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HEARING
ON
NATIONAL DEFENSE AUTHORIZATION ACT
FOR FISCAL YEAR 2021
AND
OVERSIGHT OF PREVIOUSLY AUTHORIZED
PROGRAMS
BEFORE THE
COMMITTEE ON ARMED SERVICES
HOUSE OF REPRESENTATIVES
ONE HUNDRED SIXTEENTH CONGRESS
SECOND SESSION

SUBCOMMITTEE ON INTELLIGENCE AND EMERGING
THREATS AND CAPABILITIES HEARING
ON
**REVIEWING DEPARTMENT OF DEFENSE
SCIENCE AND TECHNOLOGY STRATEGY,
POLICY, AND PROGRAMS FOR
FISCAL YEAR 2021: MAINTAINING A
ROBUST ECOSYSTEM FOR OUR
TECHNOLOGICAL EDGE**

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CONTENTS

	Page
STATEMENTS PRESENTED BY MEMBERS OF CONGRESS	
Langevin, Hon. James R., a Representative from Rhode Island, Chairman, Subcommittee on Intelligence and Emerging Threats and Capabilities	1
Stefanik, Hon. Elise M., a Representative from New York, Ranking Member, Subcommittee on Intelligence and Emerging Threats and Capabilities	3
WITNESSES	
Geurts, Hon. James F., Assistant Secretary of the Navy for Research, Devel- opment and Acquisition, Department of the Navy	5
Griffin, Hon. Michael D., Under Secretary of Defense for Research and Engi- neering, Office of the Secretary of Defense	4
Jette, Hon. Bruce D., Assistant Secretary of the Army for Acquisition, Logis- tics and Technology, Department of the Army	4
Roper, Hon. William B., Jr., Assistant Secretary of the Air Force for Acquisi- tion, Technology and Logistics, Department of the Air Force	7
APPENDIX	
PREPARED STATEMENTS:	
Geurts, Hon. James F.	65
Griffin, Hon. Michael D.	39
Jette, Hon. Bruce D.	57
Langevin, Hon. James R.	35
Roper, Hon. William B., Jr.	82
DOCUMENTS SUBMITTED FOR THE RECORD:	
[There were no Documents submitted.]	
WITNESS RESPONSES TO QUESTIONS ASKED DURING THE HEARING:	
Dr. Abraham	103
Mr. Cooper	103
Mr. Larsen	103
QUESTIONS SUBMITTED BY MEMBERS POST HEARING:	
Ms. Houlahan	113
Mr. Langevin	107
Mr. Larsen	107
Mr. Scott	112

**REVIEWING DEPARTMENT OF DEFENSE SCIENCE AND
TECHNOLOGY STRATEGY, POLICY, AND PROGRAMS
FOR FISCAL YEAR 2021: MAINTAINING A ROBUST
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HOUSE OF REPRESENTATIVES,
COMMITTEE ON ARMED SERVICES,
SUBCOMMITTEE ON INTELLIGENCE AND EMERGING
THREATS AND CAPABILITIES,
Washington, DC, Wednesday, March 11, 2020.

The subcommittee met, pursuant to call, at 2:00 p.m., in room 2212 Rayburn House Office Building, Hon. James R. Langevin (chairman of the subcommittee) presiding.

OPENING STATEMENT OF HON. JAMES R. LANGEVIN, A REPRESENTATIVE FROM RHODE ISLAND, CHAIRMAN, SUBCOMMITTEE ON INTELLIGENCE AND EMERGING THREATS AND CAPABILITIES

Mr. LANGEVIN. The subcommittee will come to order.

Good afternoon, everyone. I am pleased to welcome you back to this committee, the Department's highest science and technology leadership, to testify on the fiscal year 2021 President's budget request for the Department of Defense science and technology programs.

Before us today are the services' technology and acquisition executives. These individuals must divide their attention between fielding the best technology to the warfighters as quickly and efficiently as possible in the near and mid term, and protecting science and technological innovations that enable the Department to keep its technological edge over the long term.

Under Secretary Mike Griffin, Assistant Secretary Bruce Jette, Assistant Secretary "Hondo" Geurts, and Assistant Secretary Roper, we welcome you here today and look forward to this important discussion.

At a time when our national defense planning has shifted focus to great power competition, addressing the challenge from rising science powers requires an ambitious plan of national investment and aggressive talent development in science and technology. Funding for basic research, applied research, and advanced technology development in our universities, laboratories, small businesses, and the tech sector seeds the necessary science to grow the advanced technological capabilities required for our next-generation military engagements. Yet, with bipartisan support for a drastic increase in investment in our national security innovation base in this era of strategic competition, somehow growth in the science

and technology budget is almost always sacrificed to field the mature technologies of today.

So how is it that this year, with an Under Secretary of Defense for Research and Engineering created for the very purpose of looking past the horizon, and with a National Security Strategy that claims to be focused on deterring the wars of the next two to three decades, the Department was able to submit a budget request that was less proposed S&T [science and technology] funding than last year.

Due to inflation and labor escalation of scientists and engineers, and despite Congress' efforts to restore S&T funding each year, the S&T budget has been effectively shrinking for the past decade.

In fiscal year 2021, with the total Department of Defense-wide S&T budgets annually decreasing for the first time in years, we are left wondering what the future of our defense will truly look like. Without both Department leadership and Congress protecting the S&T budget, our warfighters risk losing the technical edge to prevail in future conflicts of ever-evolving complexity.

If the U.S. is to remain a global leader in technology, we cannot simply play defense. We must also play offense. Investments in science and research and other development efforts across the whole of government are necessary and vital to maintaining a technological edge. We must invest in STEM [science, technology, engineering, and mathematics] education; programs that develop junior talent into future tech leaders; university research; and actively endeavor to diversify our S&T workforce. We must implement policies that promote a sound economic, political, and strategic environment on U.S. soil where global collaboration, discovery, innovation, public institutions, and industry can all thrive. And I recognize that the open dialogue and debate of academia can mean an anathema to the secrecy we rely on in the Department of Defense but we must also recognize and embrace the competitive advantage our free society provides us to out-innovate and develop better products faster.

Finally, I must emphasize that we will not attain the technological edge that we need if we refuse to take risks, push the scientific boundaries, and challenge the red tape. We must empower those who lean forward on innovation, whether it is to be in our laboratories, small businesses, universities, research offices, tech sector, or in contracting offices. I realize that this does not come easily for the Department, as the overriding culture is one of risk avoidance, but we need to empower the S&T workforce and community to enable technological leaps that will ensure that our warfighters never enter a fair fight.

With that, before we turn to our witnesses, I am going to turn now to Ranking Member Stefanik for any remarks that she may have.

[The prepared statement of Mr. Langevin can be found in the Appendix on page 35.]

**STATEMENT OF HON. ELISE M. STEFANIK, A REPRESENTATIVE
FROM NEW YORK, RANKING MEMBER, SUBCOMMITTEE ON
INTELLIGENCE AND EMERGING THREATS AND CAPABILI-
TIES**

Ms. STEFANIK. Thank you, Chairman Langevin, and thank you to the witnesses for being here today.

I want to stress how important our investments in science and technology, and the innovation ecosystem are to our national and economic security. The National Defense Science and Technology Strategy required by Congress and submitted in October of 2019 rightly noted that, quote, technology will be the currency of future strategic competition. This strategy identified the major modernization priorities, and set a course for continued investment, and, most importantly, persistent focus and accountability inside the Under Secretary of Defense for Research and Engineering and across the services.

I appreciate the Department's effort energizing the S&T Enterprise around these critical technologies in order to enable our long-term preparedness for the future. There is recognition that the DOD [Department of Defense] cannot meet this challenge alone. I applaud your efforts to bolster the defense innovation enterprise through initiatives like the Defense Innovation Unit, AFWERX, Army Applications Lab, Army Open Campus, and NavalX. However, we must view the adoption and application of commercial technologies as the new normal and not simply through the limited lens of a pilot program. Many of the new technologies that are being adopted for military applications grew out of defense basic research but were matured, commercialized, and fielded with private sector investment. Disciplines like artificial intelligence, biotech, autonomous systems, and additive manufacturing have advanced significantly because of the investment and collaboration across the innovation ecosystem to include academia, industry, government, laboratories, and the venture capital community.

I also firmly believe that science and technology is a team sport and we must partner with our allies to develop the technologies and policies that will provide a Western, more responsible alternative to China's authoritarian approach.

The Council on Foreign Relations Task Force on Innovation concluded in their final report that slowing China down is not as effective as outpacing it. With this challenge in mind, we must build the alliances and partnerships that will provide the investment of human capital and shared research and development that can contest the goals of Made in China 2025.

However, I remain concerned that our S&T investments represent a small amount of our overall defense budget and a decreasing percentage of our total RDT&E [research, development, test, and evaluation] budget. In fact, last year this Congress added nearly \$2.0 billion in science and technology funding to the fiscal year 2020 defense appropriation to make up for the shortfall in the budget request. This Congress, and this committee particularly, recognized the importance of research and development to our long-term technological superiority. Any degradation in these investments places the U.S. at a competitive disadvantage and, more importantly, risks skipping a generation of domestic science and engi-

neering expertise that is so desperately needed and already in such short supply in disciplines like AI [artificial intelligence], mathematics, computer science, and aerospace engineering.

Finally, we cannot allow our own risk aversion or fear of failure to constrain our military from acquiring breakthrough technologies. Congress has made strides over the last several years to provide flexibility to the Department in experimentation, rapid innovation and acquisition, and outreach through public-private partnerships. I am particularly interested in understanding how these authorities are being utilized and what more we can do to improve our defense innovation ecosystem.

Thank you again to our witnesses and I yield back to the chair.

Mr. LANGEVIN. Thank you, Ranking Member Stefanik.

We will now turn to our witnesses for their testimony. And with that, Under Secretary Griffin, you are now recognized.

STATEMENT OF HON. MICHAEL D. GRIFFIN, UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING, OFFICE OF THE SECRETARY OF DEFENSE

Secretary GRIFFIN. Mr. Chairman, Ranking Member Stefanik, I would, in the interest of time, would prefer to yield back my time for an opening statement. My written statement has been submitted for the record. I don't think I can improve on it. So, I will allow you to pass to the next witness.

[The prepared statement of Secretary Griffin can be found in the Appendix on page 39.]

Mr. LANGEVIN. Okay. Thank you, Secretary Griffin.

With that, Secretary Jette.

STATEMENT OF HON. BRUCE D. JETTE, ASSISTANT SECRETARY OF THE ARMY FOR ACQUISITION, LOGISTICS AND TECHNOLOGY, DEPARTMENT OF THE ARMY

Secretary JETTE. Chairman Langevin, Ranking Member Stefanik, and distinguished members of the Subcommittee on Intelligence, Emerging Threats and Capabilities thank you for inviting me to discuss the Army's science and technology budget for fiscal year 2021 and for making my written statement a part of the record for today's hearing.

The Army's S&T program seeks to invest in a balanced portfolio of achieving a modernized force capable of conducting multi-domain operations across an array of scenarios in multiple theaters by 2035 and beyond. Our focus is on discovery and delivery of new and emerging technologies, then, maturing technology to reduce programs' risk.

Technology prototypes, proof, affordable, and achievable requirements, experimentation with soldiers refines new operational concepts enabled by the emerging technologies. We work closely with Army's Futures Command to identify technology requirements in the near, mid, and forward term. Resources, then, are focused on Army modernization priorities, though not exclusively, to allow for unanticipated discovery.

The Army's nine priority research areas include disruptive energetics, quantum, hypersonic flight, artificial intelligence, autonomy, and science of advanced manufacturing, which closely align with

both the 8 National Defense Strategy rapid technology advancements and OSD's [Office of the Secretary of Defense's] 11 modernization priorities. We depend heavily on our S&T program to help prepare for the future, mitigate the possibility of technical surprise, and ensure that we are able to remain dominant in every environment.

The Army also employs more than 25,000 military, civilian, and contract scientists, engineers, and technicians at laboratories across the country, who are critical assets in identifying, developing, and demonstrating technical options. We are grateful to Congress for the numerous staffing flexibilities provided to the Army laboratories, such as direct hire authority, renewable term appointments, and other initiatives that have been instrumental in growing the technical workforce and shaping their skills in emerging areas.

Let me briefly talk about reform. With the support of Congress, the Army has undertaken a number of initiatives to improve efficiency and effectiveness. Our intellectual property policy fosters dialogue with industry early in the process so we are clear about our data requirements and data rights, as well as our efforts to maintain technological advantage.

Talent management is critical to efficient and effective operations. We are not only interested in recruiting top talent but have a number of programs underway to retain them. This includes a revised recruiting, retention, and management program for hard skills, particularly STEM, officers in the military.

Lastly, we continue to expand our industry outreach program to actively seek out nontraditional businesses with new and innovative ideas that are willing to engage with the Army. AFC's [Army Futures Command's] Capital Factory, Innovation Days, the 75th Innovation Command, combined with Industry Days by the program executive offices, establishment of the Rapid Capability and Critical Technology Office, Open Campus at Army Research Laboratories, xTechSearch, and many other programs have been fostered to just open these doors for innovators.

Thank you for your strong support of the Army programs, the authorities you have provided, and this opportunity to discuss Army S&T.

I look forward to your questions.

[The prepared statement of Secretary Jette can be found in Appendix on page 57.]

Mr. LANGEVIN. Thank you, Secretary.

Now, Secretary Geurts, you are recognized.

STATEMENT OF HON. JAMES F. GEURTS, ASSISTANT SECRETARY OF THE NAVY FOR RESEARCH, DEVELOPMENT AND ACQUISITION, DEPARTMENT OF THE NAVY

Secretary GEURTS. Chairman Langevin, Ranking Member Stefanik, distinguished members of the subcommittee, thanks for the opportunity to appear before you today to discuss the Department of the Navy's science and technology efforts and how they support the National Defense Strategy and, most importantly, our sailors and Marines. It is my honor to represent the entire science and technology enterprise in this hearing today.

Before I begin, I would like to extend the Department's deepest condolences to the two families of our Marine Raiders killed this weekend in Iraq, Gunnery Sergeant Pongo and Captain Navas. Their sacrifice serves as a stark reminder of the seriousness of our jobs, as we work together to best serve our Marines and sailors.

The Department's fiscal year 2021 S&T program aggressively pursues increased lethality and modernization with the greatest potential to deliver nonlinear warfighting advantages. To deliver future naval power, the Navy and Marine Corps invested in a diverse set of innovative thinkers and doers. Included in this are a technical workforce at the Offices of Naval Research, the Naval Research Laboratory, and our many warfare centers. It also includes our over 341 university partners, 91 nonprofit partners, and over 20,000 small and large businesses, all working together to support our efforts.

Scaling innovation requires tool sets to enhance the impact of this R&D. Our NavalX office, established in 2019, creates the network that thickens our ability to share best practices, relationships, and key ideas across the entire Department of the Navy.

NavalX guides, empowers, and connects our workforce to achieve the pivot speed that we need to have at enterprise scale. Part of this program includes our tech bridges, which leverage and establish ecosystems of expertise all across the country. We currently have six tech bridges established. That will double here in the next 30 days.

I would like to thank Congress for the wide range of authorities you have provided us. The Navy is taking full advantage of those authorities to increase agility, refine and streamline our business processes, and drive efficiencies. The authorities are making a real difference every day in how the Department of the Navy both recaptures our capital assets and strengthens our workforce.

Authorities such as 233 in the fiscal year 2017 NDAA [National Defense Authorization Act], allowed us to decrease processing time for procurement contracts, infrastructure action, and IT [information technology] actions. We saved over a half a million processing days using that authority alone. Again, it is making a real difference to folks down in the trenches and I thank you very much for that.

As we continue to leverage these authorities and get our iteration speed up, we are looking for other innovative business and architectural strategies that will let us go at the speed of relevance. These include reforming our SBIR [Small Business Innovation Research program] process, where we have taken our most recent BAA [Broad Agency Announcement], our end-to-end cycle time from idea to solution on contract from about 124 days down to 28 days.

We will continue to work with our teammates here at the table, as we all try and compete at the global scale. And we thank you for the strong support this subcommittee has always provided our sailors, and Marines, and their families. And thank you for the opportunity to appear here today.

[The prepared statement of Secretary Geurts can be found in the Appendix on page 65.]

Mr. LANGEVIN. Thank you, Secretary Geurts.

Secretary Roper, you are now recognized.

STATEMENT OF HON. WILLIAM B. ROPER, JR., ASSISTANT SECRETARY OF THE AIR FORCE FOR ACQUISITION, TECHNOLOGY AND LOGISTICS, DEPARTMENT OF THE AIR FORCE

Secretary ROPER. Mr. Chairman, Ranking Member Stefanik, distinguished members of the subcommittee, thank you for the opportunity to testify today on an important topic for our military, which is science and technology. It is an honor to represent the Department of the Air Force and to be here with my distinguished colleagues.

And as I testified last year, preparing for a hearing like this is good for the soul. You get to go through a lot of amazing ideas, amazing technology that are being worked on by people in our laboratory that really do make science fiction sound like it is going to be real in the future.

Too, I would like to highlight our one group working on nano-sized sonograms that are trying to make the Star Trek "tricorder" a reality in the future. And another is a new material called samarium nickel oxide, which decouples the temperature of that material from its thermal emission, paving the way for what could be a cloaking device in the future. So I am all for making Star Trek real for the military in the future. We just need a warp drive to get it over the goal line.

