So what is wrong with the "system" for producing major weapons?

Increasingly, major weapons programs are failing. Failure is defined as never making it into inventory. The reasons include an unrecognized lack of need — defined as absence of a relevant threat — cost growth and changes in roles and missions. The changes in roles and missions today pit the absence of major theater conflict against the increasing presence of asymmetric warfare and the consuming need to conduct stability operations.

When the objective of a major weapons program was matching the progression of a Soviet monolith, there might have been some excuse for program starts that would never make it to inventory. However, continuing such a process today is questionable.

During the Cold War, defense acquisition management could regularly shift development risk to contractors because they had a reasonable expectation of return on their investments. They expected to earn production contracts. It was more the rule than the exception that the process from R&D into production was compressed. The defense establishment was readily able to move the color of money from research to procurement, and the failures of this process were notable but relatively rare.

Meanwhile, the blatant efforts to shift the risk from government to contractor by the threshold use of fixed-price RDT&E contracts were — each and every one of them — distinct failures. These included the C-5A, the F-14 and a series of shipbuilding programs that included the LHA amphibious assault ships, frigates and the DD-963 destroyer, with some SSN submarines thrown in for good measure. Some of these acquisition experiments had grand titles such as "Total Package Procurement."

These programs wound up "converted" from fixed-price contracts to cost-reimbursement contracts and the most frequently used means was Public Law 85-804. The last of such overt risk-shifting programs was the A-12 reconnaissance aircraft, which was never "converted." It was terminated for default because it was clearly unneeded and, after more than 20 years of litigation, was settled by a barter arrangement.

Today's weapons manufacturing industry is about 10 percent of what existed in the 1960s and 1970s. Further, the throughput dictated by the Cold War is absent and not likely to be replaced. This accounts not only for the reduction in capacity but also for the accelerating, oncoming singling up of industry capabilities. In short, the surmised "competition" that was always the unrequited desire of many will cease almost entirely to exist. At an accelerating rate, the nation is heading to a non-competitive private arsenal system for major weapons.

These factors drive the need for developmental "risk retention" by the government. Today's weapons are immensely complex systems, consisting not simply of components and materials but also of tiers of systems. Increasingly, these systems-within-systems, often threaded together with equally complex software, are at materially different stages of development. The very idea of a new weapons system with components that are at the same stage of maturation represents a nearly impossible goal.

The critical subject to be addressed here is: Who bears the cost and financial risks of the development and maturation of compound weapons systems? As a matter of constitutional and statutory law, the government is mandated to bear the financial risks of weapons development. This constitutional and statutory premise flows directly from the so-called "appropriations" clause of the Constitution, which provides that no funds may be drawn from the treasury without an appropriation passed by Congress.

The unarguable purpose of the appropriations clause was to ensure that Congress had complete control over spending by the executive branch. This "purse strings" power was intended to be absolute, and it permits no exceptions. It could be said that a contractor who is willing to take the risks of weapons systems development and "cost share" with the government would not be barred by the purse strings powers. This is simply not the case as even the comptroller general notes that the appropriated funds may not be "augmented" by conduct on the part of the executive branch that obtains funds or benefits — such as contract performance — without the appropriation function.

Augmenting appropriations by executive branch actions is not simply unconstitutional, it is also illegal and punishable. Thus when industry and the Defense Department set out to "cost share" the development of weapons systems, the acts of cost sharing in either the design or language of contracts are illegal. This plainly ignores 55 years of common practice, but most of that practice was between consenting adults who had the appropriate expectation of mutual benefit. Because of the absence now of any reasonable expectation of sufficient throughput to amortize the development investment, there is no longer a reasonable expectation that cost-sharing investment practices will continue.

The Defense Department must abandon the practice.

Herbert L. Fenster is senior of counsel at Covington & Burling LLP, Washington, D.C.

Budget Matters By Jon Harper

Pentagon to Continue Funding A-10

The Defense Department has abandoned plans to divest itself of the A-10 Thunderbolt II in the near term, ensuring that the close-air support platform will remain in service until at least 2022.

In recent years, Pentagon leaders have tried to kill the aircraft as a cost-saving measure while the Air Force's attention has been focused on the fifth-generation F-35 joint strike fighter and other top acquisition priorities.

But the ongoing U.S. air campaign against the Islamic State terrorist group, also known as ISIL or ISIS, coupled with the fact that the F-35A has yet to achieve initial operational capability, has breathed new life into the A-10.

"We're … investing to maintain more of our fourth-generation fighter and attack jets than we previously planned — including the A-10, which has been devastating ISIL from the air," Secretary of Defense Ash Carter announced in February during a preview of the Pentagon's fiscal year 2017 budget request. "The budget defers the A-10's final retirement until 2022, replacing it with F-35s on a squadron-by-squadron basis so we'll always have enough aircraft for today's conflicts."

Keeping the aircraft in service will cost $3.4 billion over the next five years, including about $900 million in fiscal year 2017, according to Maj. Gen. James Martin Jr., Air Force deputy assistant secretary for budget.

To pay for it the service is shifting funding from F-35 acquisitions, fourth-generation fighter modernization and sustainment programs, the Air Force told National Defense.

Influential lawmakers on the Senate Armed Services Committee, who fought to protect the plane from the budget ax, applauded the Pentagon's decision.

Carter's announcement "represents a welcome and overdue victory," Sen. Kelly Ayotte, R-N.H., said in a statement. "As ISIS has learned firsthand, the A-10 represents our nation's most effective and lethal close-air support aircraft. It has been my honor to lead the fight in Congress on behalf of our ground troops and joint terminal attack controllers."

SASC Chairman Sen. John McCain, R-Ariz., lauded the decision to replace the A-10 with the F-35 on a squadron-by-squadron basis, and said it would prevent a "capability gap" from emerging.

"I look forward to seeing our A-10 pilots continue to make important advances in the fight against ISIL in the Middle East, boosting NATO's efforts to deter Russian aggression in Eastern Europe, and supporting vital missions for U.S. national security wherever they are needed," he said in a statement.

Ayotte has argued that the joint strike fighter is not up to snuff for carrying out the types of missions currently conducted by the Thunderbolt II. She vowed to "prevent the Air Force from prematurely retiring the cost-effective and combat-proven A-10 … until an equally capable replacement is fully operational."

"We should now get to work on the development and procurement of an aircraft that can eventually replace the A-10 and provide even better close-air-support capabilities for our troops," she said. "Technology will continue to advance and threats will continue to evolve, but our ground troops will always need effective, lethal and precise close-air support."

DEFENSE DEPT.

Lawmakers Want Higher Defense Budget

■ In February the White House submitted its fiscal year 2017 budget request, which included about $610 billion for defense spending. Of that, $58.8 billion would be included in the overseas contingency operations account, also known as OCO.

Many in Congress say it is not enough.

"While the [Senate Armed Services] Committee will closely review the president's defense budget request, it is already clear that this request is inadequate to address the national security threats we face and the growing demands they impose on our men and women in uniform," committee chairman Sen. John McCain, R-Ariz., said in a statement.

"By strictly adhering to the minimum spending level allowed by last year's Bipartisan Budget Act, the president's request would leave the Department of Defense with at least $17 billion less than what it said it needed and planned for this year," he added.

In a recent letter to the head of the House Budget Committee, members of the House Armed Services Committee said that $610 billon is insufficient to deal with national security threats. They also suggested that the budget numbers agreed to in the 2015 Bipartisan Budget Act are a "floor" not a "ceiling" for how much money can be spent on defense in fiscal year 2017.

"We recommend House Republicans insist upon at least an additional $15 billion to $23 billion" above the $610 billon request, the letter said. "We also recommend a further discussion of additional resources for emergent issues we see looming" for overseas contingency operations.


Sen. John McCain

During recent budget briefings, Pentagon officials have said the contingency fund request provides more than enough money to pay for planned activities in Afghanistan, Europe, Iraq, Syria and elsewhere.

"In the OCO budget as submitted we have funded all of our anticipated operational costs," Vice Chairman of the Joint Chiefs of Staff Gen. Paul Selva told reporters during a briefing at the Pentagon the day the budget request was released.

Mackenzie Eaglen, a defense budget analyst at the American Enterprise Institute, expects congressional defense hawks will secure more money for the Pentagon.

"I will predict confidently that the Hill will succeed in adding additional money above President Obama's total defense budget of $610 billion when the final appropriations bill is enacted," she said in an email. "I think Congress will simultaneously adhere to the Bipartisan Budget Act and add funds for defense only using OCO dollars. This does not rule out, however, Congress allowing the emergency supplemental funds of OCO being used for base budget spending priorities; in fact, I expect they will absolutely do so."

DEFENSE DEPT.

U.S. soldiers participating in joint training exercise, Saber Junction 15.

More Funding Expected For European Defense

■ The Pentagon is ramping up its investment in the European Reassurance Initiative, which is designed to deter Russia and support nervous NATO allies concerned about Moscow's intervention in Ukraine and elsewhere.

The Defense Department requested $3.4 billion in fiscal year 2017 to fund a range of activities. The money would support additional U.S. force rotations in Europe, expanded training and exercises with U.S. allies, more prepositioned warfighting gear and infrastructure improvements to support it, according to Pentagon officials.

"When combined with U.S. forces already in and assigned to Europe … all of this together by the end of 2017 will let us rapidly form a highly capable combined arms ground force that can respond across that theater if necessary," Secretary of Defense Ash Carter said during a recent budget discussion hosted by the Economic Club of Washington, D.C.

The funding would quadruple the amount appropriated for the reassurance initiative in fiscal year 2016, which was approximately $800 million.

The Pentagon sees growing geopolitical competition between the United States and Russia. Concerns about Moscow's intentions and capabilities is a top challenge "now driving the focus of the Defense Department's planning and budgeting," Carter said.

"We're taking a strong and balanced approach to deter Russian aggression," he said. "We haven't had to worry about this for 25 years … [but] now we do."

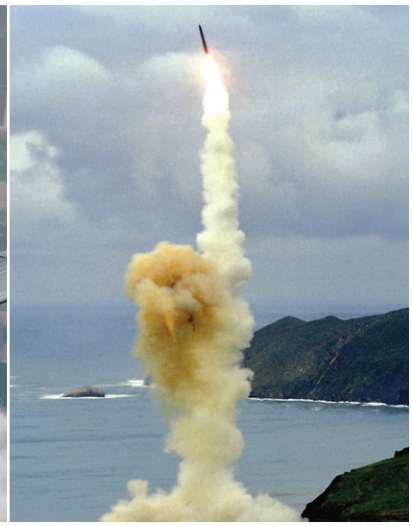
Jorge Benitez, senior fellow for transatlantic security at the Atlantic Council, doesn't expect the funding request to face any political roadblocks.

"There will be bipartisan support for providing the resources to strengthen the defense of Europe," he said in an email. "As long as Russia continues to use military power to impose its will in Europe and now Syria, there will be support in the U.S. for strengthening our security and the defense of our allies."

He faults the Obama administration for not insisting on matching contributions from partner nations.

"The White House is … committing more U.S. resources to defend Europe without requiring the Europeans to do so [along] with us," he said. "ERI should be a multinational effort, not just funded by the American taxpayer."

Email your comments to jharper@ndia.org



STRATCOM: U.S. Not in a Nuclear Arms Race

Contrary to what some observers have claimed, the United States is not in a nuclear arms race with Russia, said Adm. Cecil Haney, the commander of U.S. Strategic Command.

Despite destabilizing acts by Russian President Vladimir Putin and his signing of a new national security strategy containing anti-Western sentiment, the United States continues to make strides to achieve goals set forth in the "Measures for the Further Reduction and Limitation of Strategic Offensive Arms," or New START Treaty, Haney said.

The treaty is a nuclear arms reduction agreement between the United States and Russia. It was invoked in February 2011 and the countries must meet the agreed upon limits by February 2018.

"The United States has reduced its stockpile by 85 percent relative to its Cold War peak," Haney said during a discussion at the Center for Strategic and International Studies. "We are retaining and modernizing only those systems needed to sustain a stable and effective deterrent capability."

Given continued funding and authority, the nation is on track to achieve New START limits of 1,550 deployed warheads and 700 deployed delivery systems by 2018, he said. "That is not what I would define as an arms race."

To date, the U.S. Air Force has eliminated all non-operational intercontinental ballistic missile silos and is in the process of placing 50 ICBMs into non-deployed status, he noted. Additionally, all intercontinental missiles have been "deMIRVed," which means reducing the number of warheads on each missile to one. MIRV stands for multiple independently targetable reentry vehicle.

The Air Force has also eliminated its non-operational B-52 G-series heavy bombers and is transitioning 42 B-52 H-series to conventional-only bomber missions, Haney said.

At the same time, the Navy is converting four launch tubes on each of its Ohio-class ballistic missile submarines to non-nuclear roles, which will remove 56 launch tubes from accountability under the treaty, he said.

"The benefit of New START is that it engenders stability by maintaining rough equivalency in size and capability and, more importantly, transparency via inspections," Haney said. "Furthermore, it helps assure our non-nuclear allies [that] they do not require their own nuclear deterrent capabilities."

However, while this reduction is taking place, the United States needs to ensure its warheads are "safe, secure, effective and ready" in order to convince adversaries like Russia, China, North Korea and Iran that "they cannot escalate their way out of a failed conflict," Haney stressed.

To achieve that end, the nation must invest in modernizing and sustaining all three legs of the nuclear triad — bombers, missiles and nuclear submarines, he said. "Our intercontinental ballistic missiles, our B-52 bombers and [our] Ohio-class submarines were designed and fielded in the '60s, the '70s and the '80s," he said. Those nuclear delivery systems will need to be replaced in the 2025 to 2030 timeframe, he noted. "We are out of time. Sustainment is a must. Recapitalization is a requirement."

Effective and ready nuclear deterrents are increasingly important in today's complex strategic environment, Haney said.

Russia has declared — and at times demonstrated — its ability to escalate, "conducting destabilizing actions associated with Syria, Ukraine and Crimea while also violating the INF Treaty — Intermediate[-Range] Nuclear Forces Treaty — and other international accords and norms," he said.

At the same time, "China continues to make significant military investments in their nuclear and conventional capabilities," he said. The country is reengineering its long-range ballistic missiles to carry multiple nuclear warheads. It recently conducted its sixth successful test of a hypersonic glide vehicle, and last September the nation showcased several missiles, including the DF-21D anti-ship ballistic missile, to demonstrate its advancements, Haney said.

The United States also has to worry about continued threats from North Korea, he said. "Under Kim Jong-un, North Korea continues to heighten tensions by coupling provocative statements and actions with advancements in strategic capabilities, claims of miniaturized warheads, and more recently, claims of a successful hydrogen bomb test and developments in road-mobile and submarine-launched ballistic missile technologies."

Iran continues to pose challenges despite recent diplomatic successes. The United States must continue to keep a vigilant eye on Iran, and monitor the country's involvement in the Middle East and any shifts in its nuclear weapon ambitions, Haney said.

— Allyson Versprille ▪ aversprille@ndia.org

NAVY, AIR FORCE

Standards for 3D-Printed Rocket Engines Coming

■ Additive manufacturing — which combines layers of a substance, often a polymer or metal, to create an object — has for the past several years been touted as a way to reduce manufacturing costs across the defense industry. Aerojet Rocketdyne has now been tapped by the Air Force to set standards for using the process in rocket engines.

As part of an Air Force broad agency announcement, the service awarded the company a $6 million contract to define standards to qualify 3D-printed parts for liquid-fueled rocket engines, said Jay Littles, Aerojet Rocketdyne's director of advanced launch vehicle propulsion.

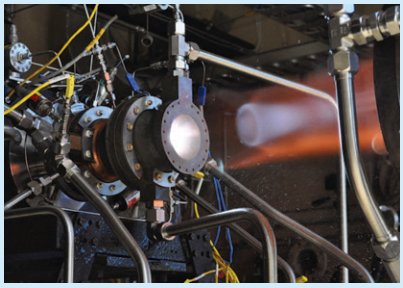
"We're going to outline a process by which you can qualify some of the really complex geometry additively manufactured components," he said. "We're going to be working with our customers at the Air Force, and we have our customers at NASA participating in the program as well."

A standard process would help companies using the technology to identify material microstructures and properties and detect where defects may be present, he said.

"It's an approach to more effectively … qualify some components that you wouldn't be able to qualify with the traditional processes," he said.

The contract is part of the Air Force's larger effort to transition off of the Russian-made RD-180 engines used on Atlas V launch vehicles, he said.

"Frankly, if you go all the way back to when we started utilizing the RD-180 domestically there was actually a requirement way back then that we would eventually evolve to a domestic engine for that application," he said. "This is really going back to trying to enforce the requirement that was there years ago. And obviously the tensions [with Russia] can kind of underline that importance of having that domestic source."



AEROJET ROCKETDYNE, LOCKHEED MARTIN

The contract is over 24 months, at which point Aerojet will supply the Air Force with a draft process. Toward the end of the contract there will be component demonstrations, he said.

Aerojet Rocketdyne has already built a liquid-fueled Bantam rocket engine using the technique. Littles said the company often uses a process known as selective laser melting "that gives us the real fine feature control that we need for some of our complex geometry parts."

— Yasmin Tadjdeh ▪ ytadjdeh@ndia.org

Australian MH-60R

International Sales Extend Seahawk Production

■ Foreign military sales of Sikorsky's MH-60R Seahawk helicopter will keep the multi-mission aircraft in production past 2018.

In previous years, analysts have been skeptical that international sales would be enough to sustain the aircraft beyond 2018 when the final MH-60 Romeo will be delivered to the U.S. Navy.

However, a $145 million contract awarded in December to Sikorsky — now owned by Lockheed Martin — to deliver 10 MH-60R helicopters to the Royal Saudi Navy will keep production moving into 2019, a Lockheed executive told reporters in January.