It is easy to stand back from amazing technology and amazing ideas like that and feel comforted that the future of our military is in good hands. And I have all the confidence in our research enterprise, but our National Security Strategy makes it clear we are competing against peers that can match us tech-for-tech, person-for-person and so we have to bring a competitive mindset into this important portfolio and make days and weeks count.

Last year we requested \$2.8 billion in our S&T account for the Department of the Air Force, up 6 percent from the previous year. We were able to hold that steady in this fiscal year in our request but take up our research and development efforts in classified S&T. I would be happy to share the classified portfolio with you in a closed setting.

We have also made a significant reform in consolidating our program elements. We are wanting to put the amount of accounts that we have in S&T, we want to reduce them so we have greater flexibility and agility to adapt to successes and also commercial tech trends.

Both yourself, Mr. Chairman, and Ranking Member Stefanik, your opening comments make it clear that our challenge is that we are a free and open society competing against a closed society. And the closed society that China and others have give them the ability to nationalize their industry base and nationalize their S&T efforts.

So we are going to have to find a way to make the Department of Defense work in this broader ecosystem in a way that is win-win. We are currently 20 percent of the R&D in this country; 80 percent is commercial. If we don't find a way to work in the 80 percent, then doing the 20 percent well will be insufficient to compete and win long term.

So we have to do four things to become a modern S&T enterprise that can compete and win long term. We need to be the best inventor of technology that we are not going to get from the commercial sector either at all or on time. We need to be the best leverager of technology that is coming out of commercial innovation. We also need to be a partner and a catalyzer of commercial tech. And then finally, as all of my colleagues have noted, we have to compete for talent. All of this is on a foundational bedrock of quality people that are world-leading focused on our missions.

So I will go through an example or two of each. In terms of inventing, there are so many military-unique technology applications that we need world-leading researchers on. Hypersonics and directed energy probably come to mind but there are things we need to start doing on next-generation solid state devices that will be required by the military before they will commercially that our research lab is leading the charge working with universities across the country.

I am also excited that the Department of the Air Force has created a new process to help transition technology out of the lab and into programs of record. We didn't have one before. So we have modeled this process, called the Vanguard process, after the Strategic Capabilities Office, partnering the technologist with a program executive officer so that the details of transition, the logistics, the cost, the training that might not be resident in the laboratory get augmented by a program executive officer that knows what needs to be done to get to the goal line.

We are leveraging technologies like AI across initiatives like "FuelAI" in our Distributed Common Ground Station and have finally gotten that to initial operational capability. And we are partnering on reforms like SBIR, fundamentally changing the way we work with tech startups, increasing our output by threefold and bringing companies that wouldn't have worked with the Air Force in. I will be happy to share more details in the testimony.

Finally, the new thing we are working on that I hope to testify more on next year is catalyzing. I have an example or two which we can hit on in the hearing today but we need to look at where commercial markets are going, skate ahead of the puck, and see how the military market can help bring not just commercial technology to bear for the warfighter but markets to bear in this country faster than in our competitors. That is part of competing in this global ecosystem, where we play a role that is synergistic with our commercial counterparts.

And finally, with respect to talent—as I said, it is foundational—you have given us authorities to hire better, hire faster, and be competitive with commercial pay scales. We have used these aggressively in the Air Force. We have gotten great talent but we can do more. We can never be satisfied with the talent we have.

Thank you for your questions today and thank you, again, for this hearing.

[The prepared statement of Secretary Roper can be found in the Appendix on page 82.]

Mr. LANGEVIN. Thank you, Secretary Roper, and thank you, gentlemen, for your testimony here today.

We will now go to member questions. I will start by recognizing myself for 5 minutes.

Secretary Griffin, I will start with you. As the R&E [Under Secretary of Defense for Research and Engineering], we look to you to champion the science and technology, and innovation ecosystem of the Department. Of course, we were disappointed to see that this year the 6.1 to 6.3 S&T budget was less than last year. The Defense Planning Guidance has, historically, directed at least zero percent real growth. So the S&T budget was, effectively, a half a billion dollars less than we expected. Indeed, your defense-wide R&E budget was even \$245 million less than last year's request.

How did the Department walk away from its commitment to protect the science and technology budget this year?

Secretary GRIFFIN. Sir, the Department has not walked away from that. We highly value S&T funding. This is a tough budget environment. We don't have topline growth and we have many, many priorities.

As we went through our budget work, I, in fact, was an advocate in R&E for S&T topline growth but, in reality, there are no bad programs. And in an environment where we didn't have any bad programs we were, inevitably, in order to close our budget, we were going to have to make priority choices, and we did.

When we talk about S&T, I will point out, on behalf of my service acquisition executive partners, that actually the Army grew by 6 percent. Navy grew by 1 percent. Air Force maintained zero percent real growth. It was OSD that took a 4 percent cut.

So, the parsing of our S&T budget was done across the Department very carefully.

I will only conclude by saying we did the best that we thought we could.

Mr. LANGEVIN. Well, Secretary Griffin, I appreciate your perspective. I see it a different way.

But Secretary Roper, let me turn to you. I am a Star Trek fan so I like the idea of developing warp drive for the next generation but you know the reality is, you are the Air Force's well-known champion of innovation. How do the Air Force's S&T requests come out at less than zero percent real growth from last year's requested funding level? And how do the Air Force's basic research and advanced technology development decrease by about 8 percent each? And what will it take for the Department to champion the long-term science and technology budget in the face of demands to field new capabilities quickly?

Secretary ROPER. Yes, Mr. Chairman, as Dr. Griffin alluded, it was a tough budget year and, sometimes, the innovation voices did not win at budget closeout. A lot of things on the Air Force's plate, with nuclear modernization, the standup of Space Force, Joint All-Domain Command and Control, and, unfortunately, when we had to make the budget balance, we had to look for areas to take risk. And I share your concern. Taking risk in basic research may not put the military at risk today or tomorrow but it is eroding that foundational layer that creates the game-changing technologies of the future.

The one area that I can share good news, and I would certainly invite the committee to take a briefing on our classified S&T, it

doesn't get reported in wide-world S&T but, as we think about competing against countries like China and Russia, if we have foundational research, that publishing it would simply let our adversary jump ahead. It is great that we have researchers that are willing to work with us at a classified level, not publish their research, and help us have a military edge. We made a sizeable movement in that portfolio and I would invite the committee to take a briefing, if of interest.

Mr. LANGEVIN. Thank you. And before—the last question I have for Secretary Griffin.

For the rapid technological advancements outlined in the NDS [National Defense Strategy] and for your 11 modernization priorities, last year's NDAA tasked the Department to lean forward strategically developing policies on how we should use and deploy these future technologies, and to consider how these emerging capabilities will contribute to new security strategies.

Concurrency in policy, in tech development, I believe is critical to successful employment of capabilities and being a global leader in establishing norms for use of technologies. Yet, too often, policy lags development. In your view, what action does the Department need to take to promote concurrency in policy, employment concepts, training, doctrine, and other matters as technologies mature?

Secretary GRIFFIN. Sir, I will take that question for the record. I can't answer that here today.

[The information referred to was not available at the time of printing.]

Mr. LANGEVIN. Okay. I think that that is pretty—would be a pretty basic answer. You have to make sure that we are doing policy development and technology development simultaneously. This doesn't seem to be rocket science.

Secretary GRIFFIN. I don't—

Mr. LANGEVIN. With that, I will yield back.

Secretary GRIFFIN. I don't disagree.

Mr. LANGEVIN. I yield to Ms. Stefanik.

Secretary GRIFFIN. I am sorry, sir. I don't disagree but your question was quite detailed and I want to give it the attention it deserves.

Mr. LANGEVIN. Fair enough. Thank you, Secretary.

Ms. Stefanik, the ranking member.

Ms. STEFANIK. Thanks, Chairman.

Dr. Griffin, I wanted to ask you about 5G. As you know, Congress provided \$200 million to the Department in fiscal year 2020 for the 5G Next Generation Information Communications Technology Initiative. This was, of course, in order to advance U.S. leadership in 5G and next-generation wireless technologies.

The Department has requested \$449 million in fiscal year 2021. Can you explain how this is improving the government-wide strategy to ensure U.S. leadership in 5G and how has private industry, from your perspective, responded to this R&D initiative?

Secretary GRIFFIN. Second question or second part first. Private industry has responded with both feet, jumping in with both feet on the initiative that DOD has taken. We are, as I am sure you are aware, we have released RFPs [requests for proposals] to industry through our Spectrum Consortium. We are judging those

now. We have received many proposals to collaborate with us. We are putting forward, initially, experiments on four—actually, we are going for five different bases because the Congress has called out Nellis as a specific base where we must experiment and we have four others in our plans.

We are conducting 5G development experiments to include smart depots, smart ports, smart airports, capitalizing on the Internet of Things capability that 5G enables.

Critical to our work in 5G is the concept of spectrum sharing, in fact dynamic spectrum sharing, so that we can get, if you will, more use out of the spectrum real estate that we have because the spectrum real estate is not increasing.

So we are all-in on 5G at the cutting-edge level of learning how to do the things we have to do for both spectrum sharing and Internet of Things to make 5G reach the promise that it offers.

Ms. STEFANIK. Shifting gears, Dr. Griffin, particularly when we are thinking about research and, in my opening statement, I talked about the importance of partnerships with academia, with labs, with private sector. There have been several recent high-profile cases of researchers with ties to the Chinese Government and this has brought a lot of attention to the issue of research security and illicit technology transfer. These concerns are amplified when these individuals are working on DOD-funded research, in some cases for over a decade.

Do you believe that the universities, the individual researchers better understand the nature of the threat? And what should the Department of Defense be doing to protect these important investments and partnerships when it comes to basic research?

Secretary GRIFFIN. We, too, are, of course, aware of these high-profile incidents. I don't want to be glib about this issue. This is one that is of the greatest importance to me, personally, and to the Department.

So first of all, I want to say that identifying individuals who are behaving badly and, indeed, illegally is a high priority for us. We are implementing measures to gather more information about who is doing research on the DOD dime and we are working with universities and other research centers to do exactly that.

But when we identify these people, whom we believe to be a small percentage of the total research community, to us this is evidence that the system is actually working. Are there undiscovered people out there who are trying to damage the United States? Yes, of course, there are, but this is the country from which other people are trying to steal. This is the country where other people want to send their kids to be educated. It should worry us if we are not the people that others are coming after, because then we don't matter.

Now, we absolutely want to prevent intellectual property theft. We want to prevent exfiltration of key ideas to our adversaries. But we got where we are in the world by espousing an open research community, an open innovation base, by being a country where others could come and start businesses and succeed.

Forty-five percent of our Fortune 500 companies are headed by a CEO who is an immigrant or the child of an immigrant. Thirty-eight percent of the Nobel Prize winners since 2000 are immigrants.

There is a risk pool—

Ms. STEFANIK. Dr. Griffin, I understand the value of immigrants and I have been long a leader when it comes to making sure that we have an immigration system that recognizes the importance of those that are highly educated, particularly in those innovative tech sectors, as well as, in my district, some of the issues related to agriculture. So, I understand what the stats are on immigration issues.

But I am concerned when we are surprised with headlines about the head of the Department of Chemistry at Harvard University, who is using Department of Defense research dollars and that information is going to China. So, while I understand your point that we are the innovative goal for other countries to look to, I cannot stress how important vigilance is to make sure that we understand this is taxpayer dollars.

And when we are talking about game-changing technologies, whether it is AI, whether it is quantum, we need to make sure that the U.S. maintains supremacy and is ahead of the game.

So I know you didn't want to be glib about it but I just want to underscore that having an understanding of who is working on these projects and, if there is any foreign nationals working on Department of Defense-funded research projects, we need to get our arms around this problem.

With that, I yield back.

Mr. LANGEVIN. Thank you, Ranking Member Stefanik.

Mr. Larsen is now recognized.

Mr. LARSEN. Thank you.

Dr. Griffin, because we matter, as you noted, can you be a little more specific about what the Department is doing in working with DHS [Department of Homeland Security] and the FBI [Federal Bureau of Investigation] to share valid counterintelligence threats and best practices with universities conducting DOD research?

Secretary GRIFFIN. Well, we are working with the university community, and with DHS and FBI to do exactly as you suggest, to make sure we know who is working on our projects, to know what other funding sources, in particular, they have, to know what their origins and connections are, so that we can identify individuals who are operating here on false colors. We are doing those things and we are stepping up our game, as Ms. Stefanik suggested that we should.

Any individual who slips through the net will be a high-profile case but—

Mr. LARSEN. Is there any objective analysis of the work that you are doing that we can assess ourselves?

Secretary GRIFFIN. I will take that for the record and if we have objective analysis on statistics, we will get that back to you.

[The information referred to can be found in the Appendix on page 103.]

Mr. LARSEN. Yes. Just how many chemistry departments are there in the United States, in American colleges and universities?

Secretary GRIFFIN. I don't know, sir.

Mr. LARSEN. A lot, probably.

Secretary GRIFFIN. Probably a few.

Mr. LARSEN. And there is one that happens to be at Harvard, which is high profile. There might be others. I don't know. But it is certainly a high-profile case, but it is one.

Secretary GRIFFIN. And one bad actor can create an awful lot of damage, as we have seen with other insider cases.

Mr. LARSEN. Absolutely, I agree.

Secretary GRIFFIN. Most of our—all of our highest profile exfiltrations have been insider threats, native-born U.S. citizens—Rick Ames.

Mr. LARSEN. Yes. Well you know, let us know how to help you on this because we do want to help you. So I appreciate that.

Can you address the—in your written testimony on quantum science, I don't know the page number, but, quantum sciences will continue to emphasize atomic clocks and quantum sensors. These quantum technologies provide the most concrete opportunities, so on, and so on, and so on.

But your statement before that says quantum science takes advantage of fundamental physical properties to devise new technologies whose performance far exceeds what is currently available. And then you make some comment that basically says we shouldn't get too excited just now; it doesn't do everything that people theorize, perhaps, but it perhaps can, one day.

What are you trying to tell us about quantum science, so we can kind of look at it more realistically?

Secretary GRIFFIN. That, sir, is an excellent question. Thank you.

It is difficult to pick up any magazine or newspaper article focusing on science and technology, generally, without finding some reference to quantum computing, quantum communication, things like that that are not beyond the boundaries of physics, as we understand them, but whose technological implementation could be and will be extraordinarily difficult. Those are longer term things.

Now, the DOD is, in fact, investing substantial monies in quantum computing and other initiatives, but the nearer term initiatives that we believe will pay off are the things to which I alluded in my testimony.

First and foremost, quantum clocks, to give us timekeeping precision—synchronized timekeeping precision two or possibly even three orders of magnitude better than we have today. That is critically important for maintaining communications in a GPS-denied environment, where we might have to fight a war.

Quantum sensors for inertial navigation or navigation by other means—quantum magnetometers come to mind for mapping and then following the earth's magnetic field, which provides very detailed navigation information.

These are the things that we will see in the next few years and where we are focusing a substantial amount of our effort.

Mr. LARSEN. And I presume, I think, perhaps, the chair and the ranking member, in their opening statements, talked about the role of commercial technologies in supporting the Department on this particular set of issues.

Secretary GRIFFIN. We are working with our commercial partners, some of whom are spending quite a lot of money in these areas.

Mr. LARSEN. I heard they are spending a quantum amount, in fact.

With that, I will—

Secretary GRIFFIN. Quite a lot of money.

Mr. LARSEN. Quite a lot, I am sure.

I yield back. Thank you.

Mr. LANGEVIN. Thank you, Mr. Larsen.

Mr. Abraham is now recognized.

Dr. ABRAHAM. Thank you, Mr. Chair.

I read your bios on all of you and even though I have two advanced degrees, I feel very inadequate among your presence. I read your opening—your written statements. They are written by scientists. They are very detailed. They are very structured. And I appreciate the attention to detail that you gave into the written statements.

Dr. Griffin, your résumé, of course, precedes you with your stint at NASA [National Aeronautics and Space Administration] and your Johns Hopkins Applied Physics Laboratory head. We appreciate that. And I will tell all of you, I, personally, am very grateful that you are at the helm of these agencies, watching our back. We know where are bad actors. As Representative Stefanik said, we know they are out there. We certainly have to guard against them, but men and women of your acuity, where you are, I think we are in a good spot.

And I simply want to give you just a minute—I will go down the line and start with you, Dr. Griffin—in an open mic scenario that we are in here, just to highlight what you would like to highlight in your particular realms, just briefly, so that the general public that may hear/watch this hearing knows what is going on at your level.

Dr. Griffin, I will start with you.

Secretary GRIFFIN. Well, we have quite a number of initiatives, as has been said. We have 11 modernization priorities taken from the National Defense Strategy, which I have said publicly, and will say again, is the best I have seen in decades. So I am bought in.

The NDS urges us to consider that we are, again, in a great power competition for the first time since the Cold War and urges us to understand that we will not win that competition with the weapons and the tools of yesterday.

So, in my particular area, we are working on modernizing our space architecture. That is critical to how the U.S. fights and wins wars, and our adversaries know that and are coming after us. I have been quite public about the need for a hypersonics offense and defense capability, to allow us to match what our adversaries are doing and to be able to defend against them.

In a less publicized way, we have undertaken a wholesale re-vamping of our microelectronics initiative. The DOD is—most of the important microelectronics work is done commercially. DOD is about 1 percent of the demand. We rely on our commercial partners completely for everything we do in microelectronics and none of our systems will work without it. So, we are fully embracing the need to be able to produce trusted microelectronics on a risk-assessed basis, all the way from initial design right through fabrication and

assembly. That is a critical area and our industrial base is under siege from abroad, as you know. It is in the headlines every day.