"The aircraft will begin delivering in 2018," said Mike Fralen, director of business development for MH-60R. "That dovetails nicely into the schedule." The final aircraft is planned for delivery in April 2019.

The U.S. government approved the sale to Saudi Arabia in May 2015 at a cost of $1.9 billion, which includes the helicopters and associated parts and logistical support, according to a Defense Security Cooperation Agency release. In addition to the 10 aircraft, other requested systems included AGM-114 Hellfire missiles, rockets modified with BAE Systems' advanced precision kill weapon system, M-240 machine guns and multi-mode radars.

Sikorsky is also in the process of delivering on contracts with the Royal Australian Navy and the Royal Danish Air Force.

As of January, 17 of Australia's 24 purchased helicopters had been delivered. The remaining seven are planned for delivery in 2016. Seventeen of the MH-60 Romeos will be used for operational squadrons and seven will be used for training, Fralen said.

At a conference last October, Commodore Vincenzo Di Pietro, commander of the Royal Australian Navy's Fleet Air Arm, lauded the Seahawk program's success.

The first Danish MH-60R was completed and delivered to the U.S. Navy in October. As of January, two aircraft had been transferred to the Navy to undergo testing of unique Danish modifications to the platform. The testing is being conducted at Sikorsky's West Palm Beach, Florida, facility; Lockheed's Owego, New York, facility; and at Naval Air Systems Command in Patuxent River, Maryland. The first aircraft will be delivered to the Danes in the second quarter of 2016 with the final delivery in April 2018.

"They will truly use this aircraft as a multi-mission aircraft platform," Fralen said. "They'll use them in the Baltic and North Seas around Denmark, as well as around Greenland. The all-weather capability will certainly be shown."

The company expects to see additional foreign military sales over the next one to three years, Fralen said. "The MH-60 Romeo is currently being considered by other countries, and we'll work to see how their analysis and contract decisions mature."

— Allyson Versprille ▪ aversprille@ndia.org

Battelle Unveils Active Shooter Response System

■ Battelle has developed a system that can notify police and security forces within moments of the first shots fired during an active shooter situation.

Analysis conducted by the company showed that delays in notifying law enforcement and human errors during such incidents "are really the things that allow shootings to go on too long and have too high of a human toll," said Ed Jopeck, business manager for critical infrastructure security and resilience at Battelle.

During the chaos of an active shooting, it can sometimes take several minutes before police are called. Further, information relayed to law enforcement can often be incorrect, such as the address of the building or which floor the shooting is happening on, he said.

To help police officers receive the information they need right away, Battelle developed the SiteGuard Active Shooter Response system. Sensors placed inside a building can listen for gunfire, and when detected will dispatch information via voice alerts or text messages to a designated security professional or automatically call 911, Jopeck said.

An extremely loud noise, like the sound of a hammer hitting a nail, isn't enough to trigger the sensor, he said. The system's algorithm measures "against a huge number of data points across the spectrum of a gunshot's audio signature to determine if it matches enough of those points."

SiteGuard also comes with a web-based control center that allows users to pinpoint and track the location of gunshots and see where the last shot was fired. They can also analyze the sound of the shot to determine if it is a false alarm. Further, if programmed to do so, SiteGuard can lockdown an area and automatically shut doors, Jopeck said.

Each sensor has a range of 30 meters. Using the SiteGuard system — which is accessible via desktop, tablet or mobile phone — the sensors can be used as a communication device to speak to the shooter or victims nearby, he said.

The system was in research and development for two years. The price continues to fall, but Jopeck did not give a specific cost figure. Battelle currently has half a dozen to a dozen clients for SiteGuard that are in varying stages of acquisition, he said.

— Yasmin Tadjdeh ▪ ytadjdeh@ndia.org

Brazil Orders Upgraded Amphibious Vehicles

■ The Brazilian marine corps recently negotiated a contract for 23 upgraded amphibious assault vehicles to be delivered in 2017.

BAE Systems — the manufacturer of the Assault Amphibious Vehicle, or AAV7A1 — was awarded the $82 million contract in late December 2015 to modernize and deliver the platforms.

Under the terms of the contract, the company will provide the upgraded vehicles and supply all tools and test equipment to support maintenance. Deliveries will begin in February 2017 and continue through the end of the year.

Brazil will receive a newer AAV7A1 variant that will have the reliability, availability and maintainability/rebuild to standard — or RAM/RS — configuration.

Over time, the vehicles degrade and the enhanced configuration is necessary to buy back performance, said Deepak Bazaz, director of new and amphibious vehicles at BAE. "What the RAM/RS does is it addresses the obsolescence issues," he said. The modernized variant has a more powerful, 525 horsepower turbo-charged engine, improved suspension and enhanced water jets.

Continued foreign military sales of the AAV7A1 family are critical because they keep the production line open and have helped the company design its offering for the U.S. Marine Corps' amphibious combat vehicle program, Bazaz said. The goal of the ACV program is to build the next generation of amphibious assault vehicles.

In November, BAE was selected as a finalist in the competition and was awarded a $103.8 million engineering and manufacturing development contract to build 13 prototypes, with an option for an additional three depending on future funding.

"Having the AAV experience is critical because that's what gives us the insight to have a very good design moving forward," Bazaz said.

Amphibious vehicles operate in a complex environment, and the company has optimized the design of its offering by surveying models and feedback from users around the world, he said. "These vehicles [are operated] on different terrains — coming on shore in Japan is different than coming on shore in Argentina is different than coming on shore in San Francisco Bay — so the ability to collect the data from all of those different events goes back into the models that we can then use to show the predicted performance of our vehicles" for the ACV program.

Other than Brazil, countries in South America that currently operate variants of BAE's amphibious vehicles include Argentina and Venezuela, Bazaz said. There has also been significant demand for such systems in the Asia-Pacific region. Taiwan has 54 AAV7A1 vehicles in its inventory and South Korea has 166, according to the company.

Bazaz said he envisions future opportunities in Japan and with existing customers — such as Brazil, which has 26 older variants of the platform in addition to the recent sale — that want to upgrade to the RAM/RS configuration.

— Allyson Versprille ▪ aversprille@ndia.org

BATTELLE

Work Begins in Earnest to Procure New Icebreaker

After years of hand wringing, the Coast Guard recently began an effort to procure a new polar icebreaker.

In January, the sea service released a notice to industry on FedBizOpps that included an acquisition timeline and requirements to procure the vessel.

The Coast Guard will host an industry day in March followed by one-on-one meetings with companies. The vessel will be required to do scientific research, rescue operations and law enforcement missions, said Adm. Paul Zukunft, commandant of the service.

Pressure has been building for years to construct a new icebreaker. The Coast Guard — which has a statutory responsibility to maintain the nation's fleet of polar icebreakers — only has two such vessels in operation.

The Polar Star, a heavy-duty vessel built in the 1970s, recently came out of a major refurbishment that is estimated to extend the service life of the platform by seven to 10 years. The Healy, a medium-duty ship, is used primarily for scientific research.

A third vessel, the Polar Sea, is currently in dry dock following an engine failure in 2010. The Coast Guard is studying whether it could refurbish the ship as well, though experts have said in the past that the vessel is in poor shape.

Compared to other nations' fleets of icebreakers, the United States is significantly behind, Zukunft said.

During remarks in Seward, Alaska, in September, President Barack Obama called for the nation to invest in more of the vessels.

"After World War II, we had seven icebreakers — four under the Navy, three under the Coast Guard. Today, in part because we haven't been reinvesting, although we technically have three, operationally we really only have two and only one heavy icebreaker," he said. "Just to give you a sense of contrast, Russia has about 40, and 11 icebreakers either planned or under construction."

The administration proposed to move the acquisition up to 2020 from 2022.

The price of a new icebreaker has been estimated to cost $1 billion. Coast Guard leadership has said that cost can't come from its topline. During his speech, however, Zukunft said he was optimistic the fiscal year 2017 budget would provide enough funding.


The Healy

"I have been in very active dialogue" with Capitol Hill, he said. "I would not be investing in [this] acquisition step … if I didn't have any faith that in the future we will see an appropriation to address icebreakers."

Congress allocated the Coast Guard $6 million in funding for a new icebreaker in fiscal year 2016. Zukunft said he has already used that money to hire a team of acquisition professionals.

— Yasmin Tadjdeh ▪ ytadjdeh@ndia.org

COAST GUARD

What NATO Must Do to Contain Russia

By Alex Haber

From encroachment in Ukraine to offensives in Syria, the Russian bear is awake and in motion. Though claims of an impending second Cold War may be overstated, Russia has gone so far as to call NATO's recent overtures a threat to the country's national security while at the same time refusing the Western alliance's efforts to set up a military-to-military dialogue.

Rumblings from the East coupled with troubling wargame results (spoiler: NATO loses badly to Russia) have presidential hopefuls, Congress and Western military brass rightfully concerned about where Putin aims to pounce next. With tensions mounting on the European front, NATO needs to develop a new resource strategy that does more to build trust among its members and achieve interconnectivity between its networks.

NATO must rapidly and publicly redress shortcomings on both of these fronts even among serious financial constraints. Though Defense Secretary Ashton Carter's proposal to quadruple the Pentagon's budget for European defense is a positive step, it is unreasonable to expect that many other NATO allies will meet this U.S. spending uptick with funding surges of their own.

Clear evidence to this point is the fact that only five of 28 NATO countries met their 2015 targets of 2 percent of GDP on defense spending.

When NATO thinks interoperability, members often turn to joint military exercises. In 2015 alone, NATO planned for approximately 270 exercises, notably with about half devoted to "reassuring Eastern European allies." One big-ticket activity to note is Trident Juncture 2015. As NATO's largest exercise in over a decade, it brought together more than 36,000 personnel from 30 countries.

Longstanding tools in NATO's arsenal, joint exercises are cost-effective ways to put faces to flags and to test capabilities in no-risk combat scenarios.

Andrew Hunter, director of the Defense-Industrial Initiatives Group at the Center for Strategic and International Studies, notes that for a bill "well south of a billion dollars, exercises drive quite a lot of value by helping soldiers gain familiarity with other countries' engagement strategies and by increasing the probability of allies coming to each other's support." Retired Army Gen. Raymond Odierno comments that recent exercises have helped allied forces identify and remedy interoperability challenges "that could have outsized impact in a fight against Russia." Along these lines, militaries get to test drive new technologies in exercises, working out kinks with industry suppliers and driving allies to consider new toys for the collective fight.

NATO could yield even greater interoperability benefits from joint exercises if allied leaders would downsize and narrow their scope to more accurately reflect Europe's diverse battle space.

Magnus Nordenman, a European security expert at the Atlantic Council, called out the fault in thinking of the Russian military as a singular, ground-based machine; Putin's aggression could emerge from the sea in Northern Europe or descend from the air upon countries bordering the Black Sea. To this point, the all-encompassing nature dilutes their value and limits their ability to address individual participants' dissimilar threat environments.

An F-22 Raptor, a Eurofighter Typhoon and a Dassault Rafale fly together during an exercise.

A U.S. Air Force colonel with two European tours under his belt went on to validate this view, noting, "Really small, specialized exercises, almost grassroots campaigns, are really valuable." Though they may not trigger the same PR spike as a 30-country wargame like Trident Juncture, narrower exercises should better prepare NATO to defend different partners in targeted ways. Such customized simulations are superior trust-building tools as well, as they demonstrate to vulnerable allies that the collective security organization knows how to fight their fight; the "bigger is better" brand of exercises is the wrong way to go.

Platform tours are a second notable approach for promoting interoperability. In the recent past, the United States has sent a range of jets, ships and tanks overseas to train with European allies and bolster regional security. In September, it deployed four advanced F-22 fighter jets across the pond as part of a continued push to deter Russia.

Aside from their less tangible signaling value, in-theater platform demonstrations have a practical upside. They are undeniably effective in syncing up the multinational cohort of pilots and platforms that would need to cooperate in the same contested airspace should Russia attack.

Several NATO countries deployed two European fighter aircraft — the Typhoon and Gripen — to train with the F-22. Additionally, the trip from a U.S. base to a European battlefield isn't a quick or easy one and rotating big platforms overseas ensures that NATO allies can come to each other's defense rapidly and effectively. In this vein, the same Air Force colonel commented, "We need to flex the muscle to ensure that we still can be expeditionary if we need to be."

Though not altogether hollow, platform tours are less valuable when the goal is just to show off one's hardware. The Army's Stryker infantry vehicle went to "Dragoon Crossing" in Central Europe and "Arctic Pegasus" in the Arctic Circle. With Strykers out of the shed, European allies may breathe a little easier and Putin may be put on edge.

Yet, signs of solidarity and scare tactics don't make for a more interoperable NATO coalition. If the Strykers had drilled with Czech Pandur IIs or infantry vehicles from other European allies, the takeaway would be different. But, as the Strykers toured solo, they left NATO's collective defenses no better than when they had arrived. What's more, active collaboration builds trust far better than just giving one's allies something to cheer at as it rolls by.

The third domain of NATO interoperability is software systems. In terms of both communications and cybersecurity, allied nations appear committed to

DEFENSE DEPT.

Putin

synchronizing and securing their networks. Leveraging the Command and Control Centre of Excellence, NATO uses and retools its communications infrastructure through training scenarios like Trident Juncture and real-time field activities like Operation Active Endeavor. Similarly, the Cooperative Cyber Defence Centre of Excellence in Tallinn, Estonia, works to align and bolster NATO-wide cyber defense, executing annual "Locked Shields" cybersecurity exercises.

These institutions signal NATO's awareness of how crucial interconnected networks are, yet the alliance has struggled on these fronts in an operational context. It took years to set up "alliance networks" both in Afghanistan and Iraq. Communications difficulties plagued missions in Libya as well. Just last year, information sharing during a joint exercise was so bad that a NATO unit would have killed its own allies had it been a real operation. Potential blunders in allied cyber defense are unsurprisingly kept hush hush; however, with NATO members succumbing to hackers on their own turf, it's fair to assume that the challenge of defending joint military networks is still very real and enduring.

If NATO is to have a hope of effectively defending against Russia in 21st century warfare, it is abundantly clear that the organization's members need to pump more resources into better aligning their networks. Members should invest in training that isolates communications problems outside of full-fledged combat exercises — as they do for cyber — and should deploy the Battlefield Information Collection and Exploitation Systems across the alliance at an accelerated clip.

> "As long as Moscow's unpredictable leadership team remains intact, calls for heightened and realigned NATO defenses should be strongly considered."

With Putin allegedly pouring money and manpower into Russia's hacking forces, NATO is long overdue to outgrow its Estonia-based cybersecurity hub, which Nordenman labels a "policy and strategy shop." Instead of committing limited resources to churn out cyber regulations, NATO should strive towards an integrated cyber defense apparatus that expands NATO's cyber relationship with the European Defence Agency and builds similar bonds with the National Security Agency, as well as peer agencies in Europe.

None of these networking milestones are feasible without a serious change to NATO's information-sharing ethos. In this spirit, the Air Force colonel from above critiqued, "The U.S. offers NATO a scaled-down version of our own communications technologies, which provides them just enough to operate." Against this backdrop, the United States' goal appears not to be interconnectivity, but rather to have allies just squeak by. Meanwhile, according to this serviceman, the advanced networking capabilities of the Italians, Dutch and certain other tech-savvy NATO members languish on the sidelines.

To be sure, there are very real security considerations that would come along with enabling a truly integrated NATO network, especially for the United States. Escorting other countries — even NATO allies — beyond U.S. firewalls is not an easy sell. Yet, as Russia could pick the Internet for its next battlefield, the United States cannot afford to invest halfheartedly and hold NATO back from achieving a reality where everyone can actually talk to each other.

Few predict that Europe is soon to be engulfed in full-scale war. Some, like Lawrence Korb at the Center for American Progress, even have argued that concerns of being underprepared are overblown or a ploy to secure funding for the Pentagon's large purse.

As long as Moscow's unpredictable leadership team remains intact, calls for heightened and realigned NATO defenses should be strongly considered. To responsibly balance the skeptics and hawks and effectively brace for potential aggression from Moscow, NATO must cultivate a collective defense built on trust and interconnectivity. The alliance will be left vulnerable to an emboldened Russian bear if it fails to evolve on these fronts. **ND**

Alex Haber is a senior analyst at Avascent, an aerospace and defense consulting firm.

ISTOCK, DEFENSE DEPT.

Five Nations Jockey for Military Influence in Arctic

By Marcus M. Keupp

This is an excerpt from the book, "The Northern Sea Route," published by SpringerGabler. Academic references are omitted here for the sake of brevity but are included in the original text.

Reports of ice quickly melting in the Arctic, Russia boosting its military expenditures and research predicting significant untapped hydrocarbon resources in the region has led many commentators to state that armed conflict and "resource wars" in the Arctic are imminent.

At the same time, many scholars and experts predict that the Northern Sea will soon become a viable alternative to the Suez Canal as a shipping route because it will significantly reduce distances between Asia and Europe.

Few would doubt that Russia — with its northern fleet, naval infantry, air force, coast guard and patrol vessels that support it — is by far the most forceful naval power in the Arctic. Besides its headquarters at Severomorsk, the fleet has four other large naval bases in the high north, each of which consists of multiple bays, facilities, ports and installations: Gadzhievo, Zapadnaya Litsa, Vidyayevo and Gremikha. Current media coverage suggests that a much smaller naval base may be under construction on Wrangel Island.

Norway also has a number of larger naval bases in its northern regions at Haakonsvern, Ramsund and Sortland. By comparison, Canada, the United States and Denmark combined have few naval bases in the Arctic. Among these so-called "Arctic Five," Russia has by far the strongest icebreaking capability, both by the number and the power of its icebreakers, allowing its combat vessels to operate in ice-infested waters with a thickness of up to two meters if they travel in an icebreaker canal.

Given that even military vessels can suffer ice-related damage if they have thin hulls, this factor is not to be underestimated. Also, Russia's nuclear icebreakers only have to be refueled once every four years. Their radius of operation is almost unlimited.

While the U.S. military today has few surface vessels capable of sailing in the Arctic, it has significant undersea capabilities and is able to operate nuclear submarines in the Arctic Ocean and in near-Arctic seas, in open water as well as under the Arctic ice cover. As of 2014, the United States is the only nation able to match the Russian submarine fleet. Both nations operate nuclear and conventional submarines in polar waters today and have done so throughout the Cold War.

The case is more nuanced when air and surveillance capabilities are considered. The United States has a significant number of well-equipped air force bases in the high north: Eielson, Fort Clear, Fort Greely, Fort Wainwright, Joint Base Elmendorf-Richardson and Qaanaaq (Thule) in Greenland.

While Canada's combat aircraft are stationed in southeast and central Canada, they are regularly deployed in the Arctic region and can operate from four secondary air bases in northern Canada. In addition, Canada and the United States have installed sophisticated satellite surveillance and early warning systems in the region such as the Polar Epsilon and Ballistic Missile Early Warning Systems.

Russia has several airfields and airbases north of the 60th parallel, some of which have reopened in the past five years. They are: Alykel, Besovets, Khatanga, Kogalym, Kotelny Island, Mirny, Severomorsk (Murmansk), Olenya (Olenegorsk), Raduzhny, Salekhard, Surgut, Syktyvkar, Tiksi, Dresba airbase at Pevek, Petrozavodsk, Ugolny and Yakutsk. However, it is questionable how many of these are fully operational from a military point of view.

The Arctic Five

- U.S.
- Russia
- Canada
- Denmark
- Norway

Russia resumed long-range bomber and patrol flights beginning in 2007 after many airfields and bases had been dormant for over a decade or even closed due to a lack of funding in the post-Soviet era. If all of these bases were fully operational for military purposes, Russia would probably match the air capabilities of its Arctic neighbors.

It is important to note that the extreme climate in the Arctic may restrict the use of aircraft, submarines and vessels not configured for such an environment. For example, the Canadian forces' diesel submarines cannot function in Arctic waters. The range of the F-35 joint strike fighter, which Norway and Canada are planning to purchase, along with the F-16, may be limited by a lack of tanker aircraft support in the Arctic regions. Thus, long-range aircraft will probably be at the core of any air capability in the Arctic.

Both from a strategic and a logistics perspective, the hostile environment of the Arctic discourages far-reaching infantry and mechanized operations. Therefore, compared to air and sea capabilities, land capabilities have only limited significance. Canada maintains a unit of 5,000 rangers in its Arctic territories, which was dubbed an "invasion force" in 2009 by some colorful Russian rhetoric. Retired Chief of the Canadian Defense Staff, Gen. Walter Natynczyk said, "If someone were to invade the Canadian Arctic, my first task would be to rescue them."

Relying on reports in the public press about planned military expenditures, some authors have suggested a correlation between the resumption of Russian long-range bomber and patrol flights from 2007 onward — and military maneuvers in the Arctic in the following years. They have concluded that a remilitarization of the Arctic was underway. Of particular concern was the alleged violation of other nations' airspace. Consequently, such perspectives predicted "a resumption of Cold War hostilities." While it is certainly not impossible that Russia aimed to test the air defense readiness condition of its Arctic neighbors, this conclusion ignores two important aspects.

First, each of the Arctic Five has a long history of military operations and exercises in the region. Russian and U.S. submarines operated in Arctic waters and below the North Pole as early as 1960. Canadian forces spent thousands of flying hours in the Arctic archipelago in the 1970s and held frequent exercises between 1950 and 1970, which trained those forces in winter warfare.

The NATO exercise Cold Response

was first conducted in 2006 before the resumption of Russian long-range bomber and patrol flights. The exercise has been repeated in 2010 and 2012. Canada's Operation Nanook has been conducted every year since 2007. U.S. submarine deployments to Arctic waters did not cease after the collapse of the Soviet Union, while the Russian military activity significantly decreased due to a lack of funding for operations and maintenance.

In other words, the Arctic is not remilitarized now because it was never demilitarized. What the world has witnessed since 2007 is the re-activation of hitherto dormant or decommissioned Russian military bases and materiel, financed by revenues from increased global sales of hydrocarbon resources. These developments constitute a return to the status quo rather than a new round of militarization.

Second, the extent to which announced investments in military capabilities are realized — if at all — is

> "The extreme climate in the Arctic may restrict the use of aircraft, submarines, and vessels not configured for such an environment."

doubtful due to budget constraints and changing political agendas, irrespective of the announcing nation. Further, many of these announcements — particularly those originating from Russia and Canada — exhibit assertive rhetoric intended for a domestic audience and are often more related to public consumption than realpolitik. Thus, they should not be taken at face value, particularly so when they are reproduced by mass media and the public press in other countries.

Each of the Arctic Five has produced a foreign policy strategy or statement by now that documents their respective security and economic interests in the Arctic as well as their policy for the foreseeable future. While those of Russia, the United States and Canada have a more assertive and security oriented tone compared to those of Denmark and Norway, all five highlight the importance of protecting their sovereignty, their economic interests and the Arctic environment.

Political differences notwithstanding, military installations and materiel are described as defensive and primarily serve to dissuade others from challenging economic interests. For Russia, this strategy represents a significant change, since its Northern Fleet was defined as an ocean-going force during Soviet times, but now is commissioned to protect Russia's borders.

All five strategies highlight their preference for regional cooperation and normal diplomatic and economic relations. If one is to believe what Russia's Security Council defines for its strategy in the Arctic up to 2020 and beyond,

Norwegian forces during the military exercise Cold Response.

WIKI / SOLDATNYTT

the strategic goal is not military confrontation, but the transformation of Russia's share of the Arctic into a strategic resource, based on scientific research and compliance with international law. The document expressly states that such long-term economic development goals are not only impossible to achieve with military means, but on the contrary, they require peace, stability and international cooperation.

Finally, the installation of military and intelligence infrastructure is not necessarily equal to an act of aggression or a signal of increased tension in international relations, but may simply constitute an act of delimiting spheres of sovereignty and protecting economic interests. As now retired U.S. Navy Adm. James Stavridis, former U.S. European Command commander, put it, "Not all military capabilities are designed for force."

Nevertheless, the development of military capabilities in the Arctic from 2008 onward may also be interpreted in a wider context of increased East–West tensions since the 2008 Georgian War. And given the Ukraine crisis from 2014 on, it is likely that these tensions will continue for the foreseeable future. However, even under the tensions of the Cold War, the Arctic remained a remarkably peaceful region, despite or because of the manifold military operations that took place there.

To date, there has never been any armed conflict between any of the Arctic Five in the region. International initiatives such as the Arctic Military Environmental Cooperation Program, its successor, the Nunn-Lugar Cooperative Threat Reduction Program, or the 2011 Nuuk declaration, demonstrate that cooperation in security-related areas among the Arctic Five is possible and workable. **ND**

Marcus Matthias Keupp (mkeupp@ethz.ch) holds the chair of defense management at the Military Academy of the Swiss Federal Institute of Technology Zurich. "The Northern Sea Route" is the result of a two-year research project he created and led.

E-Waste Export Controls Key to Battling Counterfeiters

By Tom Sharpe

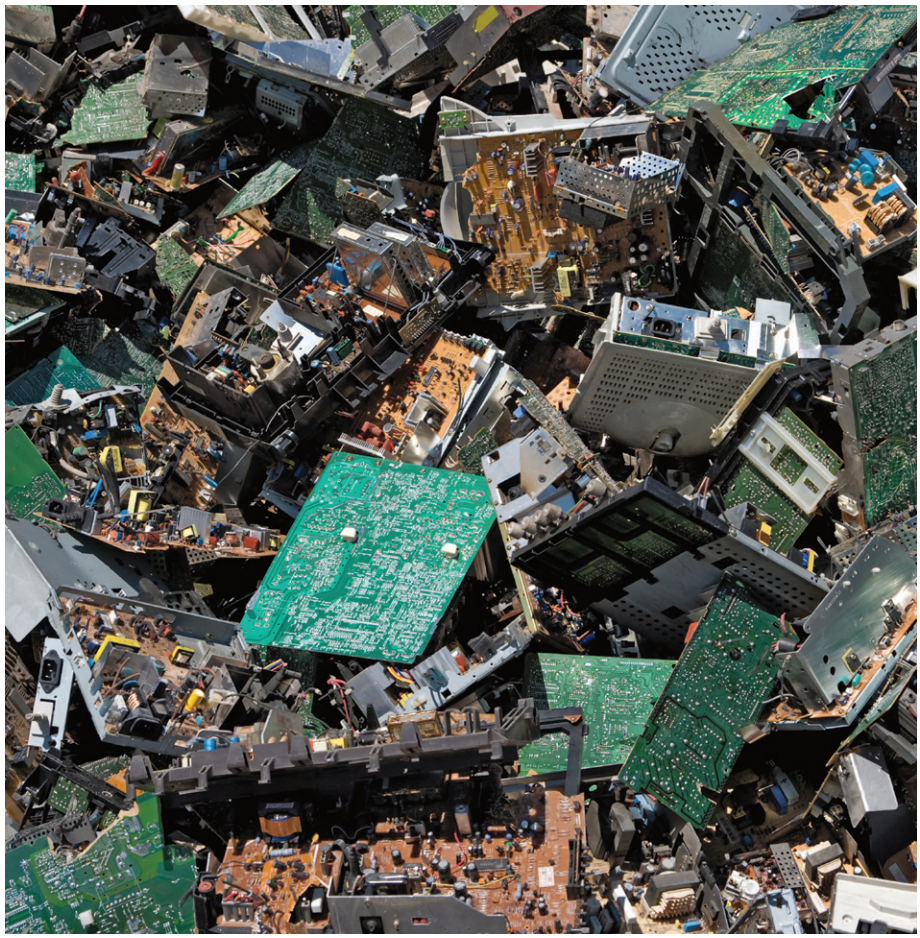
The technology sector and government agencies have been working hard in recent years to combat electronic component counterfeiters, based primarily in China. It's a fight we must win because counterfeit components threaten the reliability of technology critical to our national security as well as our health and safety.

The risks were first documented in a U.S. Senate Armed Services Committee study that identified more than 1 million individual suspected counterfeit electronic parts in weapons systems ranging from night-vision goggles to missile control systems. More than 90 percent of the counterfeits were traced to China. Adding to the national security threat, counterfeit microchips can help hackers and cyber terrorists launch attacks.

> "U.S. e-waste exports are massive — nearly 800,000 tons annually by conservative estimates."

The threat extends beyond national security to include a variety of products and systems that create public health risks. Counterfeits have been found in all sectors of the electronics industry to include medical and healthcare technologies, airport landing systems, braking systems for high-speed trains and the defense and aerospace industry, according to the Semiconductor Industry Association .

To date, we have seen significant new initiatives to improve detection of counterfeiters as they enter the supply chain. The Defense Department has implemented many newer procurement policies and contract requirements with suppliers designed to ensure delivered raw components or components within



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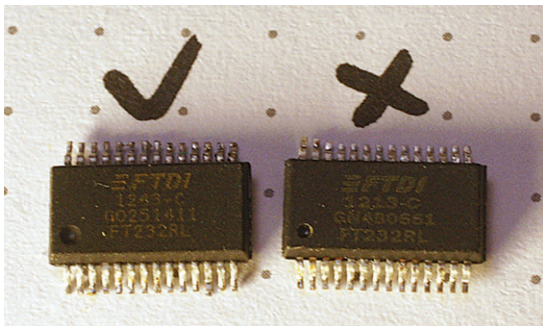
delivered systems are authentic parts, which can be traced to an authorized distributor or manufacturer.

In the cases where obsolete electronic components are required, which are no longer in production and must be procured from non-authorized sources, there are significant requirements for both authentication and functional testing.



A genuine FTDI chip (left) versus a counterfeit FTDI chip (right)

This is a critical initiative, but it's not perfect. Counterfeiters are a resourceful enemy adept at finding ways to subvert these measures.

Many larger U.S. companies whose products are being counterfeited within China have been hiring investigators based there to crack down on counterfeiters. Yet a recent Associated Press investigation details how fraud and corruption are undermining this approach. In some cases these investigators "were themselves manufacturing or selling counterfeit versions of their clients' own goods."

It is clear we are battling an enormous, well-funded criminal enterprise located in a country that historically has turned a blind eye to the intellectual property rights of others.

Emerging technologies will prove to be giant steps forward in detection. The Defense Advanced Research Projects Agency is funding the development of new technologies aimed at detecting counterfeits in the supply chain. Independently, Battelle Labs has spent the past several years and many millions of dollars developing the Battelle Barricade detection system.

Enforcement also plays an important role. The Department of Justice has recently secured convictions and/or guilty pleas of individuals knowingly trafficking in counterfeit parts aimed at U.S. military applications.

These are some of the many challenges underscoring how anti-counterfeiting measures must constantly evolve and adapt. All of these efforts are part of the solution. However, they share a common weakness — they only take aim at counterfeits once they are already in the supply chain. We must also attempt to prevent counterfeits by cutting off a large portion of the raw materials needed to produce them.

Counterfeiters use e-waste exported from our own shores as a primary source of cheap raw materials with which to create counterfeits. The United States is the world's largest producer of e-waste, and much of it ends up exported to developing countries for cheap processing.

As a result, counterfeiters thrive on a vicious cycle in which we export e-waste that comes back to undermine national security. As Pogo said, "we have met the enemy — and it is us."

Several years ago, I got a first-hand and unforeseen opportunity to see how it works while on a business trip to China, where the counterfeiting industry is centered in Guangdong Province. Components are pulled from piles of e-waste by workers in backyards and open-air dumps. Circuit boards are heated to "reflow" the solder and make components easier to remove. Parts are washed in rivers and laid out on sidewalks for sorting.

The actual counterfeiting process is equally harsh. Parts are sanded or put through an acid bath, then re-coated and re-marked through a process called "blacktopping." This process exposes these highly sensitive chips to moisture, static electricity and other damaging conditions. Acid baths used in some remarking processes can eat away at a microchip's internal parts.

A purchasing official may believe they are buying a brand-new part that has been manufactured in a pristine, clean-room environment. What they get instead is a counterfeit, pulled from e-waste then re-marked. It is virtually impossible for even a trained eye to detect the finished counterfeit.

The United States needs to fight counterfeiters with every weapon available to us. Yet we continue to allow export of untested, nonworking e-waste that provides them with an ample supply of cheap raw materials. U.S. e-waste exports are massive — nearly 800,000 tons annually by conservative estimates.

Our trade laws typically prevent exports that undermine our national security. E-waste exports clearly fit that description, and Congress must act to amend current trade policy.

To go on the offensive, Congress must enact legislation that requires domestic recycling of untested, nonworking e-waste. This approach keeps these materials within our borders and out of the hands of Chinese counterfeiters. U.S. e-waste recyclers are well equipped to do the job with secure systems already developed and in use at many processing sites around the country.

There is no magic bullet in the fight against counterfeiting. Improving supply chain procedures, improving detection and increasing enforcement are all important parts of the solution. To win the battle, we need a smart, "all-of-the-above" hard-liner strategy that most certainly includes common sense export reforms on these e-waste export feedstocks. **ND**

Tom Sharpe is vice president of SMT Corp., an electronics distributor, counterfeit mitigation and electrical testing laboratory for the defense and aerospace industry.

WIKI COMMONS

One Way to Improve Defense Acquisitions: Human Systems Integration

By Gary Gomez

Many of the current acquisition reform initiatives have been focused on programmatic and bureaucratic changes. The system design and development protocols are also ripe for review and improvement, to include ensuring that tools already in the acquisition framework are used.

One of those tools is human systems integration, or HSI. It is a discipline that contributes to improved system design, development and mission effectiveness.

The Defense Department has invested in this capability yet the use of HSI is often overshadowed by the desire to add system functions before assessing human functionality.

HSI must become a more prominent and consistent component in the acquisition process, which includes being an evaluation factor during source selection.

The U.S. Air Force defines human systems integration as "integrated and comprehensive analysis, design, and assessment of requirements, concepts and resources for system manpower, personnel, environment, training, safety, occupational health, habitability, personnel survivability and human factors engineering."

The Air Force further defines human factors engineering as "the comprehensive integration of human capabilities and limitations (cognitive, physical, sensory and team dynamic) into systems design, to optimize human interfaces to facilitate human performance in training operation, maintenance, support and sustainment of a system."

Simply put, HSI works to ensure that defense systems meet fundamental cognitive and physiological needs of the users and improves system reliability, efficiency and safety.

From an acquisition perspective, the goal is an efficient design and development process that addresses and incorporates user requirements before limited-rate or full-scale production. If HSI is not applied then it is likely that the system will not interact with the human properly and will require added time to field the system, added cost to redesign and redevelop the system, or require human interaction mitigation procedures, which will greatly reduce mission effectiveness.

The International Council on Systems Engineering states that "as a management strategy, HSI helps to ensure that human-related concerns are properly considered in an acquisition program."

For maximum effect, HSI is applied early in the design and development process to ensure the system is built to accommodate characteristics of the user population.

HSI improves human interaction with autonomous and decision support technologies by leveraging cognitive processing. It addresses issues such as combat clothing, equipment, rations, vehicle escape and safety. It supports force management and modeling and training methods and technologies, and it improves understanding of complex human terrain and sociocultural environments.

One current defense system effort is the Air Force redesign program for the unmanned aerial system pilot ground control system. The operational need for combat support outpaced the ability for the ground control stations to go through a traditional development cycle. As such, the stations were patched together quickly, are hard to use, and poor human interface created operator stress and fatigue.

The current program will produce ergonomically correct control stations, which will reduce operator stress and enhance mission effectiveness. Operator interface issues include seat recline angles; head and eyesight viewing angles; arm rest and operation stick placement; display screen size, shape and distance from the eyes; mission display icons, colors and placement; operator information flow; and information display structures just to name a few.