So those are a few—with my minute or two, those are a few of the things we are working on that are very high priority for us.

Dr. ABRAHAM. Thank you.

Yes, sir.

Secretary JETTE. Sir, I will hit three quick points for you.

I would like to just touch base with the bad actor question. For the Army, I came in, I took a look at the students we had in different universities.

I went to MIT [Massachusetts Institute of Technology] to have—we have a UARC [university affiliated research center] there, so I know where to go. And I start rooting around there and I found out that I had twice as many Chinese students on my payroll as I had U.S. students.

And I will solicit this because I need help, I think, in Congress. So when I began to try and negotiate with the university, because we send the money to the university, they pick the students that volunteer to come to work, not me, the other way around because of the way it is structured. And their issue is I can't tell somebody they can't apply for the program and be selected because we have laws against national origin preferences. So, they couldn't exclude the Chinese students and I am trying to do that. So we are both trying to apply the laws and apply reason, and it took us quite a while to come to a reasonable conclusion.

I think it is important, not because we don't publish at 6.1 level the work, but there is a big difference between reading a paper and actually having done it, and being able to fill all those knowledge gaps. So I just think that is one of the areas we could use help with.

We, in the Army, have put a deliberate focus, as you saw. We kept our 6.1 to 6.3 budget robust, plussing it up about 5½ percent, but we have increased our 6.4 budget by a third, fundamentally because for the last 20 years we didn't focus on transitioning any of the new technologies that were coming, both in the military sector and the commercial sector. So we brought those in as well. That is one reason why we have plussed up in that area.

And I am over time. So, I will just finalize my third one is I think that there is—we could have a much deeper conversation on the relationship between 6.1, 6.2, and 6.3 funds and how they play out in a timeframe, given the speed of technology today.

Dr. ABRAHAM. Well, thank you. I am out of time.

If the other two gentlemen would give me a written response, I would certainly appreciate it.

Thank you, Mr. Chairman, for the indulgence.

[The information referred to can be found in the Appendix beginning on page 103.]

Mr. LANGEVIN. Thank you, Dr. Abraham.

Mr. Cooper is now recognized for 5 minutes.

Mr. COOPER. Thank you, Mr. Chairman.

I hope that Dr. Roper's initial comments were not too helpful to any possible adversary out there. I know you just described it in the most general terms but—

It seems to me that there are funding issues and then there are jurisdictional issues. And Dr. Griffin has already mentioned that we wish, in many ways, the funding had been higher.

Let me set that aside for a minute because, with jurisdiction issues, we are going to have an MDA [Missile Defense Agency] hearing tomorrow and laser scaling was taken away from MDA entirely. Space sensors for hypersonics were given to SDA [Space Development Agency]. And as you well know, RKV [Redesigned Kill Vehicle] was killed entirely by R&E, giving us an 8- to 10-year exposure problem.

So it seems like jurisdiction isn't necessarily being handled in a way that people are understanding. Now, maybe there is a good explanation but I am going to face a lot of grief from my Republican colleagues that the directed energy for MDA is now zero.

Likewise, in Dr. Roper's testimony, the new NTS-3 [Navigation Technology Satellite 3] capability looks very exciting; all these Vanguard programs, awesome; Skyborg, Golden Horde, they have cool names. I am assuming the Space Force will end up with these, at some point, but you know good to know.

There is probably no good way to handle jurisdictional issues because everybody thinks they are the best. But can you help me understand some of these things—zeroing out directed energy for MDA?

Secretary GRIFFIN. Directed energy is important to us across the Department. The laser scaling initiative at MDA, again, I get back to the issue of priorities. The laser scaling program was one of my personal missions that I wanted to prosecute. However, we have limited funds, and many claims on those funds, and choices have to be made, and that is a program of significant size that could be used to supply funds for other areas, and is definitely longer term. It is not going to put a weapon in the field next year or the year after. So, we cut it.

With regard to space sensors given to SDA, MDA is still developing the requirements for the space sensors that we need for the low-altitude constellation and will be developing those. So, however, the overall architecture is under the direction of the Space Development Agency and the sensors have to blend into a larger architecture. So I think that is the right move but MDA is not doing one bit less work than had been planned to do previously.

I misremember your third question, sir.

Mr. COOPER. Well why don't we just move on because jurisdictional issues are less important than overall funding.

Secretary GRIFFIN. Oh, you did mention RKV.

Mr. COOPER. Yes.

Secretary GRIFFIN. If you would like me to stand down, I will, or I can answer.

Mr. COOPER. Well, I think we have all understood that, although it is my understanding that JROC [Joint Requirements Oversight Council] yesterday either shortened the acquisition period by 2 years or it didn't at all. I have heard two different versions from two different attendees.

Secretary GRIFFIN. Well, I was there and I would say that neither of those is true.

Mr. COOPER. Well what is true, 9 years?

Secretary GRIFFIN. The government estimate for the time to complete the deployment of the Next-Generation Interceptor is about a 10-year program. That estimate was put together at a 75 percent confidence level so that I could have some surety that we were not overpromising and underdelivering.

We believe, based on RFIs [requests for information] received back from the contractors, that some significant shortening of that period is possible. And when we have responses to our requests for proposal that are about to be released, we will be happy to come and share those with you.

But in re-planning this program, which we canceled because it was failing technically, in re-planning the program, I did not want to give you a buy-in estimate, if you will, of something that a few years from now you would be looking at it and saying, well, Dr. Griffin's promises didn't come true. I didn't want to be making those kinds of promises.

Mr. COOPER. Well, these are the same contractors who failed to deliver us a space vehicle that could go to space.

Secretary GRIFFIN. No, sir. One of the contractors who will be proposing will be the prior contractor but there are three other contractors in the competitive procurement phase, for a total of four, that we will be evaluating proposals from.

Mr. COOPER. Okay, good.

I see my time has expired. Thank you, Mr. Chairman.

Mr. LANGEVIN. Thank you, Mr. Cooper.

Mr. Bacon is now recognized.

Before we go to Mr. Bacon, today is the rollout of the Cyber Solarium Commission report, of which I am one of the four Members of Congress, and of course we had the executive branch participation, as well as legislative and private sector. We are doing the rollout today and I am departing for that event right now. Mr. Cooper is going to take over chairing the rest of the hearing.

But I thank the witnesses for their testimony here today and look forward to following up on these issues.

So, with that, again, Mr. Bacon is now recognized.

Mr. BACON. Thank you, Mr. Chair, and thank you, gentlemen, for being here.

I have a question on the university affiliated research centers. As a Representative of Nebraska, I stood at the doorstep of USSTRATCOM [United States Strategic Command]. And the National Strategic Research Institute at the University of Nebraska is dedicated to combating weapons of mass destruction. It is the only university affiliated research center sponsored by a combatant command, which has engaged over 40 department sponsors and research valued at over \$160 million.

So my question is: How are the entities you represent investing in academic partners to support mission requirements and utilize the dedicated research and engineering expertise ready to support the Department of Defense? Thank you.

Secretary GRIFFIN. Well, university affiliated research centers, U-A-R-Cs, UARCs, are among our go-to establishments for when we have technical questions, technical design, technical development for cutting-edge projects that are not something industry can supply—end of sentence. So, we use them a lot.

The largest of those UARCs is the Johns Hopkins Applied Physics Lab, up the road here in Maryland, and then we have smaller UARCs throughout the country. They are well and fully utilized, sir.

Mr. BACON. I know the one in Nebraska loves what it is doing with STRATCOM and I think they are now working with SOCOM [United States Special Operations Command].

Gentlemen, anything else?

Secretary GEURTS. Yes, sir, at least for the Department of the Navy, they are vital, Johns Hopkins being one of many, Penn State. I mean they are an integrated part of our R&D establishment and we could not complete the mission without them.

Secretary ROPER. Sir, for Department of the Air Force, they are critical and their role is changing, now that we live in a world of global tech. So we love initiatives. We are working with universities like our AI Accelerator at MIT was a big win for us last year, having world-leading researchers at the CSAIL [Computer Science and Artificial Intelligence Laboratory] Institute working on problems of military import.

But when we need to transition that technology into the military, we need people that understand our programs, that have clearances, and that have the technical chops to be able to guide us between the scientists and the program managers. I think they are going to be extremely vital to help us bridge between commercial innovators and the Department, just like they have in times past, while continuing their defense-unique role.

Secretary JETTE. Sir, the Army has three UARCs. One is the Institute for Collaborative Biotechnologies, focused on biotechnology from anything from consideration of disease issues to using biometric—or biomaterials to create electronic devices and material structures. That is at the University of Santa Barbara.

We have the Institute for Soldier Nanotechnology, the one I mentioned up at MIT, where we do a great deal of technology development for anything from fabrics and clothing, which sounds not very sexy but, when you think about what Under Armour does and how much money they made for some of their clothes, apparently it is pretty interesting technology.

And then we have the Institute for Creative Technology, which focuses on—it leverages the industry—entertainment industry and the technologies there to help us with training and artificial environments.

Each of those places that we work also have a related Army laboratory, so that we make sure we have a relationship that can bring the technology out of those into the Army, when appropriate, or bring problems from the Army into them.

Mr. BACON. A follow-on question and I want to talk about—ask about particularly nuclear C3 or NC3 [nuclear command, control and communications].

Most of that technology is 1970s that we do at the new STRATCOM building. Is there an opportunity here with the universities or UARCs to figure out where we are going to go with the next level on NC3?

I don't know. It is maybe more of an Air Force question but it could be Navy, too. Thank you.

Secretary ROPER. Yes, Congressman, we have a large portion of the NC3 portfolio, and absolutely.

There are a lot of commercial technologies that we can bring to bear for NC3. And General Hyten, our Vice Chairman at the Joint Chiefs, really brings a great perspective coming in from STRATCOM that having the one trusted, perfectly secure way of communicating is probably not our future. We are going to need to have multiple conduits, use statistics as our ally, and a lot of commercial technology can aid that.

Then similar to the previous point, we can work with commercial innovators but when we got to get down to classified applications, we need trusted insiders and that is what UARCs and FFRDCs [federally funded research and development centers] can do.

In the case of MIT, we have Lincoln Laboratory. It is a federally funded research and development center sitting up you know at Hanscom Air Force Base that can work closely with campus to take technology out of that university into the Air Force. The same model will work well with companies.

Mr. BACON. Thank you very much.

Mr. Chairman, I yield back.

Mr. COOPER [presiding]. Thank you.

Ms. Trahan.

Mrs. TRAHAN. Thank you, Mr. Chairman.

I am so happy that you brought up MIT Lincoln Labs, right in the heart of my district. Thank you for that.

This question is actually for you, Dr. Roper. The SBIR program, the Small Business Innovation Research program is one of the most successful and effective programs that is authorized by Congress.

I was surprised and, frankly, a bit concerned when I learned that the Air Force Innovation Unit is attempting to unilaterally implement drastic changes to that program. Many of those changes diverge from the intent of the SBIR law. And I know—well, I understand that you are interested in transforming the Air Force's acquisition system in order to appeal to the startup world.

Instead of having companies submit Phase 1 proposals to technical topics written by the Air Force subject matter expert, the Air Force now has Pitch Days, where literally hundreds of companies are awarded Phase 1 SBIR grants that are not in response to a specific topic but, instead, give each small business initial funding and 3 months to form a feasibility study and customer discovery of the technology.

I share your goal of making the Air Force and the entire DOD more adept at attracting the best innovation from the small business community but I do have concerns about the integrity of the SBIR program. And of course, if the Air Force wants to propose a new grant program, we would be happy to consider supporting that.

Can you just speak to these changes, as well as the goals of these changes?

Secretary ROPER. Yes, Congresswoman. It is a topic I am truly passionate about. I will just say I know I won't be able to answer all your questions here. I will be happy to come chat with you or any other members of the committee.

In a nutshell, the SBIR is an amazing program. It is amazing that we have this authority to go to work with early-stage companies. And coming into the Air Force, the thing that was missing was the connection to the acquisition system, so companies with good technology trying to find their customer, their mission, and not having the program dollars to transition them.

The other limiting factor we had is that our model didn't work really well with dual-use companies, companies that are working on tech that could apply to both the military mission as well as a commercial mission. And so with 80 percent of the Nation's R&D in commercial, it is a huge risk to the country if we can't work with that 80 percent.

So what we have tried to with the big overhaul at SBIR is bring in program dollars for transition, have a model that works with those dual-use companies, who won't know how to propose to a specific DOD topic but that can propose to an open topic, which is bring us interesting technology and let us help work on mission with you.

In the future, we have to do both. We have to keep the best of what worked in the past for defense-focused companies, allow them to work without having to work through commercialization channels, but we need a new process that allows commercial companies in.

What I think we have succeeded on is the latter. It is getting most of the hype and buzz because it is new and it is augmenting the system in the past but our goal is to keep the best of both going into this year, ma'am.

Mrs. TRAHAN. Great. Thank you for that. And so in terms of customer discovery, can you just speak to how, you know, normally those were written on spec for something specific. And now customer discovery—I understand that in the startup world is kind of where I came from but translate that to me in your world.

Secretary ROPER. Yes, ma'am. So we have those specific solicitations you have referenced, where we say we need a thing that flies this far, this fast, and a company that knows defense knows how to propose to that.

A company with amazing technology won't have the people on staff that understand our missions. And so they may know that there is a military application but they don't know where it is.

By having very small entry-level awards, around \$50K, it allows the company to bring their technology, use that money to apply it to a military mission that we help them find so that, when they are talking to that customer at a Phase 2 Pitch Day—so you have got the warfighter, the acquisition person, the technologist across the table and they are saying what it can do, they are informed and they don't have to have that DOD experience to get there.

Last year we did a thousand—we brought more money into SBIR than has ever been in before because of the program dollars and private dollars that came in. We did over a thousand contracts, 700 companies, 350 new to the government, and most of them saying they had never planned to work with us.

So we are not willing to do away with the old, but if that trend doesn't continue so that companies say I want to go work with the Air Force because it is easy to innovate with them, we won't keep

up with China. Remember, China has a nationalized industry base. So this is a model to try to mitigate that risk.

Mrs. TRAHAN. Great. Thank you. I yield back.

Mr. COOPER. Thank you.

Mr. Scott.

Mr. SCOTT. Thank you, Mr. Chair. Dr. Roper, the last time I saw you was at the Advanced Technology and Training Center in Warner Robins, just outside of Robins Air Force Base. And we have talked about a lot of advanced weapon systems today.

Could you speak to how the Air Force is using the Advanced Technology and Training Center to improve depot maintenance with regard to the more traditional weapon systems, the C-130s and everything that we use today?

Secretary ROPER. Yes, sir, another topic I am very passionate about.

I mean 70 percent of our money is in sustainment. So just from a business case, we should be putting more technology to lower the cost of sustainment. And coming into this job early on, I didn't know a ton about sustainment. All of my programs had always been development. So it is an amazing enterprise, sir. The depots are true national assets but not getting a lot of the technology from the Air Force.

So we did a couple of things. We stood up the Rapid Sustainment Office to help transition technology from the research lab, from industry, into the depots and flight lines. And they have done a great job getting predictive maintenance operational, 3D printing operational, and to your point, sir, these training centers.

The point of the training centers is not to dump technology on the sustainment enterprise, where they don't know how to use it. So walking through, early on, there was a laser in the corner of the depot in one of them, I can't remember which one, that could strip paint off of tools that normally takes hours to do, but no one was using it simply because training wasn't there. People were afraid to.

This is a friendly off-prem facility with some of the world's leading 3D printing and other technologies like cold spray, where we help the maintainers understand how to use it and the results have been phenomenal. And I definitely enjoyed doing the ribbon-cutting with you, sir.

Mr. SCOTT. It is a great partnership. And I want to focus on one of the points you made. Seventy percent of the budget is sustainment. And one of the challenges has been with the older systems, sometimes the suppliers don't have the parts that are available. And so a lot of concern about contracting on systems as we go forward.

3D printing is there. As we get into future procurement contracts, have the Departments adopted any type of standard clause that the military would be entitled to standardized credible designs?

Secretary JETTE. Well I can tell you what the Army has done. So when you are waiting to be confirmed, you may sit there a while, so you make a list of things that you think are important. One of the ones, having IP [intellectual property] myself, was to develop

an IP policy that meant something, as opposed to what I had experienced when I was in the Army.

So we developed an IP policy which gives equity to both the developer on the outside, make sure you have got proper licensing coming in, and vice versa. If the government paid for it, the government should not only own it, which I found is a big problem we have, but they should get it delivered, which I was always expected to do on the outside. We have a lot of technology we paid for but we don't have in our possession.

So what we have done is made a specific concerted effort. I am trying to transition away from Level 3 drawings, which give me a stack of drawings, to digital models and that ties into advanced manufacturing. We call it advanced as opposed to additive because there is subtractive, there is conformal, there is a number of other methods, as well, we are trying to apply, and being able to have all that data put together in a digital thread that is available all the way out to the front edge of the battlespace.

Mr. SCOTT. I appreciate that comment. That is one of my primary concerns. I believe in the partnerships, especially with the more advanced institutions that have been mentioned here earlier. But in the end, if we pay to develop the system, we shouldn't have to pay to use the system. There has got to be a square deal there.

One of the questions I do have, as we talk about the move from the development into the actual use of it, where we get into a more classified scenario, is if you have an extremely valuable person, that is either in the private sector or currently working at one of the colleges, and we want to transition them into one of the Departments, are you limited to the GS schedule to transition people in, when they can make 2, 3, 4, 10 times more if they stay in the private sector?