Recent HSI applications include the Joint Tactical Radio System Handheld, Man-Portable Radio. Analysis and feedback from multiple user assessments drove design decisions and identified missing system requirements resulting in reverse engineering the iPod user interface and applied lessons learned to the radio design. The operator keypad was redesigned to reduce complexity, enhance menu navigation and improve access to mission critical radio function-

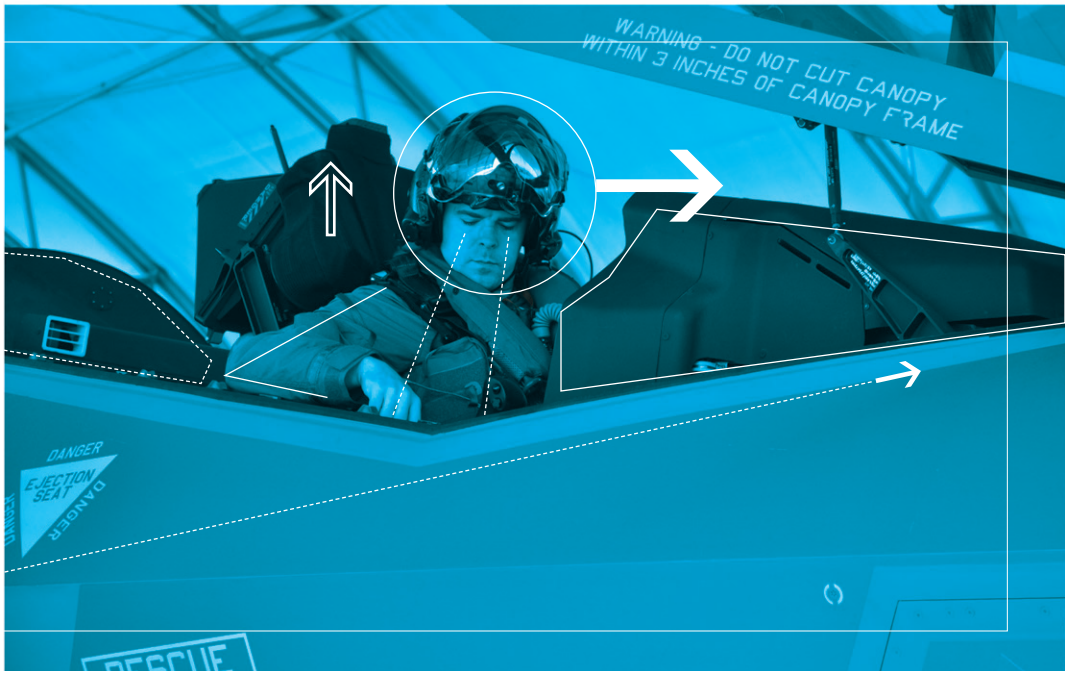


PHOTO-ILLUSTRATION / DEFENSE DEPT.

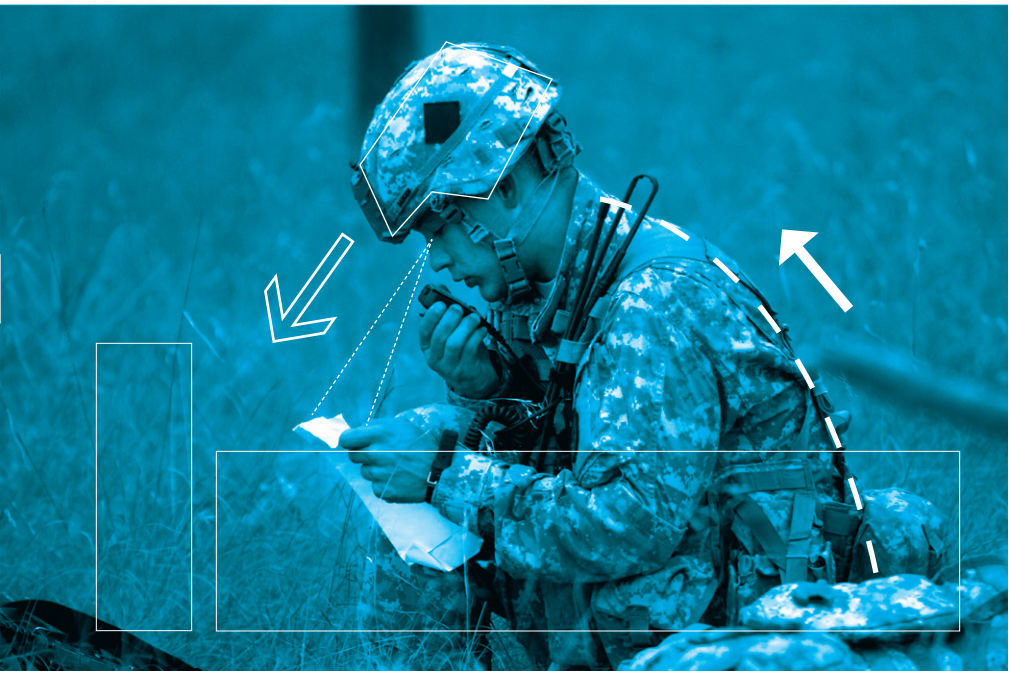
ality. Soldier input resulted in streamlined menu flows and prioritized menu item placement to meet mission needs.

Another example is the Aegis Weapons System Display Suite. User inputs resulted in display improvements that included color-coded symbology, increased symbol size and color-coded map backgrounds. These changes resulted in reduced time to identify threats and improvements for all task executions that included operator and thus mission performance improvement and improvements in situational awareness.

And then there is the F-35 ejection seat and pilot helmet. It was recently disclosed that in an ejection pilots weighing less than 136 pounds can be seriously injured, even though the ejection seat was specified to accommodate pilots in the 103 pound to 245 pound range. In addition, it has been discovered that the helmet designed for the JSF pilots is approximately six ounces too heavy, which can cause pilot fatigue, reduce the G's that a pilot can sustain in combat and exacerbate the ejection seat problems.

The Defense Department has recognized the value of HSI in the acquisition process and has established a number of venues to promote its value. Within the office of the deputy assistant secretary of defense for systems engineering there is the "HSI Initiative," the stated purpose being to focus on the role of the human in the acquisition process, specifically to provide equal consideration of the human along with the hardware and software. Further, the role of HSI within the acquisition process has been formalized through DoD Instruction 5000.02 (January 2015), which states that the program manager will "plan for and implement HSI beginning early in the acquisition process and throughout the product life cycle. The goal will be to optimize total system performance and total ownership costs, while ensuring that the system is designed, operated and maintained to effectively provide the user with the ability to complete their mission."

> "The current program will produce ergonomically correct control stations, which will reduce operator stress and enhance mission effectiveness."



Concurrently, the Defense Acquisition University Guidebook contains a section on HSI and its applicability in the acquisition life cycle, which provides the program manager information to support HSI integration into the acquisition effort. And there are a number of active efforts to address HSI integration in the entire defense research, development, acquisition and engineering process, one of which is the Joint Human Systems Integration Working Group with representation from all the armed services and the Defense Department.

By providing the knowledge necessary for program managers to apply this discipline, it is clear that the department understands and values HSI in the acquisition process. But it should be noted that these documents simply help program managers have "background and understanding" of HSI and direct that they "ensure that HSI is considered" in the design and development effort.

There is no stated requirement that HSI be a "key performance parameter" or "key system attribute." KPPs and KSAs are defined by the Defense Acquisition University as "metrics, which contain those attributes or characteristics of a system that are considered critical or essential to the development of an effective military capability."

The argument here is that HSI is a critical or essential metric that materially impacts military capability. In defense acquisition programs with finite budgets and in a perpetual state of hard decisions and tradeoffs, HSI is currently just an optional design and development tool that can be set aside in order to add system capability without a clear understanding of the human impact of that capability.

Key to enhancing HSI participation in the acquisition process is ensuring acquisition program managers and service program executive offices clearly understand its value. This can prove difficult as the HSI community of interest is not a conventional acquisition constituency.

The HSI industry doesn't build things in the conventional sense. It is an industry of capability. And since the field is based on human cognitive and ergonomic principles, practitioners can have difficulty explaining in lay terms its value, which is intuitive. As such, a critical component of the acquisition reform path is for the HSI community to ensure its participation and to continue to convey its value in the acquisition process. **ND**

Gary Gomez is a national security consultant and the deputy chair of the National Defense Industrial Association Human Systems Division.

Military Beefs Up Research Into Swarming Drones

By Stew Magnuson

The concept sounds hard to defeat: dispatch a horde of flying, thinking armed robots that can autonomously coordinate amongst themselves an attack against a target.

If an anti-aircraft weapon takes down one drone, the others change direction, push through and destroy the target kamikaze style.

Senior Air Force officers and Defense Secretary Ashton Carter are among the military leaders who have touted "swarming" robots lately, although the Air Force Research Laboratory doesn't like that term. It prefers "distributed collaborative systems."

The problem with the biological term "swarming" is that it doesn't fully describe where the Air Force and others are going with this technology, said Kristen Kearns, autonomy portfolio lead at AFRL.

Swarming fish and birds don't collaborate much, she said in an interview. "That collaboration is where we anticipate where you would be able to gain capability as opposed to blindly following or

PHOTO-ILLUSTRATION / AIR FORCE, ISTOCK

staying out of the way of everything else in the team."

Distributed collaborative systems for the Air Force is "about putting that next level of decision making and capability on the platform. Not only can it maintain itself, but it can work other parts of the team, whether those be airmen, or whether those be other machines to perform a mission task."

Also working on the concept is the Pentagon's Strategic Technology Office.

Carter in a speech at the Economic Club of Washington D.C., in February highlighted the work the office is doing.

One project uses "swarming autonomous vehicles in all sorts of ways and in multiple domains," he said. "In the air, they develop micro-drones that are really fast, really resistant. They can fly through heavy winds and be kicked out the back of a fighter jet moving at Mach 0.9, like they did during an operational exercise in Alaska last year, or they can be thrown into the air by a soldier in the middle of the Iraqi desert."

Peter W. Singer, a strategist at the New America Foundation, said, "Swarming has several potential benefits. It is a way to gain the effect of greater intelligence without each individual unit needing to be intelligent. Think how ants can perform incredibly complex tasks, even though each ant is not all that smart."

Gen. Ellen Pawlikowski, commander of the Air Force Material Command in a speech last year, said swarming drones "can be very much a game-changing reality for our Air Force in the future."

Today, once a missile is launched at a target, the human is out of the decision-making loop. He has no control over it. "When we separate the weapon from the aircraft, we separate the weapon from the human," she said. A swarm of thinking, flying munitions could be commanded in mid-flight to change direction.

Before that happens AFRL has many technological hurdles to overcome, Kearns said. It will require a lot of collaboration and data sharing between the weapon systems, she added.

Machine perception, what the robot sees, is a relatively mature technology. They can identify a large object such as a tank. But the swarming concept poses some difficulties. "The challenge becomes what happens when it can only see half of that object. How can that machine identify what it is when it needs to do some inferencing?" Kearns asked.

That will require more research, she added.

And given that missiles move rapidly, the data stream becomes vital — not only maintaining connections between the robots, but managing what is passed between them, she said.

"What is the amount of information that needs to be shared between the systems to be able to do that collaboration?" she asked.

"Sending a lot of data would be easy but the problem is because of the time and the speed, you have to know exactly the data that needs to be sent in order to have that coordinated interaction," she said.

A consultant familiar with the Defense Department autonomy programs, who declined to be named, said the human operator may not be able to compete with a fully autonomous system that identifies, analyzes and geolocates a target, especially in such a scenario where the swarm is moving rapidly.

Nevertheless, "the power and the sheer speed of execution would give them a huge advantage over their adversaries," he said.

There is a fundamental debate in the armed services about the correct amount of human and autonomous operators, he said.

"Getting the right blend of autonomous, semi-autonomous and autonomous systems, which related to drones or robotics or other physical or virtual capabilities, is an evolving debate, but that's where the future is going," he said.

When targeting, it's important to remember that humans are moral creatures. Machines are not, he said.

"The ultimate safeguards on the use of lethality are driven by humans and will be driven by humans until such time as we have sufficient capabilities in moral, smart machines," he said.

Singer said, "Just like with past human 'swarms' in war, like German U-boat wolf packs, it is a lot easier for them to operate if they can easily communicate. But that may not always be possible. So you then have to pack in more and more intelligence, and give them greater and greater autonomy."

Kearns said: One of the major challenges with any autonomous system is verifying and validating that the decisions it is making are correct. "And that is the case across the Department of Defense, when we work with the Army and the Navy, that is a challenge that we all have."

Trust, or "verification and validation," becomes paramount with what is essentially artificial intelligence, Kearns added. "How do we assure safe and effective operations when we put decision making in the platforms?"

Some of the technologies needed to advance the field of distributed collaborative systems will be developed before the problem of verification and validation is solved, she said.

Arati Prabhakar, director of the Defense Advanced Research Projects Agency, said in a briefing with reporters, that there is a powerful new wave of research happening with artificial intelligence but "one of the biggest issues is trust and confidence in what [machines] tell us what they think is

Swarming drones "can be very much a game-changing reality for our Air Force in the future."

GEN. ELLEN PAWLIKOWSKI

AIR FORCE

DARPA swarming concept

happening and what course of action to take." The field needs more of a rigorous theoretical foundation, she added.

Kearns said the first step in the program will be to develop what the AFRL is calling a "loyal wingman." In that case, a remotely piloted aircraft would follow a jet fighter. It could serve as a "bomb truck" and carry extra ordnance, or be another set of eyes with its sensors. It could be directed to go to a hazardous area where the pilot doesn't want to go, she said.

While this is a step toward distributed collaborative systems, it has its own questions and challenges.

What is the airman's job today, and what can researchers do that enhances and allows him to do that more effectively? How can they efficiently and effectively help pilots to make decisions and support them so there is a fluid operational team of both this intelligent system and airmen working together? she asked.

"What we don't want to do is hand them a tool ... and actually make their jobs harder," Kearns said.

The question becomes how to manage the workload of that pilot as you add a robotic wingman, she said. "What work does that pilot need to do and how much workload can you give them before you start impacting performance?" she asked.

"It is critical that your pilot isn't up there flying his plane and another plane," she said.

Steve Walker, deputy director of DARPA, said his agency has been working on developing battle management systems with a blend of manned and unmanned vehicles.

"You have humans and unmanned systems and you need data fused together quickly and things are happening fast and you don't want to overload the human with all that information. … You want to give him or her exactly what he needs to make a decision and have all these distributed effects work together," he said.

Singer said swarming is "a more resilient approach. Rather than having one single system or single point of failure, it can take losses and still function. This also means it complicates an enemy's job by having so many more targets to have to take out. And it might also be cheaper than trying to put all your capability in one exquisite system that tries to do it all, that is 'too big to fail.'"

Hordes of autonomous robots attacking a target or performing other tasks are still a number of years in the future, Kearns said. AFRL is looking to conduct experiments on the loyal wingman concept by fiscal year 2022. Expanding the distributed collaborative system concept would come later.

There is a lot of ongoing work in autonomy across the Defense Department, and AFRL will leverage some of it. For example, there is no need to do a lot of research into autonomous landing when the Navy has already demonstrated this on an aircraft carrier with its UCLASS unmanned aerial vehicle. Landing on a moving ship is a lot harder than landing on the ground, she noted.

Singer said, "Some things are possible today if we were willing to pull the trigger, budget-wise, and some are several years off." Meanwhile, there are many videos on YouTube showing some amazing advances with robots flying, sailing or moving in formation, he said.

"But one thing to note about the YouTube aspect: it's also a good illustration of how so much of the advancement in this space is happening outside the defense world," he added. ND

Email your comments to smagnuson@ndia.org

DARPA

Military Eyes Sixth-Generation Fighter

By Yasmin Tadjdeh

As key Air Force and Navy fighter jets — such as the F-22 Raptor and F/A-18E/F Super Hornet — face the end of their service lives in the 2030s, work is being done in earnest by the two services to field a new fighter.

The sixth-generation fighter, as it has been called, is still largely conceptual. While the services have ideas about some requirements and industry has already begun distributing artist renditions of potential aircraft, a formal program is still years away.

Sterling Anderson, deputy chief of Air Combat Command's air superiority core function team, told National Defense that the Air Force already has a few capabilities in mind.

The service wants to cut down on the amount of mid-air refueling, he said. Fighters, which are traditionally small and compact, often have less space for extra fuel, he noted.

"We think it's going to have to be long range, for sure," he said. "If you look at almost any part of the world, even in the Middle East, and look at some of the distances required and the tankers required, we would like to have a fighter with a longer range probably than the standard 500 miles that we have today."

Since the end of the Cold War, combat aircraft have had the luxury of operating from bases that are close to the enemy, like in Iraq, said Mark Gunzinger, a senior fellow at the Center for Strategic and Budgetary Assessments, a Washington, D.C.-based think tank. In the future, where enemies have precision-guided weapons like cruise or ballistic missiles, those bases could be at high risk.

"We might need to operate our future combat air forces from great distances from an enemy in areas that are not at such risk," he said.

However, that doesn't necessarily mean that the Air Force will go for a larger aircraft that resembles a bomber, Anderson said. "We're working on a lot of really advanced propulsion technologies … that are going to have a pretty good … increase in specific fuel consumption, so even keeping aircraft fairly small, we believe we are going to be able to get some pretty good range increases."

An aircraft as big as a bomber would likely be extremely expensive, he said. "That's probably out of reach to be that big. It's just not affordable."

Stealth will also be a key requirement, he added. It "is the price of admission in future conflicts."

Additionally, the service wants to field smaller weapons.

"One of the issues we have today is just the amount of weapons we can carry on any given fighter," he said. "The weapons are fairly large and the fighters are fairly small because they're fighters. So you don't have a deep magazine."

Emerging technology such as directed energy weapons might be one way to obtain a deeper magazine, he noted.

"We have a requirement for things like survivability and lethality, deep magazines, range and persistence," he said. "When you look at that, the laser kind of helps you in all of those areas. Now, whether it will be mature enough, whether we can figure out how to integrate it on a fighter-type platform, those are all questions to be answered. But it certainly contributes to all of the major areas that we need to work on."

While kinetic weapons will be critical, there is also a need for electronic weapons, he said. Cyber capabilities, offensively and defensively, will be necessary in the future as the United States faces more advanced adversaries, he said.

The Air Force is also looking at ways to better manage an aircraft's heat signature, he noted.

"We've got several efforts ongoing looking at how we manage our power and how we manage thermal loads. Part of that is in the engine itself," he said. "There's a lot of work going on in what they call a third-stream engine, which has a third stream of much cooler air that you can use to mitigate a lot of that heat."

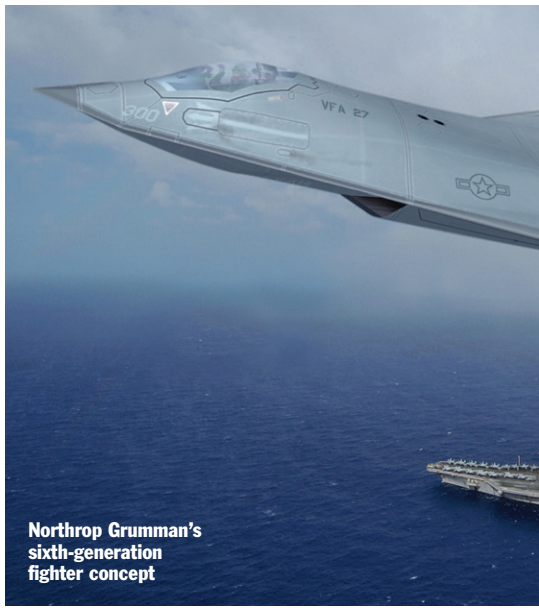
The Air Force Research Laboratory is currently working on developing this next-generation engine, Anderson said.

An Air Force group known as the Air Superiority 2030 Capability Collaboration team is researching much of the requirements for a sixth-generation aircraft, he said. The group includes personnel from Air Force headquarters and from Air Combat Command.

"They're taking a comprehensive look … at air, space and cyber and how we want to do air superiority out there in the far term in the 2030s," he said. "They're going to brief the chief [of staff of the Air Force] in … March and get a vector from him on how to proceed."

"How we do this sixth-gen thing, or if we do it, all depends on the outcome of that study and the chief's direction," Anderson said. At the moment, the Air Force plans to begin an analysis of alternatives in the first quarter of fiscal year 2017 that will run through the middle of fiscal year 2018, he added.

While capabilities are being parsed out, the service is already examining ways it can avoid some of the acquisition pitfalls that plagued other fighter jets, such as the fifth-generation F-35, he said.



Northrop Grumman's sixth-generation fighter concept

NORTHROP GRUMMAN

"One of the largest single things we're looking at and working on is how to take all the lessons learned from F-35 and other activities here in the last few years and avoid those in the future," he said. "It's everything from starting with requirements to the acquisition process, finding ways to shorten that and make it more efficient."

The service would likely want to avoid concurrency when fielding the aircraft, which can bring "a lot of baggage," Anderson said.

The Air Force intends to partner with the Navy as it makes plans to potentially field a sixth-generation aircraft, he said.

"We're working pretty closely with the Navy, not because we'll have the same airplane — because we won't, we've got significantly different requirements

— but there are a lot of things we can take advantage of to reduce cost," he said. "We're going to do a very closely coupled analysis of alternatives — not a joint AOA, but closely coupled — so that we can discover those ways to save the services money."

Rear Adm. Michael Manazir, director of air warfare in the office of the chief of naval operations, said as the service embarks on an analysis of alternatives for the F/A-XX — the Navy's designation for the sixth-generation aircraft — it is keeping its study wide-ranging and examining all options.

"The Navy's point of focus is the capability gap set that occurs when F/A-18E/F and EA-18G start to retire in the mid 2030s," he told National Defense in a statement.

F-22 Raptor

F/A-18F Super Hornet

The service's analysis of alternatives team is currently working "with industry and the acquisition, intelligence, science and technology communities along with other experts to find an affordable blend of capability and survivability to address the predicted future threat," he said.

Over the past several months, the Navy has conducted a series of technical interchange meetings to address affordability, modification of current platforms, new start aircraft, propulsion, avionics, weapons and more, he said.

Manazir stressed that the service plans to work closely with the rest of the military to field the aircraft. "It is anticipated that the services will collaboratively investigate common technology investments and interoperability. The analysis will provide insights into the utility of a joint solution, focusing on commonality and interoperability between solutions."

As the military has ramped up its efforts to procure the aircraft, industry has taken note. In a highly coveted Super Bowl commercial slot — where a 30-second ad cost millions of dollars — Northrop Grumman showed off concept art for a potential sixth-generation fighter.

The commercial started with engineers working on what looks like a bomber-type aircraft in a factory. The finished aircraft then zips off a runway and into the sky. A voiceover says, "Just wait until you see what's next."

Chris Hernandez, vice president of research, technology and advanced design at Northrop Grumman, said the company is making investments today to better address the challenges of the emerging operational environment.

"The integrated systems that the nation needs to acquire to assure air dominance in 2030 … [and beyond] will likely be very different than legacy fighter solutions," he said in a statement.

"The emerging operational environment demands long-range, survivable, penetrating, persistent systems with deep magazines to prevail against a numerically superior adversary."

In concept art, a laser weapon is visible on Northrop's aircraft.

Andrew Hunter, director of the Defense-Industrial Initiatives Group at the Center for Strategic and International Studies, a Washington D.C.-based think tank, said the sixth-generation aircraft might not actually be a fighter jet.

"It could be a swarm of" drones, he said. "It could be missile trucks that don't look anything like current fighter aircraft but operate at much longer ranges."

"I think one of the biggest questions that's kind of out there to be answered — is this idea of something called a fighter relevant … in the 30 years from now timeframe," he said.

It can be extremely expensive to try and put capability on top of capability on an airframe while also making it as stealthy as possible, he said. Officials and experts are mulling over whether it is a better payoff to disaggregate some capabilities and reduce vulnerability to losses by distributing the various parts of a fighter in a more networked approach, he said.

Gunzinger, the senior fellow from CSBA, said the term "fighter" is antiquated.

The term tends to "draw a box for this future capability which no longer exists because technology has progressed so quickly," he said. "The next-generation fighter will be capable of multi-missions … and it may look very different from the kind of 'quote unquote' fighters that are now in the inventory."

Gunzinger suggested calling the system "the sixth-generation combat platform" or "the next-generation combat platform."

The aircraft will have to support air dominance, strike and electronic warfare missions, he said.

The United States is moving into an era where the operational environment is going to be increasingly contested, and that means the sixth-generation fighter will have to be "highly survivable, capable of penetrating areas that are well defended by a vast air defense system — surface-to-air missiles and other weapons — and it's going to probably have to have quite a bit of range."

The United States must think about threats from Russia and China and the anti-access/area denial capabilities that they have, Gunzinger said. Additionally, those nations are exporting their capabilities to other countries, including Iran.

"These capabilities are proliferating globally, so you also have to think about the Syrias of the world and what they may be able to get their hands on," he said. ND

Email your comments to ytadjdeh@ndia.org

Special Operations Aircraft to Be Outfitted with Laser Weapon

By Yasmin Tadjdeh

Air Force Special Operations Command expects to equip a directed energy weapon on its new AC-130J Ghostrider gunship by 2020, said its commander.

Officials said the combat aircraft — which will be used for close-air support and air interdiction — is an ideal platform for a laser.

"Most of the senior leadership in the Air Force would argue that the logical step to the advancement of high-energy lasers in the battlefield is to use this AC-130 platform" and then move on to a fighter jet, said Lt. Gen. Bradley Heithold, commander of AFSOC. "It makes too much sense. Use me as a way to get where you finally want to go."

The AC-130J — a modified C-130 Hercules transport aircraft built by Lockheed Martin — has more size, weight and power than a fighter, making it an appropriate platform to use initially, he told National Defense.

AFSOC has been working with industry, Defense Department laboratories and think tanks to mature lasers. "We believe technology is ripe to move this forward," he said.

Heithold described lasers as a leap-ahead technology over precision strike munitions. The development of such systems goes hand in hand with the Defense Department's third offset strategy, which aims to maintain the United States' technological edge, he said.

"The next evolution is here and this is where I would argue that I'm at the red zone," he said. AFSOC is working closely with Special Operations Command's acquisition arm to field the technology, he added.

AFSOC anticipates it will have its first laser on board a gunship and in demonstrations by 2020, he said. For now, the command is aiming to equip it on four systems, but that number could be adjusted. "It all depends on where this technology goes. You may find that eventually all AC-130s have it," he said.

Without giving specific figures, Heithold said adding a laser to the aircraft wouldn't be extremely costly.

"If I can get the department on board and a little bit of money in '16 — and I mean a little — I can move the ball forward and [if we can] get enough money in '17 — about $20 million — and then a little bit in … '18 and '19, we'll field it," he said.

"I don't think it's a lot of money. This isn't a billion dollar" program, he said. The "investment in this capability has already been done. It's been done by industry, the laboratories" and the Defense Advanced Research Projects Agency.

Bill Lane, AFSOC's chief of strike and intelligence, surveillance and reconnaissance requirements, said a laser would be "another arrow in the quiver of the weapons suite of an AC-130J."

The command has already submitted a concept of employment to the Air Force Research Laboratory to help them better understand how AFSOC would use the laser. They are also working on drafting a requirements document for the AC-130J, he said.

AFSOC is currently in a study phase, Lane said. Its acquisition personnel have contracted with Naval Surface Warfare Center Dahlgren in Virginia to complete a two-phase study. Scientists and engineers at Dahlgren are responsible for much of the research associated with a laser weapon system that is undergoing demonstrations on the USS Ponce, he noted.

The first part of the Dahlgreen study is examining the maturity of systems developed by top defense contractors such as Lockheed Martin, Northrop Grumman, Raytheon and General Atomics. The second phase is to look at various design options. The study is expected to wrap up by the end of 2016, he said.

Once a design concept is settled upon, the command will release a request for proposals from industry, he said.

"We've haven't gotten to that point yet, so a source selection would probably be over a year from now," he said.

A laser on board a combat aircraft could be useful in a slew of different missions, he said. They offer users precision accuracy with low collateral damage. For example, such a system could easily target a communication node or power line. A kinetic weapon that explodes would cause widespread damage, he noted. Lasers can also be used defensively.

"When we say laser weapon, there are really two aspects," Lane said. "There's an offensive aspect where you would look at destroying certain enemy targets, and we think technology-wise, that would be the easiest to achieve at this point."

"Then there's also defensive capability where you would use a laser on your aircraft, for example, to counteract or shoot down enemy missiles. … That's a little tougher technology-wise and probably a little further out," he said.

In addition to having utility on the battlefield, lasers are also affordable, Lane said.

While there is an expense to install, support and maintain a laser system, "the cost per shot is really the cost of flying the airplane, having the engine generator supply the power. So it is very low cost … as opposed to say a missile or a smartbomb that you drop that could be anywhere from $100,000 a piece to $1 million."

Lane did not specify how much each shot would cost, but the Navy has estimated that it could be as little as $1.

A laser would require a large amount of onboard power, he said. When a system shoots out a beam, there is a peak of high energy use but it is only for a short duration.

"You could have … battery power that would store up the energy and be recharged by the engine generators or you could have an additional generator in the aircraft that … using the aircraft's fuel [could] provide that amount of power," he said.

As for the positioning of the system, the laser could replace either the gunship's 30mm or 105mm gun, he said.

So far, AFSOC has not run into any obstacles that would prevent a laser from being put on the platform, Lane said.

Industry has already begun envisioning other aircraft that could host a laser weapon on board.

Bob Ruszkowski, director for advanced air dominance and unmanned systems at Lockheed Martin Skunk Works, said such a system could one day be outfitted on the F-35 joint strike fighter.

PHOTO-ILLUSTRATION / ISTOCK

"While we are confident we can do it, we still need to get" more data, he said. "For a supersonic jet … [there is] a little bit more work that needs to be done and some more demonstrations and more data that we'll need to make sure that it is going to be low risk."

Subsonic and supersonic aircraft are markedly different, he said. Additionally, tactical fighters are much smaller than an AC-130J, he noted.

"These aircraft have been optimized for very condensed packaging of the subsystems, so for an F-35 — or an F-22, for that matter — you're probably … [going] to integrate the laser weapon system components or at least some of them in perhaps one of the weapons bays," he said.

This could be done in a modular way that would allow a laser to be used for certain missions and then swapped out later for others, he added.

Lasers equipped on unmanned aerial vehicles are another possibility, he said.

"I'm more referring to the next-generation of unmanned systems" that will be developed in the next 10 to 20 years, he said. "I think we're probably talking Group 5 or Group 4 maybe, depending on how laser technology matures."

Group 5 aircraft include systems such as the Global Hawk. Group 4 include Predators and the Fire Scout.

In a recent conceptual drawing of a Northrop Grumman-built sixth-generation fighter, a laser weapon is evident on the aircraft. Northrop representatives were unable to comment for this article by press time.

Iain Mckinnie, business development lead for laser sensors and systems at Lockheed's mission systems and training division, said the company is working on putting a laser on an Army truck.

The company is developing a 60-kilowatt system that will be outfitted on the service's high-energy laser mobile demonstrator, he said.

"We're very excited for it because it will be a … significant step forward in demonstrations of laser weapon systems," he said. The program is on schedule and Lockheed plans to deliver the laser toward the end of 2016.

For the demonstrator, Lockheed is using a new modular laser approach with fiber modules, which offers flexibility and scalability, Mckinnie said.

The system works much like a prism when it breaks up light. "We have a number of fiber laser modules, we run them through an optical element that does the beam combination and out comes a single high-powered beam with very good beam quality," said Rob Afzal, a senior fellow at Lockheed Martin. Such a system could project a beam for a long distance, he noted.

The laser — which is being built at Lockheed's Bothell, Washington, facility — could be scaled up to 120 kilowatts, Mckinnie said.

"To double the power, all you really have to do is build another set of these modules that we're manufacturing and swap them in since we've designed the laser to have available empty slots," he said.

Lockheed has looked at outfitting its laser on the Army's family of medium tactical vehicles as well as the Stryker, Mckinnie said. **ND**

Jon Harper contributed to this story.

Email your comments to ytadjdeh@ndia.org

Pentagon Seeks Smarter Machines for Future Combat

By Jon Harper

Defense Department officials view autonomous systems and artificial intelligence as the key ingredients of their new warfighting strategy. The Pentagon is now laying the groundwork for the rise of smarter military machines.

Deputy Secretary of Defense Robert Work said several recent studies conducted by the Pentagon and the Defense Science Board focused on answering the following questions: "Where are we missing capabilities and where would we like new capabilities?"

"There was remarkable consistency," he said at a recent conference hosted by the Center for a New American Security. "The theme that came out over and over and over again is what we call human-machine collaboration and combat teaming. ...What is it that really is going to make human-machine collaboration and combat teaming a reality? That is going to be advances in artificial intelligence and autonomy that we see around us every day."

Air Force Gen. Paul Selva, vice chairman of the Joint Chiefs of Staff, noted that the commercial world has already developed sophisticated autonomous systems.

"You and I are on the cusp of being able to own cars that will drive themselves," he told a largely civilian audience at the Brookings Institution, referring to smart vehicles such as ones developed by Google. "The technology exists today. It has been proven."

The Pentagon already possesses unmanned ground, undersea and aerial systems, which are remotely piloted by human beings, he noted. Now "we can actually build autonomous vehicles [that don't require direct human guidance] in every one of those categories."

The technology is advancing rapidly, said Paul Scharre, director of the 20YY Future of Warfare Initiative at CNAS.

"The rapid growth of computing power is resulting in increasingly intelligent machines. When embodied in physical machines, this trend is allowing the growth of increasingly capable and autonomous munitions and robotic systems," he said in testimony to the Senate Armed Services Committee in November.

The scientific community has reached an "inflection point" in the power of artificial intelligence and autonomy, which could lead to "entirely new levels of what we refer to as man-machine symbiosis on the battlefield," Work said.

Greg Zacharias, the Air Force's chief scientist, said military researchers are focused on the following areas: development of more advanced sensors and data-gathering technology for systems to better understand their operating environment; development of reasoning systems and software to assess situations and make recommendations or decisions; and the refinement of different ways of carrying out those recommendations and decisions, whether through direct action such as guiding another unmanned platform or through recommendations to another human or machine teammate.

"The overall goal here is to enable systems to react appropriately to their environment and perform situationally appropriate tasks, synchronized and integrated with other autonomous human or machine systems," he said at a House Armed Services Emerging Threats and Capabilities Subcommittee hearing in November.

The Pentagon's plans include the acquisition of "deep learning" systems. Work outlined a potential scenario for how artificial intelligence could be employed in combat as part of a "learning" network:

"If we launch seven missiles at a surface action group and one missile goes high and is looking at all of the different things that the battle group is doing to defend itself and it sees something new that's not in its library, it will immediately report back on the learning network, which will go into a learning machine, which will say [to military commanders], 'There is something you should do' … so that the next seven missiles launched will be that much more effective."

Artificial intelligence and autonomous systems will be critical in future high-tempo warfighting environments, defense experts said.

"A key contest in war will be between adversary cognitive systems, both artificial and human, to process information, understand the battle space, and decide and execute faster than the enemy," Scharre said. "Advances in machine intelligence show great promise for increasing the ability of artificial cognitive systems to understand and react to information."