Secretary GEURTS. Yes, sir. This committee has given us and the NDAA has given us lots of authorities. There is a variety of them we have used, depending on the case. So I think the authorities are there. It is not yet common practice to do that at scale, I would say, across the departments. So we are kind of learning from each other.

We have taken, we call it 1101 authority, 150 percent of SES [Senior Executive Service] pay to match that out. That has been a great authority to bring in. There are also experts for us to help on different things.

So I think the issue is less needing authorities. We just need to get them into practice.

Mr. SCOTT. But you are capped at 150 percent of the GS schedule?

Secretary GEURTS. Yes, sir.

Secretary ROPER. And there is also the enhanced pay authority, which has been wonderful for the Air Force. It allows us to go up to \$318,000, I believe. It is letting us get great experts that wouldn't come into the government otherwise. I believe we have done seven hires. We are able to do 10 across the Department of the Air Force. The authority expires next year, I believe, and I would certainly ask for Congress to consider extending it.

Mr. SCOTT. Okay, thank you. Thank you for your service.

Mr. COOPER. Thank you.

Ms. Houlahan.

Ms. HOULAHAN. Thank you, gentlemen. Thank you, Mr. Chair.

I don't know if you all remember about a year ago when I sat in this chair as a brand new freshman, I asked you a question regarding what are we doing to elevate women and people of color in STEM and, particularly, in your organizations. And I am a proud alum of MIT and I served at Hanscom Air Force Base. So I have a lot in common with all of you folks.

I also aspired, when I was a young girl, to be Sally Ride but she said, famously, you can't be what you can't see.

So I was really excited to see that in section 229 of the NDAA we had the diversification of the research and engineering workforce of the Department of Defense. And that was included, thankfully, in the NDAA. And I was wondering if you might be able to give us an update or an assessment on how or if you have learned anything since about who works within your ranks, what your hiring practices are to encourage diversity and inclusion of more people, and what you are doing to attract more people who are not traditional STEM professionals.

Secretary GEURTS. Yes, ma'am, maybe I will start here. And again, I think great learning across the Department and diversity in all its dimensions, whether gender, race, how you think, who you know, what your skills are, is our ultimate competitive advantage. We have got to foster that.

The Department of Navy, a lot of focus on STEM and promoting from the earliest onset programs are at the high school intern level. We have summer interns. We have college interns. We have the Naval Academy has got programs. We watch the diversity statistics in there.

Ms. HOULAHAN. But are you, in fact, watching them? I mean are you—

Secretary GEURTS. We are. So for the summer hires last year, we had 43 percent female participation at the high school level, 32 percent at the college level. That is not, obviously, where we want to get to. In the U.S. Naval Academy programs, it is about 60 percent female in that one dimension.

And so we are watching it and then working hard within the Department to have the right workforce, how we choose people, how we promote them, what the selection panels look like so everybody has got equal opportunity, as they work their way through the system.

Ms. HOULAHAN. Is there anything that we can be doing to be helpful in asking for those metrics or measure of performance standards? I think one thing that I reflect on in my first year in Congress was the ability to recruit for the academies and, specifically, within my office, trying to make sure that I understood what, of the 70 or so people who applied, what the diversity was there, and you know kind of asking that question across the country would be a good one.

Is there anything else that we can be doing to be helpful in asking—

Secretary GEURTS. I would say, I mean last year, asking the question was helpful.

Ms. HOULAHAN. Good.

Secretary GEURTS. And then continuing to ask the question.

I think when I look at the NDAA, there is a broad set of authorities there. So I don't know of an authority limitation yet that I would highlight. But we have got to focus on that as we go through; the expedited hiring authority and some of the hiring authorities that let us pick the best performer faster also is a help. That way, we can find best of breed.

And again, I would just say we need to look at it in all dimensions—gender, race—

Ms. HOULAHAN. No, absolutely.

Secretary GEURTS [continuing]. All of them because we need the diversity if we are going to compete and win.

Ms. HOULAHAN. Absolutely.

Gentlemen, do you have anything else?

Secretary ROPER. Yes, ma'am, I do, and we really appreciate you asking the question last year.

If we are going to compete against China long term, we can't have any blind spots. You need people that see the world all different ways, because the next Jobs, or Gates, or whoever could be that person that is not coming into the workforce if there is not an open door.

In addition to what Secretary Geurts mentioned, one thing that is helping us, surprisingly, in the Air Force is the Direct Site Hire Authority because we are able to go out and work with organizations, associations that are targeting greater diversity in STEM fields and we are able to use them as job fairs at direct hiring events.

For people that wouldn't think about coming to the Air Force, haven't been exposed, don't have that background, we are able to go out to them and not use the Federal hiring system that I think is too opaque and not useful.

So we had 13 percent increase in diversity hires last year. I think that is great. We can't be satisfied with it but we are not as diverse of a workforce as we need to be. The Direct Site Hire Authority is a great tool to help us get there.

Ms. HOULAHAN. Thank you. And other comments?

Secretary JETTE. I would just say that we did go back and do a good survey of our workforce, trying to make sure we had a good feel for our diversity. And the Army actually came out—the report I received was that we are in good shape. We are proportional. We are above the percentages that the population is in.

Ms. HOULAHAN. Meaning you look like the population, the general population?

Secretary JETTE. Yes, right. Actually, we probably look a little bit more diverse than the general population.

Ms. HOULAHAN. And is that across all kinds of career fields or just specific careers? I mean do you look at the depth of kind of detail?

Secretary JETTE. Yes, I didn't look at beyond the depth of the inside of the ASA(ALT) [Office of the Assistant Secretary of the Army for Acquisition, Logistics and Technology] itself, in general. I will say that I think there are programs—we do have programs that do outreach to HBCUs [historically Black colleges and universities], MSIs [minority-serving institutions], et cetera. I think that we go

out to 30,000—we have seen 30,000 students a year, where we send professors or laboratory people out to schools, do lectures, meet people. I know that that is a big motivator.

Just as you said, if I don't know this is a possibility, I don't pursue it.

Ms. HOULAHAN. Right. And I know that I have run out of time and I am so sorry for running over, but I really would like to have the opportunity to follow up with you all on this because I mean we are all a bunch of engineers and geeks. You know performance means that we have to measure it. So I just want to make sure that we genuinely have the metrics and performance standards that we are all looking towards to make sure that we are making progress.

And I yield back. Thank you.

Mr. COOPER. Mr. Waltz.

Mr. WALTZ. Thank you, Mr. Chairman.

I just wanted to echo my colleague Representative Houlahan's encouragement and continue to work on the issue of diversity. And I certainly want to thank all of my colleagues for including, in the last NDAA a study for the National Academy of Science on how we can better include HBCUs and minority-serving institutions in our research development enterprise.

Dr. Griffin, I wanted to shift to some of—echoing my colleague the Ranking Member Stefanik's questions on Talents, on how we handle our technology protection. I also sit on the Science and Technology Committee and I am really wrestling with how we balance the openness that is one of the fundamental aspects of academia and our research and development enterprise, and I think that is one of the things that has made it great, but protect our IP.

And I have to be candid. I am not going to continue supporting the funding of Beijing's research and development. And I think we have to be honest, and open, and really I think very aggressively move out on how we strike that—how we strike that balance. And I agree with you. I agree with our testimony that immigrants form the basis. I love the statistic that you cited on how many Nobel Peace Prize winners have gone to immigrants, 38 percent I believe.

But would you support legislation that limited or, frankly, barred Defense Department R&D dollars going to institutions that have research professors in the Talents program? I mean I think we need to draw a hard line but I want your perspective, please.

Secretary GRIFFIN. Specific organizations, like the Thousand Talents program and all that, can be highly suspect. And I would not want to make a blanket assertion about what legislation we could or couldn't go with. But yes, we are concerned about those kinds of organizations. We are concerned about the idea that we would not know who is doing work being done on DOD dollars. I agree with you on those concerns.

Mr. WALTZ. I think we need to—Dr. Griffin I think we need to—I think we are all concerned. I think we have been concerned for some time.

I am interested in what concrete action and where we can draw some lines. They are stealing the way to the top and we will continue this arms race of money but we are facing an adversary, for

the first time ever in our history, that is on track to have a bigger economy than ours.

So we could have a long debate about our innovation talent and our values versus theirs but I am not for continuing to pour taxpayer dollars into their R&D. And what concretely can we do, can we help you all do, to stem this siphoning that continues to happen?

Secretary GRIFFIN. I understand and we are concerned. It is an extremely difficult problem in order that we—we don't want to become our adversary in the process of remaining ahead of our adversary. We—

Mr. WALTZ. We also don't want to be sharing a world or subsume to our adversary, which is President Xi's stated goal through the use—you know China 2025 and through, essentially, stealing our technological edge.

Secretary GRIFFIN. I could not agree more. I came back to the DOD in order to deal with this issue of great power competition with the skills that I can bring to the table, which are, as Ms. Houlahan was saying, geek skills and not warfighter skills.

Mr. WALTZ. Right.

Secretary GRIFFIN. But I want us to be aware of the long game, the long-term strategy of changing what got us to where we are. I want us to go after, with full force, those people who are here under false colors, those people who commit espionage or IP theft. I want us to go after the bad actors.

Mr. WALTZ. I think, just in the interest of the time, I would welcome a follow-on with any and all of you. I am sitting on both sides of this, you know, on both committees.

But we have to be cognizant that every single Chinese student, professor, you name it, is violating Chinese law, under President Xi's intelligence laws, to not provide whatever they are asked for.

So they have no choice. They can be the greatest people that we have ever known, and wonderful, and willing, but their families are held at risk should they not provide. And we have to be cognizant of that and I think we need to take some pretty meaningful and drastic action.

Thank you. I yield my time and I look forward to a follow-on conversation with you.

Secretary GRIFFIN. Thank you, sir.

Mr. COOPER. The gentleman's time has expired.

We will now have a second round of questions. I will recognize myself first.

I was wondering if the witnesses would be willing to supply the subcommittee with a list of industries or scientific areas in which U.S. companies are not the world leaders. Because it is my impression, for example with 5G and our competition with Huawei, that the leading competitors are Ericsson and Nokia but not a U.S.-based company.

So I would be interested in areas like that because I think sometimes we blithely assume that U.S. companies are leading the way, and always on top, and I think, increasingly, we may not be. Facial recognition—there are a number of things where it could be that, in order to get world-class expertise, we have to go outside our borders.

Would you all be willing to supply the subcommittee a list like that? Okay, thank you.

[The information referred to can be found in the Appendix on page 103.]

Mr. COOPER. The second question is this, and this is a bit more lawyer-like—I am worried that contracting with the defense industry hasn't kept up with the times. When I was looking, for example, at the various RKV contracts, I saw, in bold print at the start of the contract, the Air Force retains design authority. And that looked pretty authoritative and important.

And I looked further in the contract to see that the defense industry really was helping the Air Force to come up with their design parameters. So that made me wonder if this was circular and who, in fact, was designing the RKV.

So it seems to me, and this is just anecdotal experience, that more and more our services are essentially kind of shopping from a catalogue to see what industry has to offer, as opposed to specifying to industry exactly what they need.

We will have testimony tomorrow from a very important four-star, and my purpose isn't to embarrass him, but he makes this seem like it is a virtuous thing to do. We don't know what we want, so why don't you tell us and then we will pick what we like? And that might work in an environment in which U.S. companies are number one but it is not going to work if U.S. companies are second, third, fourth, fifth place.

Secretary GEURTS. Yes, sir, from the Department of the Navy, I think it, like many things, depends. There is no absolutes.

What I would say is the government just blindly throwing out a specification without understanding is it obtainable, or at what cost or price, is not terribly useful. Likewise, having the contractor propose the specification without any expertise or oversight is not useful.

What we try and say in our frigate program is probably our best example of, we talk about the need but not the detailed specifications and then iterate with numerous industry partners in competition to find that sweet spot of capability, versus cost, versus schedule. And I think that is a good place to be.

Secretary ROPER. Representative, it is a great question.

I can't speak to the RKV. That is under Dr. Griffin's purview. But one thing that is helping us in the Department of the Air Force are the rapid prototyping authorities that were granted by Congress. It is allowing us to push design more on the government side, without tying the program to a long production and sustainment where we can't get out of it. Speeding up programs, when you can prototype, is the bridge between the idea and the requirements that come from it to the production line and it is also a natural conduit to get things out of the laboratory into programs of record, without having to commit to them up front.

The lesson we have got to learn across the Department is, if we fund things late to need, then you have to go with what industry can build. If you have the foresight to fund things a little ahead of need, then you have time to explore designs when the government is driving towards a more aggressive solution. And I hope that we will learn that lesson, sir.

Mr. COOPER. Mr. Jette—Dr. Jette.

Secretary JETTE. Sir, very much like Dr. Roper, there are some circumstances where just shopping is probably the appropriate thing because we need something and we need something quick.

We have, in the Army, changed our lexicon. Pretty much, we have said we have requirements. Now we are talking about characteristics versus requirements, where requirements are the type of thing we put on the street for a production model and the characteristics are the type of thing that we are evolving through digital design, prototyping, and a cycle between these and industry. That way, we can get all the way from just industry talking to us to building a digital design, to a refined design, to, finally, a prototype. And in each phase, it gives us a chance to get industry input and insight, where we may not have seen it, but not necessarily give our soul away to them.

Mr. COOPER. My time has expired.

Ms. Stefanik.

Ms. STEFANIK. I yield the balance of my time to the final question for the minority side to Mr. Waltz.

Mr. WALTZ. Thank you, Ms. Stefanik.

I wanted to—two questions for you, Dr. Jette. I just wanted to get your assessment on the realignment of the Army labs under AFC, under Army Futures Command. I am sure you are aware there are concerns floating about short term versus long term and just how that alignment is going.

The other question, I think not only for you but for everyone, is you know we have a lot of discussion about recruiting the right talent. We were just out at the JAIC [Joint Artificial Intelligence Center] and, maybe a little counterintuitively for an AI Center, their number one concern is human talent, right, database managers, all of the folks that we all struggle to bring in to the enterprise.

One of the things that I, personally, have seen as a still-serving guardsman is that we have a database of our civilian skill sets but it is not structured in a way that is useable, searchable, and the Guard and Reserve certainly isn't organized around it. So if you ask the Guard or the Reserves how many people do you have working at the Big Five tech firms or you know have those civilian skill sets that can be that bridge, and are they better used for that civilian skill set they bring in already, already cleared, already in the system, you know ready to go, or are they more useful as you know an O4 MP, military policeman, or a database scientist that they are bringing to the fight?

So those are the two, the labs and then, also, that civilian database that somewhat exists but I think could be used—in my opinion, could be used better, or maybe there are efforts underway that I am unaware.

Secretary JETTE. Sir, both great questions.

So AFC, the laboratory system, the DECs, the development and engineering centers, the Army Research Lab, the Army Research Office are all under one entity, CCDC [Combat Capabilities Development Command], under AFC.

I have—there is an Army directive the Secretary signed out that puts me—continues my role as overarching supervisor of the facility. I work very closely with General Murray on programs. My

head of like my DASA(R&T) [Deputy Assistant Secretary of the Army for Research and Technology], who is my deputy for research and technology, participates in program reviews. We have phase gate reviews. So, we are deeply involved in the technology, technology selection, maturation. We still have transition agreements from the programs.

So I think, at this point, there is always, when you change something between organizations, there is—I always say there is forming, storming, norming. We are past any of the storming. We are pretty much forming. Occasionally, we will have a tornado roll by and Mike Murray and I will resolve the issue. But things are, generally, working fairly well.

In the recruiting talent department, so it would be interesting to see what State you are referencing because we have just rolled out a new personnel system to the States. It is IPPS-A [Integrated Personnel and Pay System—Army] Rev. 2 and it should begin picking up these type of things.

We have another one, which is going on, which is IPPS-A Rev. 3. That won't be out for a little bit longer and that will subsume everything, all three COMPOs [components], to be able to manage. And it has got a—

Mr. WALTZ. I would just encourage you to take a hard look down at the user level because all I hear are complaints about that system.

Secretary JETTE. Okay.

Mr. WALTZ. So I would just encourage you to deep dive because I still, on the weekends, jump out of perfectly good airplanes and then hear about the complaints.

But it is one thing to get it structured in a new system. It is another thing, you know, as an institution, to mine that, and to utilize that, and perhaps to pluck that data scientist out of one thing where he is in his military occupational specialty and use him—him or her—excuse me—for that civilian skill set.

And I think, if we saw that in the stability operations world—are they better as a deputy sheriff or as a trigger-puller, right, and that back and forth—and I think I would venture to say that it is not a silver bullet but just something I would encourage you to look at.

Secretary JETTE. Yes, sir. And we never even knew the list before. Now we, at least, are working on getting the list.

We pulled a number of them out and formed the 75th for work under AFC—

Mr. WALTZ. And DIUx [Defense Innovation Unit], but it has been ad hoc. It has been—

Secretary JETTE. Yes, sir.

Mr. WALTZ [continuing]. You know by personality and by who you know, rather than a systematic approach.

Secretary JETTE. You are right, sir. Just it is going to take a little time to get this turned into a real process.

Mr. WALTZ. Thank you, Ranking Member. I yield.

Ms. STEFANIK. I yield back.

Mr. COOPER. Thank you.

If there are no further questions, the subcommittee is adjourned. [Whereupon, at 3:46 p.m., the subcommittee was adjourned.]

A P P E N D I X

MARCH 11, 2020

PREPARED STATEMENTS SUBMITTED FOR THE RECORD

MARCH 11, 2020

Opening Statement
Chairman James R. Langevin
Intelligence and Emerging Threats and Capabilities Subcommittee
Fiscal Year 2021 Budget Request for Department of Defense
Science and Technology Programs:
Maintaining a Robust Ecosystem for Our Technological Edge
March 11, 2020

The subcommittee will come to order.

I am pleased to welcome back to this committee the Department's highest Science and Technology leadership to testify on the Fiscal Year 2021 President's Budget Request for the Department of Defense (DoD) Science and Technology (S&T) Programs. Before us today are the Services' technology and acquisition executives. These individuals must divide their attention between fielding the best technology to the warfighters as quickly and as efficiently as possible in the near and mid-term and protecting the science and technological innovations that enable the Department to keep its technological edge over the long-term. Under Secretary Mike Griffin; Assistant Secretary Bruce Jette; Assistant Secretary Hondo Guerts; and Assistant Secretary Roper; we welcome you and look forward to this important discussion.

In a time when our national defense planning has shifted focus to great power competition, addressing the challenge from rising science powers requires an ambitious plan of national investment and aggressive talent development in science and technology.

Funding for basic research, applied research, and advanced technology development in our universities, laboratories, small businesses, and the tech sector, seeds the necessary science to grow the advanced technological capabilities required for our next generation military engagements. Yet with bipartisan support for a drastic increase in investment in our national security innovation base in this era of strategic competition, somehow growth in the science and technology budget is almost always sacrificed to field the mature technologies of today. How is it that this year, with an Under Secretary of Defense for Research and Engineering created for the very purpose of looking past the horizon, and with a national security strategy that claims to be focused on deterring the wars of the next two to three decades, the Department was able to submit a budget request with less proposed S&T funding than last year?

Last year I spoke of the declining buying power of the Department's S&T portfolio. Due to inflation and labor escalation of scientists and engineers, despite

Congress' efforts to restore S&T funding each year, the **S&T budget** has been **effectively shrinking** for the past decade. In FY21, with the total Department and Defense-wide S&T budgets actually decreasing for the first time in years, we are left wondering what the future of our defense will truly look like. Without both Department leadership and Congress protecting the S&T budget, our warfighters risk losing the technical edge to prevail in future conflicts of ever evolving complexity.

The Department's S&T ecosystem is complex and comprises agencies; offices; laboratories; federally funded research and development centers; university affiliated research centers; academic partnerships; test and evaluation entities; and partnerships with the private sector – including small businesses. In the past four National Defense Authorization Acts (NDAA's) alone Congress has granted over thirty authorities to improve the Department's S&T workforce; facilities; infrastructure; and access to small businesses; to champion in-house and extramural innovation for the future of force modernization, warfighting operational concepts, and acquisition. We remain disappointed that many of those authorities have been underutilized by the Department, and the FY20 NDAA required the Secretary to submit a master plan for implementation of authorities relating to science and technology reinvention laboratories. I look forward to hearing how you're doing in championing them today.

If the U.S. is to remain a global leader in technology, we cannot simply **play defense, we must also play offense**. Investments in science and research and other development efforts across the whole-of-government are necessary and vital to maintaining a technological edge. We must invest in STEM education; programs that develop junior talent into future tech leaders; university research; and actively endeavor to diversify our S&T workforce. Last year the NDAA included Section 229 on Diversification of the research and engineering workforce of the Department. And Section 262 established a National Study on Defense Research At Historically Black Colleges and Universities and Other Minority Institutions.

We must implement policies that promote a sound economic, political, and strategic environment on U.S. soil where global collaboration, discovery, innovation, public institutions, and industry can all thrive. I recognize that the open dialogue and debate of academia can be anathema to the secrecy we rely on in the Department of Defense. But we must also recognize – and embrace – the competitive advantage our free society provides us to out-innovate and develop better products faster. Indeed, our free society and open, basic research environment focused on discovery for the U.S. – and the world – has, for the last several decades, allowed our American universities to undertake nothing less than a talent acquisition program for the U.S. economy.

To that end, last year this committee, in partnership with the House Science, Space, and Technology committee, enacted in the FY20 NDAA Section 1746: Securing American Science and Technology. This provision created an Office of Science and Technology Policy-led interagency working group and a National Academies of Science roundtable with academia to tackle issues of foreign influence, cyber-attacks, theft, and espionage. These teams are charged with developing best practices for Federal science agencies and grantees, while accounting for the importance of the open exchange of ideas and the international talent required for scientific progress and American leadership in science and technology.

Setting ourselves apart from our strategic competitors also means abiding by our American values and keeping our policy as – or more – developed than the technology itself. Foundational development for the current understanding of Artificial Intelligence (AI) done in the 1950s and ‘60s was funded through **S&T budgets** by DARPA and the Office of Naval Research and aided by the convening power of universities. ¹ Now more than half a century later – this year the Defense Innovation Board helped the Department begin necessary discussions on Ethics in AI, and the National Security Commission on Artificial Intelligence, established in the John S. McCain FY19 NDAA, is preparing to deliver its first tranche of recommendations on talent, appropriate national security missions, and how to protect and build upon our tech advantages.

For each of the rapid technological advancements outlined in the NDS, and for Under Secretary Griffin’s modernization priorities, Section 232 of last year’s NDAA tasked the Department to lean forward on strategically developing policies on how we should use and deploy these future technologies, and how these emerging capabilities will contribute to new security strategies. It also directed a strategy and implementation plan for 5G information and communications technologies; a Department-wide software S&T strategy; and a Defense Science Board study on national security emerging biotechnologies.

Following on the importance of developing the Department’s policies and understanding the implications of these many emerging threats, we are disheartened that this year the Department decided to terminate the Minerva program. Minerva is a unique social science basic research program that has helped DoD understand nontraditional threats to national security – from the rapid growth of China’s technological prowess; to the human systems underlying the cyber threat; to the behavior of populations involved in conflicts; and to the mind of a suicide bomber. How can the Department continue to build out its policies without

¹ Babb, Colin E., “How We Got Here – A Small Tale of the Autonomy and the Sea”, Future Force: Spring Edition 2014

having the tools, techniques, and frameworks to understand the dramatically changing landscape of our future threats?

Finally, I must emphasize that we will not attain the technological edge we need if we refuse to take risks, push the scientific boundaries, and challenge the red tape. We must empower those who lean forward on innovation – whether it be in our laboratories, small businesses, universities, research offices, tech sector, or contracting offices. I realize this does not come easily for the Department as the overriding culture is one of risk avoidance, but we need to empower the S&T workforce and community to enable technological leaps that will ensure our warfighters never see a fair fight.

It is incumbent upon the leadership in the Department to champion this important ecosystem, develop and attract talent, improve its facilities, and work to remove bureaucratic barriers to allow the workforce to concentrate on the best science. As long as the Department is transparent, Congress – and this subcommittee in particular – must be willing to provide top-cover for those that fail fast, fail smart, fail forward, internalize the lessons-learned, and achieve the scientific discoveries that will help us win in the future.

I'll now turn to Ranking Member Stefanik for her remarks.

**STATEMENT OF
MICHAEL D. GRIFFIN
UNDER SECRETARY OF DEFENSE FOR RESEARCH AND ENGINEERING**

before the

**HOUSE ARMED SERVICES
SUBCOMMITTEE ON INTELLIGENCE, EMERGING THREATS AND
CAPABILITIES
FY2020 SCIENCE AND TECHNOLOGY POSTURE HEARING
11 MARCH 2020**

INTRODUCTION

Chairman Langevin, Ranking Member Stefanik, and Members of this Subcommittee: thank you for the opportunity to come before you today to discuss the Department of Defense (DoD) Science and Technology (S&T) efforts. Maintaining technological superiority is critical to the future security of the United States and its allies – and the foundation for this superiority is a strong S&T enterprise.

When I last appeared before you, I noted that China and Russia were testing and deploying new and unique weapons as they seek to offset the edge in military capabilities the United States and our Allies have enjoyed since the end of the Cold War. That activity continues at an alarming rate, and neither country appears likely to change course. That leaves us, and our Allies with no alternative but to respond with an aggressive program of technology modernization focused on growing, maintaining, and in some cases regaining, our technological edge. I am here today to report on how we are doing that.

THE OUSD R&E ORGANIZATION

Two years ago, when Congress established the office of the Under Secretary of Defense for Research and Engineering, it gave that office a mandate to advance technology and innovation within the Department, and in partnership with the Under Secretary of Defense for Acquisition and Sustainment (A&S) to deliver advanced capabilities for the joint force. To that end, the R&E organization is composed of three major entities: 1) Research and Technology (R&T), which includes oversight of the labs, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARC)s, academic research, manufacturing institutes and Small Business Innovation Research (SBIR); 2) Advanced Capabilities (AC), which conducts developmental test and evaluation, accelerates and prototypes more mature technologies to support transition to acquisition; and 3) the Modernization organization, responsible for unifying and advancing the Department's investments and capabilities pertaining to the National Defense Strategy (NDS) modernization priorities. Each entity is headed by a Director for Defense Research and Engineering (DDRE), and collectively they comprise the research, development, engineering, prototyping, test and evaluation responsibility of the Office of the Secretary of Defense (OSD).

Several other offices, defense agencies, and field activities crucial to the national research and development enterprise fall within the R&E organization: the Defense Advanced Research Projects Agency (DARPA), the Defense Innovation Unit (DIU), the Defense Technical Information Center (DTIC), the Missile Defense Agency (MDA), the Space Development Agency (SDA), the Strategic Intelligence Analysis Cell (SIAC), and the Test Resource Management Center (TRMC). Collectively, the FY21 request for these R&E organizations is \$16.2 billion.

- DARPA, with a \$3.6 billion FY21 budget request, has a 61-year legacy of developing breakthrough technologies and capabilities that both avoid and impose technological surprise. DARPA remains one of this nation's brightest crown jewels. I am honored to be able to assist and support that agency in carrying out its mission.
- DIU, with a \$57 million FY21 budget request, seeks out commercial products and solutions for military applications, which come from businesses that do not typically engage with DoD. Working with potential military users across the Services and using an expedited contracting process, DIU ensures the Department's access to the highest technology segments of the U.S. industrial base. This request supports DIU's efforts to add transformative capabilities and transition successful solutions to the warfighter.
- DTIC, with a \$62 million FY21 budget request, is responsible for collecting, curating, and disseminating DoD technical information for search and download by DoD, industry, and public users.
- MDA, with a \$9.2 billion FY21 budget request, is charged with developing and deploying a layered Missile Defense System to defend the United States, as well as our deployed forces, allies, and friends, from missile attacks in all phases of flight. The request reprioritizes and increases investment in defense of the homeland, increases speed of delivery of new capability to address the evolving threat, and continues delivery of capacity for regional defenses.
- SDA, with a \$337 million FY21 budget request, is responsible for driving the department's future threat-driven space architecture and accelerating the development and fielding of the new military space capabilities necessary to ensure our technological and military advantage in space. SDA's initial focus is to develop a low-latency meshed communication network in space to enable beyond-line-of-sight targeting and advanced missile tracking.
- SIAC, with a \$23 million FY21 budget request, collaborates with the Joint Staff, the Services, and the Intelligence Community to provide an operational, technical, and threat-based analytic foundation that informs technology strategies and decisions across the R&E enterprise.
- TRMC, with a \$691 million FY21 budget request, is responsible for oversight of the Major Range and Test Facility Bases (MRTFB), the core set of DoD Test and Evaluation infrastructure funded, operated, maintained and sustained by the Services and Defense Agencies. TRMC utilizes this enterprise-wide perspective to work with the Services, the Director of Operational T&E, Developmental Test & Evaluation, and other stakeholders to assess the modernization and recapitalization needs of the MRTFB and ensure that these assets fully support developmental test, operational test, and live-fire test requirements of the Department.

We are moving out on the direction you provided in the FY20 National Defense Authorization Act and updating the processes by which we 1) oversee developmental tests and 2) appraise the technical risk in the Department's acquisition programs. This office will continue to exercise oversight of ACAT 1D programs with respect to developmental test plans and will advise the

Service Acquisition Executives and the Services on developmental test practices for all other category programs. Similarly, R&E will perform the independent technical risk assessment (ITRA) for ACAT 1D programs, will approve ITRAs performed by the Services on selected ACAT 1B and 1C programs and will establish procedures and standards for ITRAs that are performed by the Services.

MAKING NEW INVESTMENTS IN MODERNIZATION

We are working hard to drive the Department toward technical dominance in the modernization areas outlined in the 2018 National Defense Strategy (NDS). The FY 2021 budget supports the irreversible implementation of the NDS, which remains our guidepost and drives our decision-making. It continues to strengthen military readiness and bolster the modernization of a more lethal force. The President's Fiscal Year 2021 (FY21) budget puts forth the Department's largest research, development, testing, and evaluation (RDT&E) request in over 70 years, at \$106.6 billion, to advance emerging technologies that will expand warfighting advantages over our strategic competitors. Funding for Science and Technology (S&T) is foundational to this, and \$14.1 billion is requested for S&T efforts across the Department.

The NDS outlines a clear approach to outpacing our adversaries, through investment in focused modernization priorities: 5G, artificial intelligence, autonomous systems, biotechnology, cybersecurity, directed energy, fully-networked command, control, and communications, hypersonics, microelectronics, quantum science, and space. These technologies overlap, complement, and connect to create a more lethal future force.

5G

Communications networks have become fundamental to how the United States wages war, providing our forces with information to make decisions, communicate decisions to other warfighters, and direct our weapons. Commercial, strategic, and tactical networks now share a common technology base that is increasingly threatened by peer adversaries who are subsidizing their commercial entities in order to gain military, intelligence, and economic advantage. The FY21 budget requests \$484 million to advance the Department's efforts in "5G to Next G". Thanks to your support for the FY19 reprogramming request and the FY20 budget, we have been able to move out quickly. This year's request builds on important activities we have initiated this past year to 1) accelerate the military's ability to use and protect these new 5G technologies and applications, 2) provide the capability to operate through contested networks and spectrum wherever we deploy, and 3) innovate to ensure that the U.S. is in the lead for the "Next G" – the next generations of mobile information technology. We have moved forward rapidly, and in collaboration with the Services, we have selected our first set of projects that will be executed at four different military bases. In these projects, we will be assessing 5G-enabled applications for military training, smart warehouses and logistics, and spectrum sharing between 5G and military systems, as well as developing technologies to make these networks more secure and robust.

Artificial Intelligence

The National Defense Strategy predicts that artificial intelligence, or AI, will change the "character of war" in ways not yet even imagined. To maintain U.S. dominance in AI, R&E will continue to invest in cutting-edge AI research and will utilize a systems engineering approach to synchronize efforts to accelerate AI adoption across the Department. DARPA's investment in "AI-Next" technologies - where systems are capable of acquiring new knowledge through generative contextual and explanatory models - is key to maintaining U.S. leadership in AI. DARPA will invest \$459 million in FY21 in a variety of future AI technologies, including improving the robustness and reliability of AI systems; enhancing the security and resiliency of machine learning and AI technologies; reducing power, data, and performance inefficiencies; and pioneering the next generation of AI algorithms and applications, such as "explainability" and common sense reasoning. R&E will also focus on moving "AI-Next" to "AI-Now" by partnering with the JAIC and the Services to accelerate and streamline transition from research to use by the warfighter. We will leverage lessons learned from incorporating DARPA's MediFor (Media Forensics) AI software - which detects "Deep Fakes" - into the Joint Common Foundation, an enterprise-wide AI platform under development by JAIC, as well the operational testing of DIU's predictive maintenance prototype to U.S. Army Aviation. We will focus on lowering the barriers to a successful transition, to include bringing a software engineering approach to AI-engineering; improving the connection between test and evaluation with user adoption; and developing infrastructure connections between the Enterprise cloud and edge compute.

Autonomous Systems

Human-machine teaming will significantly transform combat effectiveness by enhancing the freedom and speed of maneuver as well as lethality in contested environments while reducing human casualties and collateral damage. We will continue to focus on advanced autonomy for unmanned attritable aircraft to support manned aircraft operations, persistent operations of unmanned surface and subsurface vehicles under severe sea conditions, and robotic ground vehicles to expand battlefield formation geometry while increasing situational awareness, lethality and survivability. Continued developments will extend these capabilities to include multi-domain, heterogeneous swarms at scale to overwhelm future adversaries by increasing lethality, capacity, and operational tempo. To ensure consistency with the principles recently adopted by the Department for the ethical use of artificial intelligence, we will continue to strengthen the foundation for trust in autonomous systems through rigorous testing. These efforts will develop robust 'test like you fight' test and evaluation methodologies that include realistic environmental and mission variables required to validate intended performance as well as identify and minimize undesirable or unanticipated behaviors.

Biotechnology

Biotechnology has the potential to be a transformative national security technology. For example, biotechnology can enable advanced biomanufacturing that will provide the United States with domestic production of critical supply chain components such as rare earth elements and pharmaceuticals on demand. However, without action by the United States, China will

become the global biotechnology superpower. China has signaled willingness to use this and other emerging technologies against their opposition and adversaries without respect for protocols, conventions, or human rights. The Department is prioritizing partnerships with the commercial sector, and in collaboration with the Services, is focusing biotechnology modernization on three lines of effort: 1) critical capacity and infrastructure, 2) data as a strategic, operational resource, and 3) workforce development, to rapidly field biotechnology-enabled products for the warfighter.