Humans will not be able to match the capabilities of autonomous systems when it comes to certain types of operations such as missile defense or cybersecurity, Work said. "When you're under attack, especially at machine speeds, we want to have a machine that can protect us. … You cannot have a human operator, operating at a human speed, fighting back against a determined cyber attack. You're going to have to have a learning machine that does that."

Learning machines could be especially helpful when it comes to analyzing big data, Selva said. "We have … a requirement to be able to sort some of the largest databases on the planet, if you just think about our intelligence databases and all the digitized information that exists."

The Defense Department needs algorithms that would allow a machine to detect abnormalities or changes in the operating environment, highlight them for analysts and then make recommendations about how to respond, he said.

"The data sets that we deal with have gotten so large and so complex that if we don't have something to help us sort them, we're just going to be buried in the data," he said. "The deep learning concept of teaching coherent machines ... to advise humans and making them our partners has huge consequences."

But testing deep learning systems to ensure their effectiveness and reliability could be challenging. Software capable of telling defense officials what a military machine has learned does not yet exist, Selva noted.

"That is one of the milestones we are going to have to cross before we can actually get into a high confidence area where we can say the technology is actually going to do what we want it to do, because not only can we physically test it, we can intellectually test it," he said.

Autonomy and artificial intelligence could save the Pentagon money and

significantly reduce manpower requirements for deploying unmanned systems, officials and analysts said.

"I think inherent to unmanned are tremendous savings" as individuals are able to manage and oversee multiple systems, said Rear Adm. Robert Girrier, director of unmanned warfare systems within the office of the chief of naval operations, during recent remarks at the Center for Strategic and International Studies. "The technology is driving us in that direction. And clearly you can see how that's something in the back of our mind" in an era where budgets are strained.

Defense Department agencies are researching and developing relatively inexpensive "swarm" systems, which humans could supervise during operations. "These efforts hint at the next paradigm shift in warfare — from fighting as a network of a few, expensive platforms as we do today, to in the future fighting as a swarm of many low-cost assets that can coordinate their actions," Scharre said.

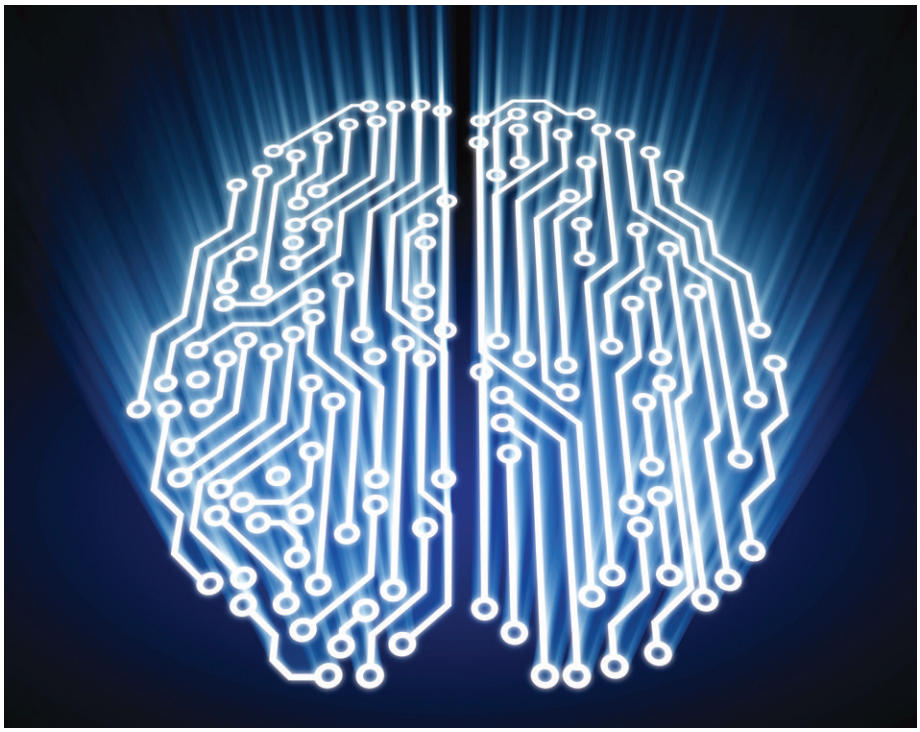
Work said the Pentagon is "actively looking at a large number of very, very advanced things" such as large-capacity unmanned underwater vehicles that "cascade" smaller UUVs and form underwater networks; as well as autonomous small service vessels and UAVs that could operate together.

"You're going to see a lot more mother ships whose [autonomous] offspring work to execute the mission," he said.

The integration of autonomous systems and artificial intelligence into the force are key elements of the Pentagon's new "third offset strategy," which is intended to leverage emerging high tech to maintain military superiority over potential adversaries, who are acquiring sophisticated weapons similar to those currently possessed by the United States.

"We are going to place multiple bets" on promising technologies, Selva said.

"My tolerance for risk is pretty high," he added. "When I go out to Silicon Valley and ask a software engineer to think about a learning software that's going to answer one of my problems, it's a really hard question. … In this cycle of rapid innovation in civilian and military technology, we have to be able to accept failure, not in the battle space [but] in the development phase."



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The Pentagon isn't keeping up with the private sector, Selva said. "There is much more innovation going on at a much faster pace in the software and artificial intelligence sector of the civilian world than in the military world. We're going to have to take advantage" of that.

"We have a small fund in the department … that we're using to go out and interact with companies that are operating in those spaces," he said. "They have been very open to looking at the kinds of innovation we want to involve ourselves in. That goes a little bit to artificial intelligence, it goes a little bit to the deep learning, it goes to the exploitation of big data to answer very specific Defense Department-related questions."

The Pentagon has "entered into some of those arrangements," he said without identifying the companies involved.

Developing and procuring these technologies aren't the only challenges the Pentagon is facing, officials and analysts noted. Organizational and operational paradigms also need to evolve.

"It might be a new unit that does something a new way, that employs a technology in ways that we haven't seen in the past, or it might be a new doctrine … which completely changes the focus of the entire Army," Work said. "You need new technological capability to try to achieve overmatch, [but] you need to have new organizational and operational constructs to make it real and to gain operational advantage."

Convincing troops to rely on autonomous systems to perform well in combat is also critical.

"These innovations in autonomy … need to be nurtured and introduced in a manner which will gain the trust of our sailors and Marines and the public we are here to protect," Frank Kelley, deputy assistant secretary of the Navy for unmanned systems, told lawmakers in November. "Realizing the vision of a fully integrated unmanned and manned naval force will depend as much on significant military cultural evolution as on the technology innovations."

The technologies also raise ethical questions. Today, troops are in the loop when it comes to making decisions about killing adversaries. But as technology improves, the Pentagon could eventually face a "Terminator conundrum," Selva said.

"What happens when that thing can inflict mortal harm and is empowered by artificial intelligence?" he said. "How are we going to deal with that? How are we going to know what's in the vehicle's mind ... [and] how do we know with certainty what it's going to do?

"Those are the problem sets that I think we are going to have to deal with in the technology sector that [are] making building the platform actually a relatively simple problem." ND

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Navy Presses On With Long-Delayed Bomb Disposal Robot Program

By Stew Magnuson

The Navy expects to field the first of three planned explosive ordnance disposal robots in 2017, almost 10 years after the program was announced, service officials said in a recent interview.

The Navy is the executive agent for explosive ordnance disposal technologies and as such is responsible across the four services for developing the next-generation of robots that EOD teams use to help them dismantle unexploded ordnance, roadside bombs and other improvised explosive devices.

Its advanced explosive ordnance disposal robotic system (AEODRS) program is developing a family of three robots: increment 1, a small backpackable reconnaissance system weighing less than 35 pounds; increment 2, a two-man-portable robot weighing about 165 pounds with an arm, or arms that can help dismantle bombs; and increment 3, a robust 750-pound robot that can pick up heavy unexploded ordnance.

The largest potential customer for the program, the Army — at risk of losing its obligated funding if it didn't commit to procuring a product — has abandoned the program. It announced in December upcoming programs of record to acquire systems similar to the Navy's increments 1 and 2 robots and has no requirement for increment 3.

An Army Tank Automotive Research Development Engineering Center spokesman in a statement said it was proceeding with its own program for the time being. "While we would defer any specific questions about AEODRS to the Navy, we remain open to potential system collaboration based on mission requirements," he said.

The Air Force pulled out of the increment 1 program in 2014. It recently completed development of a similar-sized reconnaissance robot in less than one year. Meanwhile, the Naval Surface Warfare Center's Indian Head EOD technology division — the Navy customer for the AEODRS program — continues to buy off-the-shelf robots. It signed three indefinite-delivery, indefinite-quantity contracts with iRobot from August to October last year for small recon robots for the Navy and Marine Corps, spare parts for its legacy Mark 1 robots, and new-build MK1s, of which the increment 2 robot is intended to replace.

Michael J. Alperi, deputy program manager of SEA-06 expeditionary missions at Naval Sea Systems Command, said progress toward completing development work on the increment 1 robot is being made after the Navy awarded a contract to Northrop Grumman last year.

The new robot will have its critical design review in the coming months. The Navy will take delivery of the systems in the fourth quarter of this year after the company completes validation testing in the third quarter, he said. The Navy will verify the performance of the system prior to making a production decision.

"There is a lot of positive movement since we have made the award. There have been no major technical issues, so we are really pleased with our progress," Alperi said in an interview.

Production and development of increment 1 is expected in the second quarter of fiscal year 2017, according to a Navy PowerPoint presentation released in December. Marine Corps and Navy EOD teams are the only remaining customers for this robot.

Increment 2, which has been described as the workhorse of the EOD robots, is not scheduled to go into production until the third quarter of 2019.

Alperi said, "The contract is set up where we have the ability if they [the Air Force and Army] come back in and see that the program is successful, or find money, we could buy for them."

While the Army would not provide officials for comment, an Air Force EOD officer who has attended Army briefings on its plans said the service will refurbish and repurpose the chassis of the off-the-shelf robots it acquired in the thousands during the Iraq and Afghanistan wars. Some of these would be the same weight class of the increment 2 robot.

"The chassis are valuable," Maj. Shane C.R. Frith, commander of the Air Force EOD division, said in an interview. The Army will strip down the Talon robots, originally manufactured by Qinetiq North America, and rebuild them with modules for a variety of missions including chemical-biological detection, reconnaissance and EOD.

"It's going to be completely modular and tailorable to the mission set. It's cheaper and much more feasible for them to gut what they have rather than just scrapping them and waiting for something that may or may not come out," Frith said.

Frith, a vocal critic of the Navy AEODRS program, said the Air Force fielded its own increment 1 alternative robot within one year. "The guys down at the Air Force civil engineering center did a fantastic job with the acquisition process to make that happen. They did that very rapidly." The Air Force chose a modified off-the-shelf robot manufactured by the U.S. subsidiary of an Israeli company, Roboteam.

"That particular system won out across all of the averages of course — from cost to sustainability packages to user preferences. Obviously, it didn't win across the board in every area, but when you consider all of the weightings … that was the one that won out," he said.

The company had previously sold versions of its 20-pound Micro Tactical Ground Robot to U.S. Special Operations Command and the Department of Homeland Security. The contract is for up to 250 units.

Frith said the robots are adaptable. "If we want the newest, latest and greatest [technology], it's not a laborious process. They tell us what's available, we tell them what we want. … They fix the fabrication line and they field it, and there we go."

AEODRS Family of Systems

Increment 1: Dismounted Operations

- **A small backpackable reconnaissance system weighing less than 35 pounds**

Projected production: 2017

NAVY

The Air Force was forced to go its own way on the program or risk losing its funding, he said. "We put the funding that we did have to good use and now we have a full fleet," he said.

As for the Air Force's future intentions, Frith made it clear that he did not speak for the service. Nevertheless, he predicted that it may run into the same budgeting problem and be forced to develop its own increments 2 and 3 style robots. In addition, the service was happy with the speed and results of the off-the-shelf backpackable robot acquisition.

"I think we will go down the same path. We have had success with this first robot so chances are good that technology from industry will far surpass what the government is developing as a program of record, and that will force us into the same position," he said.

The Air Force is currently the only service with a requirement for the large, increment 3 robot, which is mostly intended for cleaning up unexploded ordnance on runways. Production isn't expected on increment 3 until the first quarter of 2022, the Navy PowerPoint indicated. The Air Force abandoning the 750-pound class robot would leave it without an end-user.

Frith, along with an Army EOD officer in National Defense Magazine last year, harshly criticized the job the Navy has done on the program. They accused the service of being autocratic and wondered why it was the executive agent for EOD technology.

In a recent interview, Tom Dee, deputy assistant secretary of the Navy for expeditionary programs and logistics management, pushed back at the criticism and said the Navy is the best service to develop this technology because it has the widest counter-bomb mission set, which includes everything from dismantling roadside bombs to destroying undersea mines.

"All of the services have had a voice in the AEODRS program," he added. There is a Joint Service EOD Program Board, organized consistent with the guidelines of a Defense Department directive. Each service is responsible for appointing a flag or general officer to ensure that their equities are met. The board operates on a consensus basis and those officers are responsible for ensuring that the program is adequately addressing their requirements for technology development, Dee said.

"In the event the military services are unable to reach consensus on technology development issues, the issue would be elevated to our [office of the secretary of defense] proponent for resolution. To my knowledge, that has never happened."

Further, "frustration with the pace of the defense acquisition system is not unique to the AEODRS program," he said.

The reasons for the delays are twofold, he said at an industry conference last year. Developing the open architecture system proved to be difficult. The initial contracting vehicle also caused a delay.

Alperi said the Navy originally wanted a fixed-price contract, but after negative feedback from contractors it was forced to change its approach to a cost-plus incentive fee in order to build the first manufacturer's models. That change delayed the program.

After performance verification of increment 1 later this year, there will be a "price redetermination" of the fixed-price contract, he said. This means once Northrop Grumman delivers, if it meets the requirements, the Navy can award the production piece of the contract to deliver the units to the services, he said. "Given that they have learned what they learned, the contracting officer asks the manufacturer what the final and best cost would be. You can never raise the price of what they proposed, only lower [it], so it is advantageous to the government," Alperi said.

Byron Brezina, a former leader of the program at Naval Sea Systems Command's EOD technology division, at an industry conference in February 2010 said the Navy would go without prime contractors for the AEODRS program and the technology division would be its own lead system integrator through the development process. He predicted full-scale production of increment 1 by 2014.

Alperi said the in-house approach has been changed in favor of a more traditional lead system integrator. "They [Northrop Grumman] are the prime system integrator. They put their best value proposition before us and had their own consortium."

Makers of the subcomponents don't give up any of their intellectual property during the process, he added.

Dee said: "Everyone involved with the acquisition system is striving to make it more agile and to better promote innovation." The program board "is continually striving to improve its processes in order to be more responsive to quickly evolving user needs while appropriately balancing risk."

It is the program's intention to field robots that are better than any off-the-shelf solutions, he noted.

"Within the AEODRS program, our joint service requirement was not to simply buy a new robot. It was to push industry to develop a truly modular robot with an open systems architecture that would allow … users to more quickly incorporate new technologies and new capabilities," he said.

"We admittedly, but quite consciously, traded near-term speed of acquisition for longer term agility and performance," Dee added.

Alperi added: "We have learned a lot from that first increment that we will apply to increment 2 and 3, so we think that the rough spots and the lessons learned from that will make it much easier to go through the process of increment 2." ND

Email your comments to smagnuson@ndia.org

Increment 2: Tactical Operations

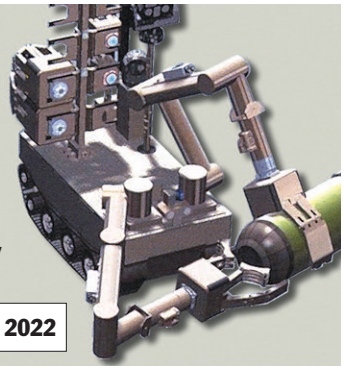
- **A two-man-portable robot weighing about 165 pounds with a bomb dismantling arm**

Projected production: 2019

Increment 3: Base / Infrastructure

- **A strong 750-pound robot that can pick up heavy unexploded ordnance**

Projected production: 2022



Quest for Greater Lethality Drives Navy Modernization Plans

By Jon Harper

The Navy is teeing up a number of high-tech projects aimed at boosting the firepower of its platforms, but challenges lie ahead as the service prepares to fight advanced adversaries.

The Navy's modernization and budget plans are in line with the strategic concept of "distributed lethality," which Pentagon leaders are now pushing as other powerful countries such as China are developing more advanced strike capabilities that put U.S. naval assets at greater risk.

"We are increasing the size of the Navy, but what's really important … is to increase the lethality of each ship," Secretary of Defense Ash Carter said during a recent budget discussion hosted by the Economic Club of Washington, D.C.

Aircraft carriers have been the centerpiece of Navy power projection for decades. The lead ship in the new Ford-class, CVN 78, is slated for delivery this spring. The carrier, built by Newport News Shipbuilding, was expected to be capable of generating a 33 percent higher air combat sortie rate, while requiring much less manpower than the Nimitz-class.

But the vessel has been dogged by cost overruns, schedule slippage and technology concerns.

"Poor or unknown reliability of newly designed catapults, arresting gear, weapons elevators and radar, which are all critical for flight operations, could affect CVN 78's ability to generate sorties, make the ship more vulnerable to attack or create limitations during routine operations," J. Michael Gilmore, the Pentagon's director of operational test and evaluation, said in his office's fiscal year 2015 annual assessment report to Congress, released in February.

Navy officials said the service has made progress addressing the technical issues. "Most of the risk is starting to fade away on that ship," Vice Adm. William Hilarides, commander of Naval Sea Systems Command, said at a Surface Navy Association symposium in January.