Cyber

For many years our adversaries have engaged in wide-ranging and highly impactful malicious activities in cyberspace, often with near-impunity. Fortunately, through the implementation of the 2018 DoD Cyber Strategy, which embraces a defend-forward and persistent engagement approach, US Cyber Command and the Service Cyber Components are now blunting and disrupting many of our adversaries' malicious cyberspace activities. Through this approach, and by leveraging new capabilities made possible through significant and long-term DoD S&T investments, our cyber forces are now exacting far greater costs on our adversaries. To build on this momentum and ensure increasing dominance, our cyber strategy calls for increased investments to accelerate the development and rapid transition of technologies that provide the basis for 1) vastly enhanced resilience of DoD systems and critical infrastructure 2) substantially increased capacity and unrivaled capabilities for the conduct of cyber and cyber-enabled operations, 3) overmatching skills and expertise within the Cyber Mission Forces, and the Cybersecurity and Cyber S&T workforces. These increased investments will compound the dividends of the now decade-long increased focus, by DARPA and the Services, on the development of innovative and increasingly sophisticated cyber technologies.

Directed Energy

Achieving near-term directed energy technology progress is vital. We must move quickly from the laboratory to the weapons platform, and gain operational experience with these new weapons. Working with the services, we plan to accelerate operational weapon system development and operational experimentation. Through our Laser Scaling Program, we are on the path to building 300 kW high-energy lasers by 2022, increasing to 500-1000 kW capability over the next decade. Through our Rapid Prototyping Fund, the Navy will operationally test new laser and high-power microwave weapon prototypes at sea in 2020 and 2021. Further, we have partnered with the Special Operations Command to accelerate programs for airborne and land-based laser strike weapons and partnered with the Army Futures Command and the Navy to accelerate land- and sea-based laser and high-power microwave weapons for integrated air-and-missile defense, with initial operational capability by FY2022. In anticipation of new and more lethal directed energy weapons transitioning to programs of record, we are upgrading our test and evaluation capabilities with new infrastructure at the test ranges.

Fully Networked Command, Control & Communications (FNC3)

The Department faces two primary challenges with command, control, communications, and networking systems: interoperability and resilience. These longstanding issues are exacerbated

by the absence of synchronization across the Department during previous modernization efforts. The FNC3 strategy contains investment in three areas: 1) a Universal C2 language and architecture, 2) diverse communications links and the software-defined networking techniques necessary to take full advantage of them, and 3) multifunction radio-frequency and optical systems that can perform sensing, communications, navigation, and electronic warfare tasks. This investment approach is being adopted by the Joint Staff, Acquisition and Sustainment, the CIO, and the Services. This represents an important first step to ensuring coordination of these and future investments across the Services, but more work needs to be done. FNC3 is closely tied to other initiatives across the department to include JADC2. FNC3 represents the medium- to long-term vision for JADC2, and is developing technologies that will become an integral part of JADC2 three years into the future and beyond. As such, the testing and demonstration of the FNC3 technologies are included in the JADC2 testing and demonstration battle rhythm.

Hypersonics

The Department continues to accelerate the development and demonstration of prototype hypersonic weapon systems. The \$3.2 billion requested for hypersonics in FY21 represents an increase over the FY20 enacted amount of \$2.7 billion. One specific example of how the FY21 funding increase will be put to work is the accelerated delivery of an Army Long Range Hypersonic Weapon battery. We are also moving towards flight testing of many of our hypersonic weapon system prototypes in 2020. We intend to conduct approximately 40 flight tests over the next four years, with the goal of delivering new capabilities to our warfighters years earlier than previously planned. Additionally, DARPA is investing aggressively in foundational hypersonics research and related technology development. Two programs within the portfolio are being pursued in close partnership with the Air Force – Tactical Boost Glide (TBG), and Hypersonic Airbreathing Weapon Concept (HAWC) – and are scheduled for flight demonstrations this year.

Microelectronics

The department must have assured access to state of the art microelectronics to effectively deliver innovation and modernization into our military systems without compromise. Historically, the department has relied upon a flawed approach to security that has resulted in an inability to access advanced microelectronics. We are working with our partners in the private sector to remedy this situation, by taking a cue from our colleagues in cybersecurity, who have learned over the past decade that perimeter defense (or “trusted foundries” in this domain) does not work, and who have begun to adopt ‘zero-trust’ security models. The \$597 million requested by R&E for microelectronics in FY21 will focus on technologies, frameworks, and policies that will enable a zero-trust, risk-management-based approach to security along the entire life-cycle of microelectronics (to include design, manufacturing, assembly, test, and packaging), informed by data, not perimeters. This work is complemented by a DARPA investment of \$318 million in its Electronics Resurgence Initiative (ERI), which aims to create performance advancements in electronics by leveraging circuit specialization, including new materials, architectures, and designs.

Quantum Science

Quantum science takes advantage of fundamental physical properties to devise new technologies whose performance far exceeds what is currently available. We will continue to emphasize atomic clocks and quantum sensors – these quantum technologies provide the most concrete opportunities for continued warfighting advantage. Longer-term, advances in quantum computing and quantum networking may have an impact on our joint warfighting concepts. Still we caution that the hyperbole surrounding these topics may be getting ahead of their military and economic utility. Our research strategy across all quantum technology areas will be guided by scientific rigor and discipline, and our focus will be on the potential military impact that these technologies can provide. For example, in our FY21 budget request, we have included \$23 million to advance the development of an enhanced-stability atomic clock, a project initiated at DARPA that will enable GPS-quality time synchronization in a GPS-denied environment, providing a constant connection to sensor networks and encrypted communication channels for our most critical missions. The goal is to reach demonstration-scale by FY 2025 and commercial availability by FY 2027.

Space

The Nation's warfighting capabilities and global commerce are dependent on continued freedom of operation in space. To counter the increased adversarial activity of China and Russia in space, the Department is fundamentally changing how we field critical capabilities. Space modernization is required to outpace adversary development timelines and to negate the incentive to attack our space capabilities. As an example, the Space Development Agency was established to execute rapid prototyping and fielding of systems that will enable a threat-driven architecture. The FY 2021 budget request for research, development, test and evaluation makes a \$12.2 billion commitment to the space domain to strengthen our resilience, deterrence, and warfighting options in space.

SPACE DEVELOPMENT AGENCY

The Space Development Agency (SDA) was established in March 2019 to develop and field next-generation space capabilities. SDA is developing capabilities to address a wide range of national security space needs identified in the DoD Space Vision of August 2018. The most urgent of these needs include low-latency tactical communication that will enable beyond-line-of-sight targeting and advanced missile tracking.

SDA will deliver these capabilities by employing a rapid acquisition model, not necessarily developing and fielding all capabilities, but orchestrating those efforts across DoD, filling capability gaps in the integrated architecture. Since its establishment a year ago, SDA has published several requests for information and a Broad Agency Announcement soliciting input for various technical areas. This information will feed SDA's development efforts during the remainder of FY20, including an industry day in Colorado Springs on April 2nd to discuss detailed plans for the first demonstration phase of the transport layer (Tranche Zero), which is the

low-latency meshed network of satellites that will serve as the backbone to deliver critical capabilities to the warfighter. These early demonstrations will provide warfighters with early insights into the capabilities of the new architecture and will inform future development spirals.

In Fiscal Year 2021, SDA plans to demonstrate optical satellite crosslinks and direct downlink and to conduct a flight experiment to collect data in wavebands of interest for detection of advanced missile threats from low Earth orbit (LEO). SDA is leveraging creative partnerships across DoD, including, for example, a recent memorandum of agreement with the Naval Research Laboratory to develop an SDA-specific hardware-in-the-loop testbed and to provide ground system and mission operations support.

SDA plans to field improved defense capabilities every two years, starting in FY22. This rapid development approach ensures that the Department stays ahead of our adversaries' development timelines. As these capabilities are developed and fielded, SDA will remain in lockstep with the warfighter to ensure that the agency remains focused on emerging threats and capabilities that will maintain the United States' military advantage by leveraging the many possibilities the space domain can bring to the fight.

MISSILE DEFENSE AGENCY

The Missile Defense Agency (MDA) cancelled the Redesigned Kill Vehicle (RKV) program in 2019 as a result of its failure to meet the requirements to pass critical design review (CDR), and the subsequent assessment, based on test results, that those contractual requirements could not be met short of a complete redesign. Therefore, MDA is developing a Next Generation Interceptor (NGI), which we believe will improve homeland missile-defense performance and survivability against the assessed threat as part of the Missile Defense System (MDS). In FY 2021, MDA will continue design and development activities for two competitive NGI development contracts, which it intends to award in the fourth quarter of FY 2020.

To deal with the delay imposed by the cancellation of RKV, and as part of a layered homeland defense system, MDA will assess the Aegis Weapon System capability by using an Aegis Standard Missile-3 Block IIA missile to defeat an Intercontinental Ballistic Missile threat-representative target with a demonstration flight test planned for third quarter FY 2020 (FTM-44). MDA will also begin development of an enhanced Terminal High Altitude Area Defense (THAAD) interceptor and will assess its capability to provide greater depth of defense for the homeland. The Aegis SM-3 Block IIA and THAAD are not replacements for the long-range missile defense capability provided by Ground-based Midcourse Defense, but as part of a layered architecture are expected to make a significant contribution to homeland defense.

The Department is investing in technologies and is studying capabilities to defeat offensive hypersonic weapons, the first element of which is to detect and track incoming threats. MDA has delivered a capability for USINDOPACOM under a Joint Emergent Operational Need (JEON) for real-time sensing and display of hypersonic and maneuvering vehicle tracks. This capability is operational now in support of the Missile Warning and Missile Defense missions. In

collaboration with SDA, MDA is pursuing a Hypersonic and Ballistic Tracking Space Sensor (HBTSS). MDA is focusing on risk reduction through competitive prototyping of the payload design and signal chain-processing demonstrations of clutter rejection algorithms.

The Department has demonstrated early capability against advanced maneuvering threats during flight-testing of the SM-6 Sea-Based Terminal defense and will conduct a flight test against a hypersonic threat-representative target in FY 2023. Later this year, MDA will award multiple contracts focused on technology risk reduction for the Regional Glide Phase Weapon System interceptor concept, with the eventual goal of providing greater depth of fire in a layered defense architecture. We are also pursuing advances in joint all-domain and global command and control to support USNORTHCOM in countering very long-range cruise missiles.

With the achievement of the Technical Capability Declaration in FY21, MDA will add the Long Range Discrimination Radar in Alaska into the MDS architecture to provide a persistent capability to defend the United States homeland against IRBMs and ICBMs. With the upcoming test demonstrating the ability of the Patriot missile defense system to intercept a short-range ballistic missile target using THAAD/AN/TPY-2 track and discrimination data (FTP-27), MDA also is continuing to mature an integrated air and missile defense capability in South Korea to support the U.S. Forces Korea JEON.

SHAPING THE WORKFORCE

To stay ahead of our competitors, both economically and militarily, the United States must continue to develop and attract world-class engineers, scientists, and researchers. The Department employs more than 100,000 scientists and engineers, of which nearly half are in the Federal workforce. Despite challenges recruiting and retaining technical talent, the DoD laboratory workforce continues to be exceptional.

Growing Our Pipeline of STEM Talent

In FY 2021, the Department requested \$77 million to advance our largest workforce development program, the Science, Mathematics, and Research for Transformation (SMART) Scholarship Program. SMART provides scholarships to United States citizens to pursue bachelors, masters, or doctoral degrees, helping to build the workforce to address the Department's toughest problems. Upon graduation, recipients work in a civilian position in a lab or agency of the Army, Navy, Air Force, or other DoD entity, and have a one-year service requirement for each year of tuition. During 2019, we targeted specific degrees and Ph.D. studies in the Department's modernization priority areas of hypersonics, microelectronics, biotechnology, and artificial intelligence. We are also enhancing our international partnerships through the SMART program. In FY19, we continued our partnership with the United Kingdom (U.K.) to connect SMART scholars with U.K. researchers. We also established a partnership with the von Karman Institute for Fluid Dynamics, where SMART scholars can perform research on hypersonics. Through both of these efforts, the scholars will conduct research with their

overseas peers and gain a better understanding of how the S&T community contributes to the Department's international outreach and collaboration.

Further, to attract and advance an inclusive DoD STEM workforce, the Department is working to increase female and minority involvement in STEM through our STEM Education and Outreach efforts. We are also targeting recruitment for the SMART Scholarship program at Historically Black Colleges and Universities and Minority-Serving Institutions.

Utilizing Hiring Flexibilities

The Department makes use of authorities provided by Congress to enhance recruiting and retention of our science and technology workforce. These authorities give Service laboratories the ability to conduct direct hiring in particular fields, such as cybersecurity, send personnel for continuing education, provide recruitment bonuses, and reward employees with performance-based pay. All of these tools allow the laboratories to recruit and retain top S&T talent and remain competitive with the private sector. For example, AFRL has used the Enhanced Pay Authority to hire subject matter experts in the areas of autonomous systems, data analytics, and communications and networking, directly enhancing their ability to support the Department's modernization priorities. During 2019, the United States Army Space and Missile Defense Command began to implement more fully their personnel demonstration program to take advantage of flexible hiring and other talent management authorities. In addition, the Joint Warfare Analysis Center, the Army Research Institute for the Behavioral and Social Sciences, and the Naval Facilities Engineering Command, Engineering and Expeditionary Warfare Center also began the process to establish new personnel systems that would afford them access to the same flexibilities.

INNOVATION BASE

Maximizing the Impact of Our Federally Funded Research and Development Centers (FFRDCs) and University Affiliated Research Centers (UARC)s

In addition to our Defense Laboratories, the Department's FFRDCs and UARCs are a critical element of our innovation base, providing independent and objective scientific and technical expertise that the Department relies on to create overwhelming technical superiority for the nation. In the last year, we undertook a concerted effort to ensure the Department employs our FFRDCs for maximum strategic impact. Our goal is to make certain the FFRDCs only perform work that cannot be done by the private sector, and that they act as trusted advisors to the government utilizing their unique core competencies and access. Each FFRDC is now prioritizing its research to directly support the National Defense Strategy and the Department's modernization priorities, with a special emphasis on increasing the lethality of the joint force.

In FY19, the FFRDCs and UARCs made numerous contributions to enhance the capabilities of the Joint Force. For example, the Aerospace Corporation FFRDC was an integral part of the Government and contractor team that successfully launched a GPS III on a Falcon 9 rocket. This was the first flight of a competitively awarded National Security Space Launch (NSSL) mission

in nearly 20 years. And Johns Hopkins Applied Physics Laboratory (APL) developed a technically rigorous “space game” that enabled participants to grapple with realistic and technically informed timelines, authorities, questions, and rules of engagement, and the operational implications of pursuing different space architectures. Playing out these scenarios has informed the department’s investment decisions.

Overseeing our Academic Partnerships

The capabilities and technologies needed by the future force will be driven through fundamental discoveries made by scientists in our universities and laboratories. For decades, scientists at universities, supported by the DoD, have made ground-breaking discoveries that have led to dramatic commercial and national security advances and significantly improved the lives of citizens here and abroad. DoD’s relationship with academia is an incredibly valuable force multiplier for the basic research enterprise. Today’s U.S. universities welcome a high percentage of international students, scientists, professors, and industry collaborators, even as our adversaries recruit U.S. and foreign personnel for the benefit of their global dominance. Our strategic imperative is to continue to draw the best high-skilled talent to the U.S. research enterprise. This is an imperative that is not always fully appreciated until we recognize that immigrants have been awarded 38 percent of Nobel Prizes won by Americans in Chemistry, Medicine, and Physics since 2000 and that immigrants or their children founded 45 percent of the 2019 Fortune 500 companies.¹ We want these talented individuals to come here, to stay here, and to choose to work with us no matter where they were born.

Small Business

The DoD SBIR and Small Business Technology Transfer (STTR) programs harness the innovation of domestic small businesses to accelerate the introduction of pioneering technologies into the Department from the small business industrial base and nontraditional suppliers. The Department has made recent improvements to the management of our SBIR and STTR investments. First, the Department has focused the SBIR awards to support the NDS modernization priorities. Second, the Department streamlined the SBIR and STTR programs to be more accessible to small, domestic firms by modernizing the processes by which businesses submit their proposals. For example, we rolled out a new Defense SBIR/STTR Innovation Portal that makes it easier for small businesses to engage with the Department and participate in the SBIR/STTR programs. We are also encouraging innovative contracting initiatives to enable us to reach nontraditional firms and reduce the time it takes for promising SBIR ideas to be put on a contract. DIU continues to harness innovation from startups and other nontraditional vendors via its expedited contracting process, signing 128 contracts to small businesses and adding 66 first-time vendors to DoD. The Department is committed to ensuring these technologies transition

¹ Immigrants and Nobel Prizes: 1901-2017, NFAP Policy Brief, National Foundation for American Policy, 2017. For more background on Nobel Prize winners see <https://www.nobelprize.org/>. Source: <https://nfap.com/wp-content/uploads/2019/10/Immigrants-and-Nobel-Prizes.NFAP-Policy-Brief.October-2019.pdf>
Source: <https://nfap.com/wp-content/uploads/2019/10/Immigrants-and-Nobel-Prizes.NFAP-Policy-Brief.October-2019.pdf>

into commercial markets and military applications, further strengthening the National Security Innovation Base.

THE MANUFACTURING BASE

Manufacturing technology is critical to any of our modernization objectives if we are to deliver capacity in the needed time frame. The DoD Manufacturing Technology program (MANTECH) executes a portfolio of project investments across OSD, the Services and Agencies, focusing on advanced manufacturing technologies and challenges. The MANTECH program also serves as a lead Federal strategic investment partner to eight of the fourteen Manufacturing USA innovation institutes. These institutes promote domain-focused manufacturing ecosystems in areas of value to the DoD, and of emerging importance to the U.S. manufacturing base through pre-competitive technology advancement, community building, and workforce development. They bring together industry, academia, and federal partners to increase U.S. manufacturing competitiveness and promote a robust and sustainable national manufacturing R&D infrastructure.