But lawmakers have directed the service to "shock test" the vessel. Fulfilling those requirements could delay the first operational deployment until 2021, said Bryan Clark, a naval analyst at the Center for Strategic and Budgetary Assessments.

In a boost for carrier aviation, the Defense Department has decided to procure an additional 13 F-35C joint strike fighters over the next five years.

The move will benefit Lockheed Martin, which produces the high-tech fifth-generation aircraft. The F-35C was expected to achieve initial operational capability in 2018, but the joint strike fighter program has been plagued by delays and technical problems, and the critical Block 3F software may not be ready in time.

"It looks like it is going to be 2019, which is not surprising, and it may be even later than that" before the software will be available, Clark said.

To help cover tactical aviation shortfalls, the Defense Department intends to buy 16 additional F-18 Super Hornets over the next five years, a boon for manufacturer Boeing, as the service seeks to extend the service life of legacy platforms.

"The complementary capability of those Super Hornets along with the F-35C gives us our striking power, our reach off the aircraft carrier," Rear Adm. Michael Manazir, director of air warfare in the office of the chief of naval operations, told lawmakers during a recent House Armed Services tactical air and land forces subcommittee hearing. "The extra Super Hornets over the next several years covers the slide in initial operational capability of F-35C to the right … so it is vital to maintain that [production] line."

Some observers are concerned that these aircraft are too limited in range for carriers to project power into so-called anti-access/area denial environments, where the threat of enemy missiles could make it difficult for carriers to operate.

The Navy has decided to pursue a new tanker — the carrier-based aerial refueling system, or CBARS — to extend the range of fighters, which in turn would enable carriers to stay farther away from hostile forces when they launch their aircraft. The system will also provide some intelligence, surveillance and reconnaissance, according to the Navy's fiscal year 2017 budget request. The Navy has decided to restructure the unmanned carrier-launched airborne surveillance and strike program, or UCLASS, and focus on CBARS in the near term, the budget document said.

Clark said industry could probably develop an unmanned tanker within two years or so, given the current state of technology, but the system might be vulnerable to hostile fire.

"It won't necessarily be stealthy enough to fly into a threat environment," he said. "It will be sort of a big gas station in the sky kind of aircraft as opposed to being a stealthy [long-range] strike aircraft, so it doesn't necessarily fix the problem that the air wing has."

To enhance ship lethality, the Navy is making a big push to develop more sophisticated offensive missiles. The Defense Department plans to spend $2 billion over the next five years to purchase 100 additional Tomahawks, fund research, development, test and evaluation, and support other Tomahawk-related activities.

"We want to diversify the kinds of targets that they can hit, from land attack, which is probably how you first met the Tomahawk many years ago — to an anti-ship version … in the spirit of making everything we have lethal," Carter said during a recent tour of Navy facilities in California.

Raytheon recently completed a successful captive flight test of a seeker designed for the Tomahawk Block 4 cruise missile, which has a range of approximately 1,000 miles. The multi-mode seeker will enable Tomahawks to engage moving targets on land and at sea, according to the company.

"The information that we collected … makes us very confident that the system performs at the level we want and provides the ability to detect and identify all targets that we need to care about for our naval forces," said Chris Sprinkle, Tomahawk senior program manager at Raytheon.

The Pentagon plans to invest nearly $1 billion in the long-range anti-ship missile, or LRASM, over the next five years. The weapon, originally designed to be air-launched, is now being developed

by Lockheed Martin to have sea-launch capability.

The company is striving "to reduce risk and to mature all aspects of surface ship integration … [and] investing in the design of a topside or deck-mounted launcher configuration that will allow for easy integration on multiple surface ships," Scott Callaway, surface-launched LRASM program director with Lockheed Martin Missiles and Fire Control, said in an emailed statement.

During this same five-year period, the Defense Department also plans to spend more than $400 million on the advanced anti-radiation guided missile-extended range, a homing missile designed to strike enemy air defenses.

Additionally, the Pentagon is pursuing the standard missile-6. Originally designed as a missile interceptor, the SM-6 is also capable of hitting targets at sea at long ranges, Carter said. The Defense Department plans to invest $2.9 billion in the technology over the next five years.

"The more we utilize and test SM-6, the more we demonstrate its capability, the more we see the potential for it to do other missions" besides missile defense, said Thadeous Smith, SM-6 business development manager at Raytheon Missile Systems.

Going forward there will be "big, big, big money for munitions," Carter said.

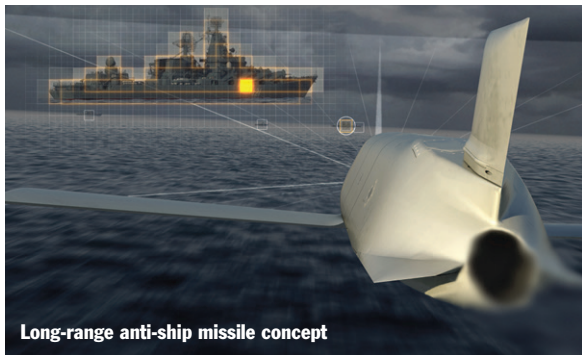
In addition to advancing missile technology, the Navy also intends to increase the number of missiles that its ships can carry. Over the course of the next five years, the Navy plans to procure nine Virginia-class attack submarines. Several will be equipped with the Virginia Payload Module, which will enable the vessels to carry 40 Tomahawks, up from the 12 that they can haul now.

Carter recently ordered the Navy to scale back its littoral combat ship/frigate program, from 52 ships to 40, to help pay for these advanced systems. The Navy is now looking for ways to enhance the lethality of the LCS such as equipping it with an over-the-horizon missile, said Rear Adm. Peter Fanta, director of the surface warfare division within the office of the chief of naval operations.

Meanwhile, high-tech destroyers are moving through the pipeline. The lead ship in the new Zumwalt-class, DDG 1000, has been undergoing sea trials and is expected be delivered in April. DDG 1001 is slated to be launched in June, and DDG 1002 is under construction, said Rear Adm. select James Downey, DDG 1000 program manager.

The Zumwalt-class, with possesses a unique hull design, is stealthy and about 60 percent larger than legacy Arleigh Burke-class destroyers. It is equipped with advanced vertical launch cells for missiles, and its high power-generation capacity could enable it to carry laser weapons or an electromagnetic rail gun, officials and analysts have said. But due to cost concerns, the Navy decided to only build three.

"This … is the coolest ship ever built," Adm. Harry Harris, commander of U.S. Pacific Command, said during recent remarks at the Center for Strategic and International Studies. "If Batman had a ship it would be that. … We can only afford three of them, [but] all three are going to the Pacific somewhere, which is pretty exciting."


Long-range anti-ship missile concept

The Defense Department plans to purchase an additional 10 Arleigh Burke-class destroyers over the next five years and is pursuing the more advanced Flight III variant. The first Flight III was appropriated in fiscal year 2016.

The destroyers can carry large numbers of advanced munitions such as the Tomahawk and standard missile, and the Pentagon is interested in arming the ships' guns with new hypervelocity projectiles, officials have said.

But when it comes to firepower, no platform in the Navy's arsenal packs more punch than nuclear ballistic missile submarines, termed "boomers." Looming over the service's long-term acquisition plans is the Ohio-class replacement, also known as ORP or SSBN(X).

Chief of Naval Operations Adm. John Richardson has identified the submarine as the Navy's number one acquisition priority. The service hopes to procure 12, with the first purchased in 2021. The Navy has estimated that the program will cost approximately $75 billion, but the Congressional Budget Office has put the price tag at about $100 billion.

The Defense Department requested $1.9 billion for research and development and advanced procurement in fiscal year 2017, and expects to spend $13.2 billion on the Ohio replacement over the next five years for R&D and initial construction.

The program "has to continue on track, on schedule within the cost constraints so that we deliver the first Ohio replacement in 2028 and it's on patrol in 2031," said Rear Adm. Michael Jabeley, program executive officer for submarines. "Now that's a challenge in and of itself because we're incorporating several new technologies into this program" including an electric drive for the propulsion plant and a newly designed missile compartment.

Eric Labs, a senior analyst for naval forces and weapons at CBO, is skeptical that the project will avoid cost overruns. "It would be virtually unprecedented that such a new large, technologically complex shipbuilding program comes in on cost. And that is going to roil shipbuilding as well as the ORP program itself if that materializes," he said.

Labs described the Ohio replacement as "the 800-pound gorilla in the Navy's budget for most of the next 20 years."

"Whether you like the Navy's cost estimates of this shipbuilding program or you prefer the CBO's cost estimates of this shipbuilding, the ORP is going to dominate every shipbuilding budget debate for a decade and beyond," he said. "With the Ohio replacement [program in full gear] and without commensurate increases in resources, in my view the Navy is on a path to 237 ships," far short of the goal of 300-plus.

But Hilarides is more optimistic that the Navy will receive the money it needs in the 2020s when modernization programs are at their peak. "The idea that there's no ability to grow any part of the budget, that [the Ohio replacement] has to squeeze out everything else I think is in question," he said. "I'm confident … that the nation knows that we need a full range of capabilities." ND

Email your comments to jharper@ndia.org

LOCKHEED MARTIN

LCS Cuts Could Strain Shipbuilding Industry

By Allyson Versprille

Projected reductions to the Navy's littoral combat ship program and the ensuing uncertainty surrounding the platform could have a significant impact on the industrial base, according to experts and industry executives.

New concerns over the program's long-term future stem from a December memorandum in which Secretary of Defense Ash Carter directed the Navy to reduce its combined procurement of littoral combat ships — and the more heavily-armed frigates to follow — from 52 to 40. The memo also called for a downselect to one variant of the vessel in fiscal year 2019.

Carter's directive lays out a construction plan to build one ship per year — at alternating shipyards — from 2017 to 2020, and two ships in 2021, removing a total of eight vessels from the Navy's future years defense program for fiscal year 2017 to fiscal year 2021.

The 2017 budget request released Feb. 9 asked for funding for two ships in 2017 — one more than what Carter had directed in his memo — in order to give the two manufacturers of LCS, Lockheed Martin and Austal USA, a more even playing field when competing in the 2019 downselect. The new budget request will add an extra littoral combat ship, while cutting a frigate that would have been purchased after 2021, committing the Navy to 33 LCS and frigates within the FYDP and seven frigates forecast outside of the FYDP, for a total of 40 ships.

Bryan Clark, a naval expert at the Center for Strategic and Budgetary Assessments, said cuts to the program would have a significant impact on both shipyards. The Austal shipyard located in Mobile, Alabama, and the Fincantieri Marinette Marine shipyard in Marinette, Wisconsin — where the Lockheed variant is being constructed — were sized for the three ships per year the Navy originally planned to build through 2025, Clark said in an email. Fiscal year 2019 was an exception with only two ships allotted for construction.

"A reduction from that level will result in layoffs at both shipyards to control costs," he said. "If the Navy does not develop and fund a follow-on ship, the shipyards will have to begin laying off workers as they work through any backlog on their current ships, which is not large at this point."

Employees who work in the initial construction phases such as welders, shipwrights and pipe fitters will be the first laid off, and those who outfit the ships such as electricians and combat systems installers will be let go last, he noted.

Layoffs of the former could occur at one of the shipyards as early as fiscal year 2018 when the Navy is projected to buy a single ship, allocated to only one of the LCS manufacturers, Clark said. "The other shipyard is going to be stuck and not going to be able to keep those people [working in those initial stages] gainfully employed."

The directive in Carter's memo to downselect from two vendors to one in fiscal year 2019 is "perhaps the most disruptive aspect of the decision," Clark said.

Technically, both shipyards could bid on the single variant for the frigate design, and the Navy could award the ship to both shipyards at about one per year, he said. But that scenario is unlikely. "The two LCS variants are so dramatically different — one is a steel monohull and the other an aluminum trimaran — that either builder would have to invest tens of millions of dollars to retool to construct the other builder's ship," he said. "Both yards have already invested $30 million to $70 million in their infrastructure to become more efficient, much of it not recouped. It is unlikely they will want to make another large investment just for a chance to build three to four ships without a potential for a follow-on ship."

Only one builder will be able to realistically bid a reasonable price on the 11 LCS-derived frigates, which will give one of the yards a reprieve until the frigate program ends, Clark said. The other will have to come up with alternative projects.

Reduced number of littoral combat ships and frigates as directed by the secretary of defense

"I believe both would vie for some other government projects such as Coast Guard patrol vessels, Army and Navy lighterage and ship-to-shore connectors, and special warfare boats," Clark said. They could also pursue commercial construction projects, he noted. "In particular, the continued oil production in the upper plains and Ohio Valley has created a big business for barges to carry petroleum down to refineries in the Gulf of Mexico. The energy industry also continues to want offshore support vessels."

The shipyards might not be the only ones to suffer from a downselect in 2019. In a January report, Ronald O'Rourke, a specialist in naval affairs at the Congressional Research Service, said an oversight issue Congress needs to examine is: "What impact would necking down to a single shipyard have on the Navy's ability to use competition to help minimize procurement costs, achieve schedule adherence and ensure production quality in the construction of modified" littoral combat ships?

At a Pentagon briefing in February following the release of the budget request, Deputy Assistant Secretary of the Navy for Budget Rear Adm. William Lescher, said it would not be fair to say that a

AUSTAL USA

The Austal shipyard located in Mobile, Alabama

downselect would automatically equate to higher costs because there are "so many factors" at play. He added that the competition for the 2019 decision and a block buy of the initial frigates could save the Defense Department money upfront.

"I think the competition — it's fair to say — for the downselect and if we do a block buy for the first frigate ships, is going to drive some significant savings to the department as well," he said. "In terms of after that initial block buy of frigates, how that plays out in terms of pricing, I won't speculate."

Craig Perciavalle, president of Austal USA, said reductions to the program would not have an impact on the shipyard in the near term because current LCS buys will take deliveries into the early 2020s. However, the company would have to address long-term consequences.

The shipyard currently has a workforce of more than 4,000 employees building both littoral combat ships and expeditionary fast transport (EPF) vessels that are under contract with the Navy as part of a $1.6 billion, 10-ship block buy. Additionally, there are upwards of 500 suppliers in roughly 37 states supporting the company's Independence-class LCS. It has "a very sizable economic impact, nationally and certainly locally," Perciavalle said.

Current full-rate production at the shipyard involves building two of each type of ship per year, he noted. "Obviously if there are reductions in volume for the [LCS] program, that demand would reduce for us and we would have to figure out how to work through that going forward, but we don't see any short-term impacts and we would certainly look at offsetting any of that in the long term going forward," he told National Defense. "No business has infinite work, so we've got to always look into the future and see what other opportunities we can support."

Lockheed, similarly, was not worried about short-term impacts on the shipyard, but agreed that there could be consequences down the line. "Less ships is usually not as good as more ships," said Joe North, vice president of littoral ships and systems at Lockheed, to reporters in January. "We will be impacted from the long-term look."

According to the company's website, its Freedom-class variant is supported by about 9,000 jobs across 40 states, including approximately 100 suppliers in Wisconsin and Michigan. Marinette Marine's shipyard employs more than 2,000 workers daily, according to the company's President and CEO Jan Allman.

Both LCS manufacturers are exploring other options that could offset a reduction to the program.

Austal is looking at growing its sustainment business as one opportunity, Perciavalle said. "With the ships that we deliver, we want to make sure that they're supported well, and we're looking at growing that aspect of our business."

The company is exploring potential foreign military sales for its LCS platform in addition to pursuing other government projects much like the ones Clark mentioned, Perciavalle said.

Lockheed is also pursuing foreign military sales contracts. In October the State Department announced its approval of a proposed sale for four heavily armored versions of Lockheed's Freedom-class littoral combat ship to Saudi Arabia. It valued the deal — including associated equipment, parts and logistical support — at $11.25 billion.

A positive outcome to a reduction in the Navy's LCS program would be giving Lockheed more flexibility to build ships for Saudi Arabia, North said. "It could be a positive thing in a way because we could probably accelerate certain ships."

The company is hopeful that there are additional foreign military sales on the horizon. "There is a lot of interest across the globe," he said. "The deployment of those ships in Southeast Asia has driven even more interest."

Meanwhile, the LCS program has been a contentious topic, often pitting Pentagon leaders against senior Navy officials.

In his memo, Carter bluntly stated that the Navy has for several years "overemphasized resources used to incrementally increase total ship numbers at the expense of critically needed investments in areas where our adversaries are not standing still, such as strike, ship survivability, electronic warfare and other capabilities." The Navy has focused too much on presence and not enough on posture or lethality, he said. At an average cost per ship of about $360 million, cutting 12 ships will free up over $4

billion, which Carter suggests spending on high-end capabilities such as additional F-35 joint strike fighters, Flight III destroyers and upgrades to the Navy's submarine force.

Robert Work, deputy secretary of defense, said at a Pentagon budget briefing in February that the decision to cut the LCS program coincides nicely with the Defense Department's plan to focus on shape rather than size.

"If you take a look at last year's plan, the Navy was going to build up to 321 ships and then come down," he said "And we asked ourselves, what can't we buy because we're going from 308 to 321? We said, well we can't buy a lot of capability."

Reducing LCS numbers is not an indictment against the program, he said. "If we didn't like the ship we would stop buying it." Cutting the 12 ships allows the Pentagon to "put more money into torpedoes, more money into P-8s, more money into advanced munitions, more money into tactical aviation."

The Navy is much stronger because of the decision, he added. With the current plan the service will reach 300 ships in fiscal year 2019, get to 308 ships in 2021 — which is the requirement — and stay above 300 ships through 2030.

Addressing the Pentagon's desire to trade ship numbers for lethality, Secretary of the Navy Ray Mabus said the number of ships directly correlates to the service's warfighting capability. "I think that those two concepts may be broken apart for other services, but for the Navy and the Marines there is a whole lot of overlap. It's almost exactly the same thing," he told reporters following a speech at a Surface Navy Association symposium in January.