Through these institutes, we have already begun to accelerate advanced manufacturing technologies through public-private partnerships in areas such as cybersecurity, 5G, photonics, and regenerative medicine. For example, the Manufacturing times Digital (MxD) Institute recently welcomed 5G on its Future Factory Floor to serve as a testbed for demonstrating the opportunities 5G, artificial intelligence, and machine learning bring to manufacturing. AIM Photonics has established a U.S.-based Photonic Integrated Chip (PIC) manufacturing ecosystem, including design, proof of concept, prototyping, validation, and final packaging in advanced node microelectronics and photonic chip fabrication, including a test, assembly, and packaging facility.

Further, as a component of biotechnology modernization, the DoD is pursuing the establishment of the ninth DoD-lead Manufacturing Innovation Institute, specifically focused on bioindustrial manufacturing. This institute will leverage emerging biotechnologies, including modern engineering biology techniques, to develop critical domestic leadership in biomanufacturing. In line with national priorities of biotechnology as an essential industry of the future, this Bioindustrial Manufacturing Innovation Institute will build partnerships across the U.S. bioeconomy and strengthen ties between defense needs and the wealth of knowledge within our industry and academic partners.

In addition, as part of our modernization objectives, the Department is harnessing our Manufacturing Technology (ManTech) Program and cultivating the manufacturing workforce the nation needs for the future. The ManTech program is also addressing the manufacturability of carbon-carbon materials, a critical component necessary to manufacture hypersonic aeroshells at scale. This initiative, the Manufacturing of Carbon-Carbon Composites for Hypersonics Applications (MOC3HA), is working directly with domestic manufacturers of carbon-carbon material to streamline processes, improve quality and reliability at volume and size, reduce cost and cycle time, and increase yield.

Finally, we are convening a DoD-wide Manufacturing Council to coordinate the emerging technology industrial base and human capital investments and strategies and serve as a touchpoint for industry. Through this Council, we will align the funds in the Manufacturing Technology program, Industrial Base Analysis and Sustainment effort, and Defense Production Act Title III authorities to achieve our modernization goals and maintain our technical advantage.

CREATING AND PROMOTING TECHNOLOGY

Modernizing our military requires successful research, technology maturation, prototyping, systems integration, and test capability in order to turn innovative and disruptive technology into fieldable and sustainable military systems. We must ensure access to necessary technical and engineering expertise, tools and facilities, source materials, manufacturing and production, and ability to meet capacity demands. This means access to universities as well as commercial firms that provide emerging technology from all readiness levels.

For each modernization objective, we will assess the potential for the technology to support development timelines in light of adversary progress. Our focus is to understand what is needed to achieve modernization goals, to identify risks and opportunities in each of the priority areas, and to identify capabilities that are common across the priority areas. In accordance with Section 1793 of the John S. McCain NDAA for FY 2019 “Review of and Report on Certain Defense Technologies Critical to the United States Maintaining Superior Military Capabilities,” we have conducted initial baseline assessments of the above critical underpinnings for each of our modernization priorities. The initial report was provided to this committee in July of 2019.

TECHNOLOGY PROTECTION

The U.S. military has maintained its technology advantage over the decades by constantly out-innovating its adversaries. This was enabled by our culture of innovation, risk-taking, and access to the top global talent. Today, however, our technological edge is at risk. Competitor nations are acquiring intellectual property and sensitive technologies from our academic research system and industry. They do so through illegal and extralegal means that fall outside the established norms of academic integrity and collaboration.

To address this situation, the Department is taking a balanced approach. For critical technologies and programs, we are applying appropriate protections that prevent technologies from falling into the wrong hands. We are establishing procedures to reinforce the integrity of our research enterprise. We are engaging the broader S&T community and our stakeholders to provide improved threat awareness, inform necessary controls, and develop best practices that can be institutionalized across the DoD S&T enterprise.

One new initiative is the development of Technology Area Protection Plans (TAPPs) for all of our critical technology areas. TAPPs will provide a common understanding of the aspects of

each critical technology area that need to be protected, and a strategy to establish and apply appropriate protection methods. TAPPs ensure that our S&T organizations have information regarding emerging and disruptive research, so that early prevention/safeguarding measures can be applied and transitioned into the Program Protection Plans for programs of record and research and development programs. The TAPPs in development aligns with the 2019 DoD list of critical programs and technologies mandated by Section 1049 of the FY2019 NDAA.

We have taken other steps to protect open research at U.S. institutions. We are working with other federal research funding agencies to develop common standards for identifying and adjudicating conflicts of interest and conflicts of commitment. We are fully engaged with the White House Office of Science and Technology Policy to develop Federal guidance for Research Security and Integrity. In March 2019, we issued instructions to our partners in academia, requiring that key research personnel funded by DoD grants, cooperative agreements, Technology Investment Agreements, and other non-procurement transactions disclose all current and pending projects and funding sources. We are revising research grant and cooperative agreement procedures to exclude research funding for individuals posing an unacceptable risk to national security or who participate in foreign talent recruitment programs. In addition, DoD is encouraging academic institutions, associations, and councils to develop training modules for faculty to explain more clearly the landscape of threats to research integrity.

At the same time, we recognize that the free exchange of ideas and collaboration across research communities is critical to our continued success. To this end, we must preserve the long-standing norms and ethical behaviors that have benefited our research institutions, while at the same time punishing those who disregard the rule of law.

The Department has a variety of tools and resources which can be brought to bear in the face of our competitors' tactics to exploit our technology for their military and economic gain. Protection requires a nuanced approach and a community-wide partnership that includes other government agencies, industry, academia, and allies, to thwart bad behavior without discouraging the participation of the talent that we wish to attract. An uncoordinated, broad-brush approach to technology protection can result in damaging consequences that limit our ability to engage with and benefit from leading-edge research.

So, while we must guard against espionage and the theft of intellectual property, we must also recognize that the United States got to the top of the technology world not by concerning ourselves overmuch with those who sought to steal from us, but rather by nurturing an open, innovative, collaborative culture that set the pace for the world to match if they could. We became the place where brilliant minds wanted to come. We became the place where others wanted to be educated. We became the place where entrepreneurs could thrive. We became the people from whom others wanted to steal. We should worry not that this is so, but instead about becoming overly defensive, insular, and protective and thereby destroying the culture that got us to the top. Others can and will steal from us; there is no perfect defense. But while they will always be able to steal a given idea, they can't steal our culture of innovation. They can't steal who we are. We must always remember that the leaders in any competition are not the people who are looking back to see what others are doing. Winners don't win by blocking others. They

win by running faster. That is what got us where we are. And that is truly the best tool for “technology protection.”

CONCLUSION

In the two years since the office of the Under Secretary of Defense for Research and Engineering was established we, in concert with our partners in the Services and you here in Congress, have taken the first important steps in helping the Department of Defense change the way it thinks about developing and deploying the next generation of capabilities to our warfighters, and the processes by which it does so. To be sure, there is still much work to be done, and we look forward to working with you on the long road ahead.

In the final analysis, we have one mission, and that is to ensure the safety and security of the citizens of this great nation. I think we all recognize that we can best accomplish that from the commanding heights of the technological advantage we have traditionally enjoyed. This is R&E’s central goal; no higher purpose is necessary, and no lesser purpose will serve.

Thank you for your time, and I look forward to your questions.

Dr. Michael D. Griffin
Under Secretary of Defense for Research and Engineering

Dr. Michael D. Griffin is the Under Secretary of Defense for Research and Engineering. He is the Department's Chief Technology Officer, and is responsible for the research, development, and prototyping activities across the DoD enterprise and is mandated with ensuring technological superiority for the Department of Defense. He oversees the activities of the Defense Advanced Research Projects Agency, the Missile Defense Agency, the Strategic Capabilities Office, Defense Innovation Unit Experimental, the DoD Laboratory enterprise, and the Under Secretariate staff focused on developing advanced technology and capability for the U.S. military.

Mike was previously Chairman and Chief Executive Officer of Schafer Corporation, a professional services provider in the national security sector. He has served as the King-McDonald Eminent Scholar and professor of Mechanical and Aerospace Engineering at the University of Alabama in Huntsville, as the Administrator of NASA, and as the Space Department Head at the Johns Hopkins University Applied Physics Laboratory. He has also held numerous executive positions in industry, including President and Chief Operating Officer of In-Q-Tel, CEO of Magellan Systems, and EVP/General Manager of Orbital ATK's Space Systems Group. Griffin's earlier career includes service as both Chief Engineer and Associate Administrator for Exploration at NASA, and as the Deputy for Technology at the Strategic Defense Initiative Organization. Prior to joining SDIO in an executive capacity, he played a key role in conceiving and directing several "first of a kind" space tests in support of strategic defense research, development, and flight-testing. These included the first space-to-space intercept of a ballistic missile in powered flight, the first broad-spectrum spaceborne reconnaissance of targets and decoys in midcourse flight, and the first space-to-ground reconnaissance of ballistic missiles during the boost phase. Mike also played a leading role in other space missions at the John Hopkins University Applied Physics Laboratory and NASA's Jet Propulsion Laboratory.

Griffin has been an adjunct professor at the University of Maryland, Johns Hopkins University and George Washington University, teaching spacecraft design, applied mathematics, guidance and navigation, compressible flow, computational fluid dynamics, spacecraft attitude control, estimation theory, astrodynamics, mechanics of materials, and introductory aerospace engineering. He is a registered professional engineer in California and Maryland, and the lead author of some two dozen technical papers and the textbook Space Vehicle Design.

He is a member of the National Academy of Engineering and the International Academy of Astronautics, an Honorary Fellow and former president of the American Institute of Aeronautics and Astronautics, a Fellow of the American Astronautical Society, and a Senior Member of the Institute of Electrical and Electronic Engineers. He is the recipient of numerous honors and awards, including the NASA Exceptional Achievement Medal, the AIAA Space Systems Medal and Goddard Astronautics Award, the National Space Club's Goddard Trophy, the Rotary National Award for Space Achievement, the Missile Defense Agency's Ronald Reagan Award, and the Department of DoD Distinguished Public Service Medal, the highest award which can be conferred on a non-government employee.

Griffin obtained his B.A. in Physics from the Johns Hopkins University, which he attended as the winner of a Maryland Senatorial Scholarship. He holds master's degrees in aerospace science from Catholic University, electrical engineering from the University of Southern California, applied physics from Johns Hopkins, civil engineering from George Washington University, and

business administration from Loyola University. He received his Ph.D. in aerospace engineering from the University of Maryland, and has been recognized with honorary doctoral degrees from Florida Southern College and the University of Notre Dame.

Mike is a 4000+ hour commercial pilot and flight instructor with instrument and multiengine ratings, and holds an Extra Class Amateur Radio license.

57

RECORD VERSION

STATEMENT BY
THE HONORABLE BRUCE D. JETTE, Ph.D.
ASSISTANT SECRETARY OF THE ARMY FOR
ACQUISITION, LOGISTICS AND TECHNOLOGY AND
ARMY ACQUISITION EXECUTIVE

BEFORE THE

SUBCOMMITTEE ON INTELLIGENCE AND
EMERGING THREATS AND CAPABILITIES
COMMITTEE ON ARMED SERVICES
UNITED STATES HOUSE OF REPRESENTATIVES

ON

REVIEWING DEPARTMENT OF DEFENSE SCIENCE AND TECHNOLOGY
STRATEGY, POLICY, AND PROGRAMS FOR FISCAL YEAR 2021: MAINTAINING
A ROBUST ECOSYSTEM FOR OUR TECHNOLOGICAL EDGE

SECOND SESSION, 116TH CONGRESS

MARCH 11, 2020

NOT FOR PUBLICATION UNTIL RELEASED BY THE
COMMITTEE ON ARMED SERVICES

INTRODUCTION

Chairman Langevin, Ranking Member Stefanik, and distinguished Members of the Subcommittee, thank you for the opportunity to appear before you today to discuss the U.S. Army's approximately \$2.6 billion request for Science and Technology (S&T) funding for Fiscal Year (FY) 2021. The Subcommittee has a vital role in supporting Army S&T and ensuring that the U.S. Army modernizes to meet future readiness requirements, and your demonstrated commitment to our program is most appreciated.

The Army S&T vision directly supports the goals of Army modernization. Our focus is on discovering emergent S&T for future warfighter capabilities, maturing technology, reducing program risk, developing prototypes to better define affordable and achievable requirements, and conducting experimentation with Soldiers to refine new operational concepts. The publication of the *2019 Army Modernization Strategy* (AMS) outlined our holistic approach to modernization, including our priority research areas – Disruptive Energetics; RF Electronic Materials; Quantum; Hypersonic Flight; Artificial Intelligence; Autonomy; Synthetic Biology; Material by Design; and the Science of Advanced Manufacturing. Modernization is a continuous process requiring collaboration across the entire Army. Aligned with the National Defense Strategy, the Army's goal is a modernized force capable of conducting Multi-Domain Operations (MDO) across an array of scenarios in multiple theaters of operations by 2035.

As the Army executes its modernization strategy, we will continuously revise our modernization efforts to meet great power challenges to our military advantage and to create the capabilities needed to execute MDO. The strategy was established upon the vision for the future Army and the framework of our overarching strategy to balance near-, mid-, and far-term investments. In doing so, the Army is depending on its vital S&T program to help prepare for the future, mitigate the possibility of technical surprise, and ensure that we are able to remain dominant in any environment.

IMPORTANCE OF S&T TO ARMY MODERNIZATION

The Army's S&T program has a large role in enabling the six priorities outlined in the AMS: (1) Long Range Precision Fires, (2) Next Generation Combat Vehicles, (3) Future Vertical Lift, (4) Army Network, (5) Air and Missile Defense, and (6) Soldier Lethality. In the Army's FY21 budget request, approximately 79% of S&T Applied Research and Advanced Technology Development funding is aligned with the Army's modernization priorities, which is the indication of the Army's intent to maintain a well-balanced S&T portfolio near-term, mid-term, and far-term. Organizationally, the Army S&T program is working closely with Army Futures Command (AFC), the four-star command tasked with spearheading the Army's modernization efforts, and the Cross-Functional Teams under AFC that are aligned with each of the priorities. I continue to develop a close working relationship with AFC.

The major S&T efforts in support of the Army's Modernization Priorities include:

- **Long-Range Precision Fires** enable multi-domain forces to penetrate and neutralize enemy A2/AD capabilities to ensure military overmatch at every echelon.
- **Next Generation Combat Vehicles** increase firepower, speed, and survivability of land forces, allowing them to maneuver into superior positions on the battlefield and pair with robotic vehicles.
- **Future Vertical Lift** platforms and technologies increase the maneuverability, endurance, lethality, and survivability of Army aircraft – increasing their operational reach and effectiveness against near-peer competitors.
- The modernization of **Army Network** technologies is necessary to command and control forces distributed across vast terrain, converge effects from multiple domains, and maintain a common situational understanding in MDO.

- Our competitors have invested heavily in indirect fire and missiles necessitating the modernization of our **Air and Missile Defense** capabilities. New technologies will defend ground forces against adversary air threats, and will also defend our infrastructure – and the infrastructure of our allies and partners – against a host of air and missile threats.
- Finally, efforts modernizing **Soldier Lethality** will increase the capability of individual Soldier weapons, provide Soldiers with enhanced night vision, and increase their ability to quickly understand and react to emerging situations – increasing their lethality, precision, and survivability. These efforts will be complementary to ongoing Soldier performance initiatives to improve fitness, nutrition, and resiliency, to ensure we are modernizing the Soldier, not just the equipment for our Soldiers.

We have also increased emphasis on engineering prototyping to permit Soldier touch points early and often. These touch points connect Army S&T with Soldiers to bring operational common-sense to laboratory prototypes for quicker transition of new capabilities.

INFRASTRUCTURE

The Army's over 25,000 scientists, engineers, and technicians at laboratories across the country are critical assets in identifying, developing, and demonstrating technology options that inform and enable effective and affordable capabilities for our Soldiers today and in the future.

The Army relies on its laboratories to foster innovation, develop and demonstrate new technologies, assess competing technology options, and help transition basic research investments as they mature. This is one of the primary reasons why state-of-the-art facilities are imperative to the success of Army S&T.

The three primary areas for infrastructure modernization include:

- Modernizing organic technical infrastructure for state-of-the-art research laboratories and equipment;
- Engaging in Public-Public and Public-Private infrastructure collaborations; and
- Embedding Army Scientists and Engineers in the Public and Private sector, using the Combat Capabilities Development Command (CCDC) open campus business model.

Not only are these facilities important to enabling research and development, they are critical in the Army's ability to recruit new employees, develop existing employees, and retain them. I would like to thank Members of Congress for the numerous staffing flexibilities provided to the Army laboratories. Direct Hiring Authority, Renewable Term Appointments, and 2363 Authorities to give lab directors the ability to fund new research and development projects within the year of execution, and the Laboratory Demonstration Project have been critical to growing the Army's technical workforce and sharpening our technical acumen in emerging research areas.

REFORM

The Army, with the support of Congress, has undertaken a number of reforms to improve the way we do business. Chief among these reforms is the Army's Intellectual Property (IP) policy, which fosters greater communication with industry early on in the process so that we can be clear about our data requirements. IP plays an important role in our ability to develop new weapon systems and maintain the technological advantage.