Mabus defended the ship, which has faced criticism for lacking lethality and survivability. He said the newer, more heavily-armed frigates to be procured after 2019 will have more firepower, could deploy with a carrier strike group and have robust anti-mine and anti-submarine capabilities. "They are longer, faster, heavier, more maneuverable than many destroyers in the world today."

At the same conference, Rear Adm. Peter Fanta, director of the Navy's surface warfare division, lauded the littoral combat ship's utility against enemy submarines.

"The sonar going on LCS will increase our capability multi-fold against all submarines," he said. "If our submariners are afraid of a continuous, active sonar at double-digit miles, what do you think the adversaries' submariners are afraid of?"

It is not perfect, he said, but "bottom line is we'll get it there. It's like every other ship — we're building it, we're deploying it and we're figuring out what it can do."

Fanta requested industry's help to "sell the story" on LCS.

The Navy's plans to place an over-the-horizon missile on LCS by the end of 2016 will improve the ship's lethality and capabilities, he noted.

Marinette Marine shipyard in Marinette, Wisconsin

Several missiles are currently being considered.

Boeing's Harpoon would be the "worst case scenario" as it is the heaviest system under consideration, North said.

Lockheed Martin is designing a topside — or deck-mounted — launcher for its long-range anti-ship missile, or LRASM, around the Navy's frigate requirements, but the weapon could also fit on LCS, according to the company.

In addition to considering existing missiles in its inventory, the service is contemplating a second phase to the naval strike missile foreign comparative test that was conducted in 2014, said a spokesperson at the Navy's program executive office for integrated warfare systems. The second phase would occur in 2016. The naval strike missile, developed by Norwegian company Kongsberg Defence & Aerospace, was first demonstrated on LCS-4, the USS Coronado, in September 2014.

In contrast to the optimism and assurance projected by Navy leaders, the fiscal year 2015 Director of Operational Test & Evaluation annual report, which was released in February, cast doubt on the littoral combat ship program's achievements over the last year.

In August and September, the Navy conducted operational testing aboard the USS Coronado of the Increment 2 Surface Warfare mission package, which is supposed to provide fleet protection from small boats and other asymmetrical threats, the report noted. The Independence variant participated in three engagements where it faced off against small swarms of fast inshore attack craft, similar to vessels operated by Iran. Although all of the boats were ultimately defeated, an attacker managed to get dangerously close to the littoral combat ship and penetrate its "keep-out" range in two of the three engagements, the report said.

The document also made note of reliability issues on both variants of LCS including equipment failures, cybersecurity deficiencies and unreliable mine countermeasure systems.

Strong differences of opinion regarding the Navy's LCS program could pose problems for future stability, according to one expert.

The LCS program was built on a "less than robust analytical foundation," O'Rourke said at a conference in January.

"This was true both of the original program and of the restructured version that was put together in 2014," he noted, pointing to the first time the program was transformed by then-Secretary of Defense Chuck Hagel, who directed that the ships procured in fiscal year 2019 and beyond would be the more heavily-armed frigate variant that is in the design stages today.

"The LCS program has now been substantially changed twice, by two secretaries of defense in two years," O'Rourke said. Because it lacks a strong analytical foundation, it is based in the realm of opinion more than other Pentagon programs, he added.

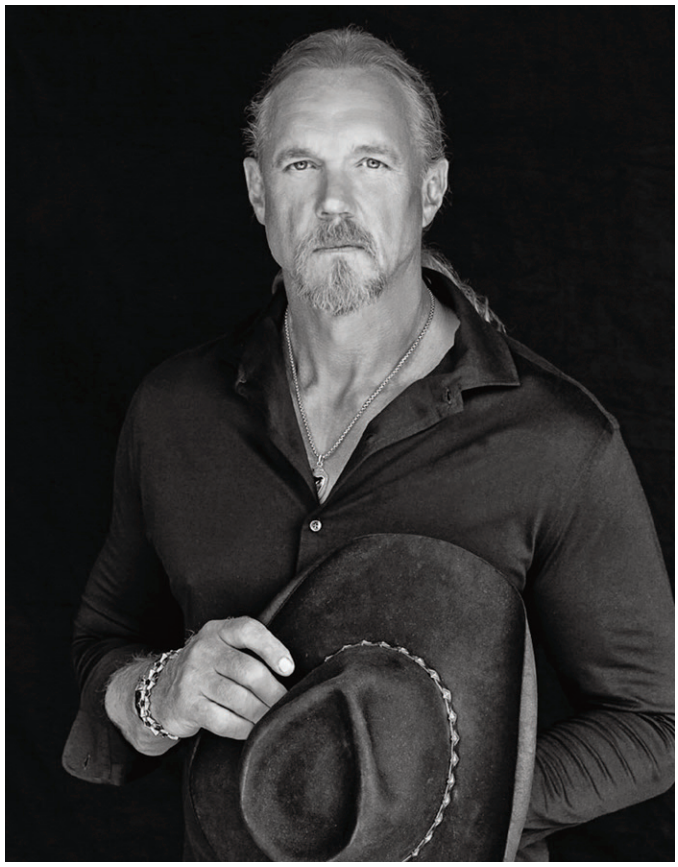
"This [has] made it easier for people in positions of authority who develop a strong opinion about the program to decide suddenly to change" it, he said.

Such circumstances leave the platform vulnerable to yet another restructuring plan when a new president is elected at the end of 2016, he said. "When we have a new administration, they may look at the LCS program and decide to change it again." ND

Email your comments to aversprille@ndia.org

NAVY

Trace Adkins to Receive Dwight D. Eisenhower Award



Country star Trace Adkins will be presented with the Dwight D. Eisenhower Award at the National Defense Industrial Association annual award dinner May 12.

The Dwight D. Eisenhower Award is bestowed annually on an individual who reflects Eisenhower's beliefs and support for a strong national security and industrial base.

Adkins, a Grammy-nominated multi-platinum country music singer, is being recognized for his staunch advocacy on behalf of America's servicemen and women. As a recipient of the award, Adkins joins public figures such as former Secretary of Defense Leon Panetta, actor Gary Sinise, current Secretary of Defense Ash Carter and former Sen. Kit Bond, R-Mo., who have received the award in previous years.

NDIA's annual award dinner is a black-tie event that will take place at the Ritz-Carlton Tysons Corner. Every year, during the event, NDIA honors an exceptional leader and advocate for America's national security.

Individual tickets and tables for this event are now on sale. For more information, visit: http://bit.ly/NDIADinner.

NDIA Releases its Top Issues for 2016 Report

The National Defense Industrial Association recently released its annual Top Issues brief for 2016, which outlines recommendations for Congress and Defense Department leadership in the coming year.

Pointing to the need to appropriately support current combat operations and to maintain a technological advantage over sophisticated potential adversaries, NDIA is asking for long-term budget stability to provide our military with "adequate and stable funding that ensures the ability to respond to contingencies now and prepare for those that may lie in our future " as its first priority.

"This will require political negotiation and compromise — a retreat from the partisan bickering that has taken us to the brink of default on the nation's debt and shutting down the government," NDIA President and CEO Craig R. McKinley wrote in the report's introduction.

Additionally, the Top Issues brief outlines NDIA's intentions to concentrate on improving the acquisition process; promoting a responsive and modern industrial supply chain; providing open, ethical industry-government collaboration; and paving the way for the defense industry to compete internationally.

To read the complete Top Issues brief, visit http://bit.ly/NDIATopIssues.

Women In Defense Announces HORIZONS Scholarship Winners

National Defense Industrial Association affiliate Women In Defense announced the recipients of its HORIZONS scholarship program for the 2015-2016 academic year.

They are: Elizabeth Irwin, Georgetown University; Katherine Leggiero, George Mason University; and Melissa Skorka, University of Oxford.

The HORIZONS scholarship program was established in 1988 to encourage women to pursue careers related to the national security and defense interests of the United States and to provide professional development opportunities to women already working in national security and defense fields. The scholarship targets rising college juniors, seniors and graduate students in a course of study aimed at a national security-related career. Women In Defense is currently accepting applications for the 2016-2017 academic year. Complete applications are due July 15, 2016. For more information on the HORIZONS scholarship program — including criteria and application guidelines — please visit http://bit.ly/WIDHORIZONS.

NDIA Calendar

March

1-2
Michigan Chapter Cybersecurity Defense Sector Summit
McLean, VA
www.ndia.org/meetings/6390

1
Live Fire Test & Evaluation
McLean, VA
www.ndia.org/meetings/6390

2-3
31st Annual National Test & Eval Conference
McLean, VA
www.ndia.org/meetings/6190

2-3
Ground Robotics Capabilities Conference and Exhibition
Springfield, VA
www.ndia.org/meetings/6380

8
2016 Women In Defense Annual HORIZONS Scholarship Dinner
Arlington, VA
www.ndia.org/meetings/6WI1

9
2016 Women In Defense Annual National Conference
Arlington, VA
www.ndia.org/meetings/6WID

9
2016 M&S Leadership Summit
Chesapeake, VA
www.trainingsystems.org

9-10
NMSC Annual Meeting
Chesapeake, VA
www.trainingsystems.org

15-16
2016 Precision Strike Annual Review
Springfield, VA
www.precisionstrike.org

17-18
Greater Los Angeles Chapter 66th Annual West Coast Dinner & Acquisition Forum
Marina del Ray, CA
www.ndia-lachapter.org

22
Michigan Chapter Networking Social
Dearborn, MI
www.ndia-mich.org

29-31
Munitions Executive Summit
Parsippany, NJ
www.ndia.org/meetings/6650
See our ad on p. 42

30-31
Manufacturing Division Meeting
Washington, DC
www.ndia.org/meetings/619B

31
Army Cyber Innovation Industry Day
Mountain View, CA
www.afei.org/events/6A31
See our ad on p. 42

April

5-6 **NEW!**
Insider Threat Workshop
Springfield, VA
www.ndia.org/meetings/6800

8
Michigan Chapter 58th Annual ROTC Awards Banquet
Troy, MI
www.ndia-mich.org

11-13
Joint Undersea Warfare Technology Spring Conference
San Diego, CA
www.ndia.org/meetings/6260
See our ad on p. 42

12-14
Science & Engineering Technology Conference
Tampa, FL
www.ndia.org/meetings/6720
See our ad on p. 42

18-20
32nd Annual National Logistics Forum
Washington, DC
www.ndia.org/meetings/6730
See our ad on p. 43

19-20
Medical Research, Development and Acquisition in Support of the Warfighter
Ellicott City, MD
www.ndia.org/meetings/6310
See our ad on p. 43

25-28
2016 Armament Systems Forum
Fredericksburg, VA
www.ndia.org/meetings/6610
See our ad on p. 43

For more information and online registration, visit our website: www.ndia.org. Or contact our Operations Department at (703) 247-9464.

27-28
Michigan Chapter Defense Exposition (MDEX)
Warren, MI
www.ndia-mich.org

26-28
MODSIM World 2016
Virginia Beach, VA
www.trainingsystems.org

May

3-5
59th Annual Fuze Conference
Charleston, SC
www.ndia.org/meetings/6560

10-11
Agile in Government
Washington, DC
www.afei.org

9-11
Annual Tactical Wheeled Vehicles Conference
Reston, VA
www.ndia.org/meetings/6530
See our ad on p. 43

9-13
29th International Symposium on Ballistics
Edinburgh, Scotland
www.ndia.org/meetings/6210

12
NDIA Annual Award Dinner & Eisenhower Award Presentation (Black Tie)
McLean, VA
www.ndia.org/meetings/6130

16
Washington, D.C. Chapter Benefit Golf Outing for USO-Metro
Suitland, MD
www.ndia.org/washdc

23-26
SOFIC
Tampa, FL
www.ndia.org/meetings/6890

24-26
Iowa-Illinois Chapter Midwest Small Business Government Contracting Symposium
Moline, IL
www.ndia-ia-il.org

June

1-2
DI2E Plugfest
Fairfax, VA
www.di2eplugfest.org

8-9
Tennessee Valley Chapter Missile Defense Agency Small Business Programs Conference
Huntsville, AL
www.ndiatvc.org

9
WID Service to The Flag Award Program & Reception
Arlington, VA
www.womenindefense.net

July

14
Integrated Air & Missile Defense Symposium
Laurel, MD
www.ndia.org/meetings/6100

22
Michigan Chapter Black Tie Dinner Meeting
Grosse Pointe, MI
www.ndia-mich.org

TRAINING & PROFESSIONAL DEVELOPMENT COURSES

Defense Systems Acquisition Management Course (DSAM)
Defense Acquisition University instructors present an intense week of acquisition program management knowledge and processes.

- **March 21-25**
  Denver, CO
  www.ndia.org/meetings/602B
- **June 20-24**
  Phoenix, AZ
  www.ndia.org/meetings/602C

Mastering Business Development Workshop
An educational and professional development program focusing on the thinking, process and discipline needed for professional BD.

- **April 5-6**
  Washington, DC
  www.ndia.org/meetings/607C
- **June 22-23**
  Boston, MA
  www.ndia.org/meetings/607D

How Washington Works
A fast-paced overview of the decision support systems, organizations and procedures underlying the defense acquisition process. Ideal for those who are new to or routinely do business with the DoD.

- **May 11-12**
  Reston, VA
  www.ndia.org/meetings/643C
- **July 27-28**
  Reston, VA
  www.ndia.org/meetings/643D

For more information and online registration, visit our website: www.ndia.org. Or contact our Operations Department at (703) 247-9464.

2016 Munitions Executive Summit and Advance Planning Briefing to Industry

"Meeting National Security Challenges: Sustaining Munitions Readiness in a Competitive and Complex World"

Parsippany, NJ • March 29-31, 2016
www.ndia.org/meetings/6650

Army Cyber Innovation Industry Day

"Micro-Cloud Management for Defensive Cyber Operations"

Hear about Army requirements and funding for infrastructure prototype solutions.

Co-Sponsored by:
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U.S. Army CYBERCOM
Army TRADOC

Hosted by DIUx

Mountain View, CA • March 31, 2016
www.afei.org/events/6A31

Joint Undersea Warfare Technology Spring Conference

"Assuring Undersea Dominance in an Era Of Major Power Competition"

Secret/U.S. Only

This annual conference focuses on the Navy's key undersea warfare missions of countering submarine and mine threats to sea lines of communication and protecting and facilitating power projection from the sea.

San Diego, CA • April 11-13, 2016
www.ndia.org/meetings/6260

Science & Engineering Technology Conference

The Conference will feature:

- Special Investment focused CoI roadmap presentations to include: Advanced Electronics, Air Platforms, Space and Counter WMDs
- Services and DARPA S&ET program updates, FY17 budget updates and more!
- CoI poster presentations, 1-on-1 sessions with CoI and Service reps, and technology displays

Tampa, FL • April 12-14, 2016
www.ndia.org/meetings/6720

32nd Annual National Logistics Forum

"Readiness Today, Innovation for the Future: Delivering the Realm of the Possible"

Come learn about:

- Sustaining the global engagement from the COCOM 4's
- Globally integrated logistics: opportunities to learn from and succeed in the global market space
- Title 10 logistics providers: trained and ready! - Service 4's
- Industry leadership fireside chat
- Improving global expeditionary capability - joint providers
- Optimizing America's defense sustainment capabilities

Washington, DC • April 18-20, 2016
www.ndia.org/meetings/6730

Medical Research, Development and Acquisition in Support Of The Warfighter

"Military Medicine in a Complex Environment"

The 2nd Annual NDIA USAMRMC Conference expands this year to include the medical research, development, test and evaluation (RDTE) missions across the Department of Defense (DoD), and will include perspectives from Army, Navy, Air Force and the Defense Health Agency!

Ellicott City, MD • April 19-20, 2016
www.ndia.org/meetings/6310

2016 Armament Systems Forum

This single event with concurrent parallel events focused on:

- Small Arms
- Guns, Ammunition, Missiles & Rockets
- Unconventional emerging Technology Armament

Don't miss your opportunity to learn about current trends in the exhibit hall and participate in the technology demonstration!

Fredericksburg, VA • April 25-28, 2016
www.ndia.org/meetings/6610

Annual Tactical Wheeled Vehicles Conference

This annual seminar historically has brought the military service, industry, prime contractors, subcontractors and their suppliers together to discuss present and future wheeled vehicle requirements for all services.

Reston, VA • May 9-11, 2016
www.ndia.org/meetings/6530

Next Month

Tactical Wheeled Vehicles

■ The Army and Marine Corps are moving forward with their ground vehicle modernization plans. Those include the procurement of the joint light tactical vehicle, as well as new mobility vehicles and the amphibious combat vehicle. Where do things stand with these key programs now that the fiscal year 2017 Pentagon budget request has been released? And what are the long-term prospects?

The Future of AM General

■ Despite losing out on the contract to build a light tactical wheeled vehicle to follow its Humvee, AM General is bullish on the future. It has enough business to last for decades. Along with upgrades and new builds of its signature vehicle, its factories are building cars for Mercedes Benz and wheelchair accessible taxis for the commercial market.

Armor Technology

■ A decade ago, U.S. ground forces in Iraq were bolting on steel plates to give tactical wheeled vehicles added protection from roadside bombs. Since then, there have been breakthroughs in composite materials, and the additive manufacturing field has made great gains. National Defense Magazine looks at the prospects for stronger, lighter vehicle armor.

Tactical Communications

■ As the U.S. military pivots to the Asia-Pacific region, that will present service leaders with a conundrum: How to keep soldiers and Marines connected to critical networks and information across vast distances. In our next issue, National Defense examines new technology the military is pursuing to bridge the communication gap.

Innovations for Ground Troops

■ Pentagon laboratories, such as the Defense Advanced Research Projects Agency, are working on new ways to keep dismounted soldiers and Marines in the loop. Through its newly unveiled Squad X Core Technologies program, DARPA is working alongside industry to develop novel ways to enhance a squad's ability to gather situational awareness.

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