We are also focused on talent management, especially the ability to recruit and retain top-talent in order to keep the Army on the cutting-edge of technology. Our plans in this area are designed to:

- Develop senior S&T leaders to enable effective execution of S&T programs;
- Reshape the existing technical workforce to meet emerging S&T challenges, dedicated to retraining current Army S&T professionals to prepare them to perform work in higher demand technical areas;
- Broaden technical opportunities for uniformed personnel in our Army Labs and Centers;
- Recruit new personnel utilizing tools like the SMART Scholarship, and timely onboarding of S&T employees; and
- Leverage the best-and-brightest from across the Army S&T Enterprise, bringing together scientific professionals – government, military, academic, and industrial – to address technical problems; these partnerships will enable the rapid technology developments necessary to outpace emerging threats.

The Army has also expanded its industry outreach program, including Innovation Days sponsored by the Army Rapid Capabilities and Critical Technologies Office, supported by AFC's CFTs. We are actively reaching out to non-traditional businesses with innovative ideas that are willing to engage with the Army via numerous mechanisms, including the Small Business Innovation Research program, the Small Business Technology Transfer Research program, Other Transaction Authority consortia, the Army Expeditionary Technology Search prize competition, the Defense Innovation Unit, the Strategic Capabilities Office, the CCDC open campus initiative, and traditional mechanisms such as Broad Agency Announcements or Cooperative Research and Development Agreements with Army laboratories.

CONCLUSION

Today, we find ourselves at a perilous place in history. Our focus is on great power competition, and the Army is moving quickly to address modernization shortfalls. Time is not on our side. We must invest in Army S&T to meet the challenges of the future. With continued support from Congress, including predictable, adequate, sustained, and timely funding, the Army will build a force ready to deter potential adversaries, and if deterrence fails, to rapidly deploy, fight, and win.

Thank you again for this opportunity to discuss Army S&T and for your strong support for the Army's program. I look forward to your questions.

The Honorable Dr. Bruce D. Jette
Assistant Secretary of the Army (Acquisition, Logistics and Technology) and
Army Acquisition Executive

Dr. Bruce D. Jette was confirmed by the United States Senate as the Assistant Secretary of the Army for Acquisition, Logistics and Technology (ASA(ALT)) on December 20, 2017, and sworn into office on January 2, 2018. In this position, he serves as the Army Acquisition Executive, the Senior Procurement Executive, the Science Advisor to the Secretary of the Army, and the Army's Senior Research and Development official. He also has principal responsibility for all Department of the Army matters related to logistics.

Dr. Jette leads the execution of the Army's acquisition function and the acquisition management system. His responsibilities include providing oversight for the life cycle management and sustainment of Army weapon systems and equipment from research and development through test and evaluation, acquisition, logistics, fielding, and disposition. He is also responsible for appointing, managing, and evaluating program executive officers and managing the Army Acquisition Corps and Army Acquisition Workforce. In addition, he oversees the Elimination of Chemical Weapons program.

Prior to his confirmation, Dr. Jette served as President and Chief Executive Officer of Synovision Solutions, LLC, an innovative company he founded to provide management and technical consulting, engineering services, and project management in support of military and governmental agencies, as well as commercial industry.

A decorated veteran of 28 years of active duty, Dr. Jette retired as a Colonel following a career that included several armor and cavalry company commands, two overseas tours, various staff assignments at the battalion and brigade level, and over two years of operational deployments to Afghanistan, Iraq and Kuwait. Highlights of his previous acquisition service include founding the U.S. Army Rapid Equipping Force; serving as Program Manager for Soldier Systems which led to the establishment of Program Executive Office Soldier; and being honored as U.S. Army PM of the Year for his success as Product Manager for all Army airborne electronic warfare systems.

Dr. Jette is a graduate of the United States Military Academy with a Bachelor of Science degree in Nuclear Engineering and Chemistry. He also holds both a Master of Science degree and a Doctorate in Electronic Materials from the Massachusetts Institute of Technology. He was an Adjunct Professor at the Edmund A. Walsh School of Foreign Service Security Studies Program at Georgetown University.

His numerous military awards and commendations include the Distinguished Service Medal, Legion of Merit (3), Bronze Star Medal, Meritorious Service Medal (3), Army Commendation Medal, Army Achievement Medal (2), National Defense Medal (2), Operation Iraqi Freedom Campaign Ribbon, Operation Enduring Freedom Ribbon, Army Service Ribbon, Army Overseas Ribbon (2), Parachutist Badge, Army General Staff Award, and Order of Saint Maurice (Legionnaire).

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HOUSE ARMED SERVICES COMMITTEE
INTELLIGENCE AND EMERGING THREATS
AND CAPABILITIES SUBCOMMITTEE

STATEMENT OF

THE HONORABLE JAMES F. GEURTS
ASSISTANT SECRETARY OF THE NAVY
(RESEARCH, DEVELOPMENT AND ACQUISITION)

BEFORE THE

INTELLIGENCE, EMERGING THREATS AND CAPABILITIES SUBCOMMITTEE

OF THE

HOUSE ARMED SERVICES COMMITTEE

ON

THE DEPARTMENT OF THE NAVY FISCAL YEAR 2021 BUDGET REQUEST FOR
SCIENCE AND TECHNOLOGY PROGRAMS

MARCH 11, 2020

NOT FOR PUBLICATION UNTIL RELEASED BY THE
HOUSE ARMED SERVICES COMMITTEE
INTELLIGENCE AND EMERGING THREATS
AND CAPABILITIES SUBCOMMITTEE

Chairman Langevin, Ranking Member Stefanik and distinguished members of the Subcommittee, thank you for the opportunity to appear before you today to update you on the Department of the Navy (DON) Science and Technology (S&T) efforts. S&T is a critical building block in the National Defense Strategy and ensures the DON maintains and expands its technological advantage against our adversaries for the future Fleet and Force.

A dominant naval force and a strong maritime strategy are the primary engines of our National Defense Strategy. Since this nation's founding, the United States has depended on naval power to defend its shores and protect free and open ocean commons. As our nation grew, naval power has been enabled by innovation, skilled seamanship, courage, careful planning, and maintaining a technological edge. Today, as we face rapid change in the global security environment—including increased access to technological knowledge, and attempts by potential adversaries to dominate emerging weapon technologies—the national security posture is adapting with a sense of urgency and innovation. The Department of the Navy (DON) continues to emphasize acceleration in everything we do to keep our technological advantage and to deliver at speed the capabilities required to compete and win.

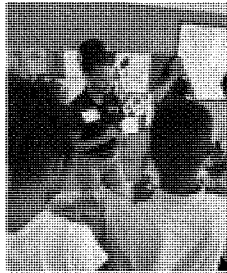
Future Naval Power: Investing in People

To deliver future naval power, the Navy and Marine Corps invests in a diverse set of innovative thinkers—and doers. This includes the impressive technical workforce inside the Department of the Navy's Office of Naval Research (ONR) and the Naval Research Laboratory (NRL). NRL alone was responsible for 1153 publications, 120 patents and 43 external recognition awards in the past 12 months. Also included in the DON's technical workforce are warfare centers across the country—including the Naval Air Warfare Centers, Naval Surface Warfare Center, Naval Undersea Warfare Centers, and Naval Information Warfare Centers. Together, these organizations make up the Naval Research and Development Establishment (NR&DE), with over 2,400 PhD's, advanced degree scientists, engineers, and technicians dedicated to envisioning and providing new technologies for the fleet and force. These highly talented individuals work closely with industry, academia and across the government to ensure our Sailors and Marines have the most advanced capabilities, now and in the future.

Our unmatched organic technical workforce partners with U.S. and global universities to perform fundamental research on behalf of the Navy and Marine Corps. That includes the best

researchers at universities inside the U.S. and abroad, working with partners and allies to find the most talented team to work on naval problems. Currently in S&T, the ONR is sponsoring over 2,500 active grants to 436 performers, comprised of 341 universities and 95 non-profits.

One area of specific interest to the Navy is Ocean Sciences. Last year, with your help, the Department of the Navy began a new initiative, called Task Force Ocean to reinvigorate the Ocean Sciences here in the U.S., ensure competitive advantage and support naval operations in the ocean domain. With the initial funding, Task Force Ocean supports graduate and post-doctoral students and awarded 38 grants to 18 universities, four University Affiliated Research Centers and Federally Funded Research and Development Centers, four Navy labs and warfare centers, and three industry partners.



It is important to remember that this A+ team is not only about today's players. The Department is also looking to develop, recruit and employ the next generation of scientists and engineers that will be necessary to meet the scientific challenges of the future. The Navy has a strong investment in Naval Science, Technology, Engineering and Mathematics (STEM) programs that starts at the K-12 level and continues through workforce development. Inventive programs such as the United States Naval Academy Summer Heroes Youth Program send midshipmen to underserved and underrepresented schools to provide hands-on education sessions in mechanics, chemistry, robotics, encryption and coding, strategy and logic, bioengineering, and flight to close to 1000 6th-8th grade students. This program, and other similar STEM efforts, provide outreach to address the urgent national need for more students to pursue technical careers. With that same goal of finding and nurturing the best minds for the future, the Navy and Marine Corps are also sponsoring \$4.5 million in grants to 15 Historically Black Colleges and Universities and Minority Institutions this year, and will do so again in FY 2021.

These efforts are foundational to our competitive advantage in this era of Great Power Competition. This winning formula of promoting intellectual diversity and investing in the right scientists to solve naval challenges has been in place since World War II, and remains one of our greatest strengths today.

Future Naval Power: Future Naval Capabilities

Carefully nurtured academic and industry partnerships are only half of the equation. The Department of the Navy relies on several key tools to transition from ideas to capabilities that can be delivered to the warfighter at the speed of relevance. The first of these critical tools is the Future Naval Capabilities (FNC) program. FNC projects are designed to provide a steady infusion of relevant technology into existing programs of record, improving and expanding the capabilities of platforms, weapons and sensors already in the hands of our Sailors and Marines. We have 27 FNCs that will be delivered in FY 2020, and another 15 projects starting in FY 2021. Of the 335 FNC products delivered through 2018, 38 percent have fielded, and 23 percent are in the acquisition pipeline preparing to field. Notable examples include the Advanced Reconnaissance Vehicle, the Long-Endurance Airborne Platform and the Deep Reliable Acoustic Path Exploitation System. The FNC process was recently restructured to accelerate both the selection and the S&T development timelines, and those revisions are working. Development cycles that once took five years now take three. We are on the front edge of that bow wave, improving the ability to get capability at scale into programs of record, through the FNC process. This is an impressive record, and it is unmatched inside the DOD.

As the Navy works to develop FNCs with our academic research partners, it is also critical to find the right industry partners, who help get technologies from the “lightbulb moment” to the user. So another area where we are moving critical research forward is the Small Business Innovation Research (SBIR) process. Just as we need the best minds in academia to achieve successful FNCs, we also need the power of innovative business productivity for prototypes and deliverables. Last year we reimagined the SBIR process to encourage wider participation, and increase relevance and speed. In a recent pilot for artificial intelligence, autonomous behaviors, and advanced technologies for training, the Department saw a ten-fold increase in the number of proposals received and a 40 percent increase in new entrants. At the same time, we were able to improve our “end to end” cycle times of Phase 1 awards from 128 days down to 28 days. Industry responds to demand signals. By making it easier for innovators to do business with the Navy, the DON is building new partnerships, increasing opportunities for success and clearing a fast lane from discovery to deployment that will allow the Department to harness the science and technology discoveries and maintain and grow our advantage.

Future Naval Power: Innovative Naval Prototypes

In addition to FNCs, the Department relies on Innovative Naval Prototypes (INPs) to introduce groundbreaking new technology out into the field. INPs are developed around anticipated naval needs rather than in response to established requirements and are meant to significantly alter the way our naval forces fight. The FY 2021 budget includes over \$400 million for these disruptive, revolutionary technologies in six major thrust areas: Directed Energy; Unmanned Advanced Autonomy/Swarm; Cyber; Advanced Long-Range Targeting; Hypersonics; and Full Spectrum Undersea Warfare. Within those thrust areas there are have 18 focused efforts including the next generation laser, future hypersonic boosters, artificial intelligence, and swarming.

The Office of Naval Research: Positioned for Success

The Department of the Navy's S&T calculus must be flexible to meet changing realities and ensure the Navy and Marine Corps are always at the forefront of scientific discovery. In a new era of Great Power Competition and new naval challenges and opportunities, the Office of Naval Research has undergone a significant reorganization, streamlining efforts and aligning, allocating and accelerating resources to sponsor the right scientists at the right time. Perhaps the most noteworthy part of this reorganization was the decision to go "all-in" on the idea of an integrated naval force—no longer separating the Navy and Marine Corps in research programs, but ensuring USMC priorities are incorporated throughout every department and at every level of ONR. This approach will be an enabler of the Commandant's call for increased naval integration.

Future Naval Power Starts Here

The Department's Fiscal Year (FY) 2021 S&T investments aggressively pursue increased lethality and modernization with the greatest potential to deliver non-linear warfighting advantages. Priority for this budget is support to the National Defense Strategy and its Research and Engineering modernization areas: directed energy and electric weapons; hypersonic capabilities; artificial intelligence (AI) and machine learning (ML); intelligent autonomous systems; cyber security; networked sensors and weapons; advanced manufacturing; high performance materials and energetics; biotechnology and quantum science and computing.

The overall naval research and development budget request for FY 2021 is \$21.5 billion. This amount represents a five percent increase over the FY 2020 funded level, with the S&T budget request at \$2.3 billion, equivalent to the FY 2020 requested level. This increase in overall R&D funding will lead to additional S&T transition opportunities and balances readiness recovery and key down payments on lethality to deliver a more lethal, resilient, and rapidly innovative force.

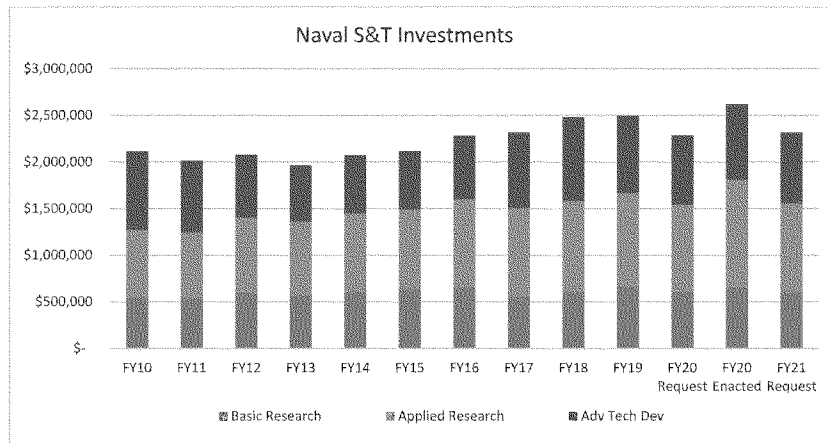


Figure 1. Naval S&T Investment History

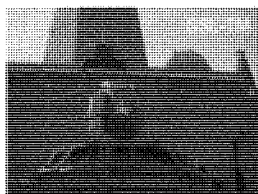
The Naval S&T portfolio utilizes a broad investment approach that leverages long-term, naval relevant fundamental research and applied research to give scientists and engineers in the naval research enterprise the flexibility to pursue new discoveries and promising ideas to support development of new capabilities for the warfighter. Highlights include:

Directed Energy

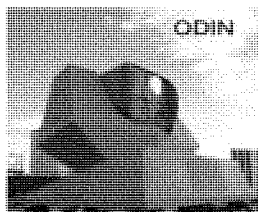
Directed Energy (DE) weapons will be essential to countering urgent threats from our nation’s adversaries. Sustained investment in basic research has allowed the U.S. to remain at the forefront of DE weapons development. The products resulting from basic research - conducted

by the NR&DE, commercial firms, and academia - form the foundation of present-day directed energy systems and will enable the next-generation of systems. The Department's investment in DE began in the 1990s in exploring high energy laser technologies and architectures as well as the related issues of high power optics, atmospheric propagation, and effects of lasers on targets. Although it takes years for science to transition to a deployable system, without that fundamental research we are assured that the U.S. would have lost its global technological edge.

The Department is rapidly advancing laser capabilities from near-term goals of countering unmanned aerial systems (UAS) and ISR to the ultimate goal of providing ship self-defense against anti-ship missiles. Laser weapons are critical to the future fight, allowing the fleet to extend their defensive capacity and preserve vital magazine space for offensive weapons.



In October 2019, the Navy installed Solid State Laser-Technology Maturation (SSL-TM) laser weapon system on USS *Portland* (LPD 27). SSL-TM is the most powerful laser weapon system installed on any Department of Defense platform. Currently undergoing certification testing, it will deploy with the *Portland* in 2021.

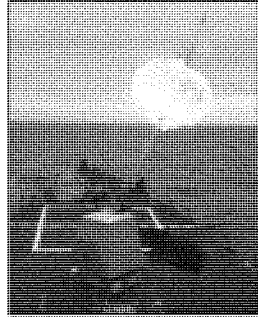


The Department's Optical Dazzling Interdictor, Navy (ODIN) provides naval vessels the capability to counter UAS/ISR threats with low power lasers. The first ODIN system was recently installed on the USS *Dewey* (DDG 105), going from an approved idea to installation in two and a half years. This will be the first operational employment of the stand-alone system that functions as a dazzler, and will allow the Navy to rapidly deploy an important, new capability to the Navy's surface force in combating UAS threats.

In FY 2021 we will field High Energy Laser with Integrated Optical dazzler and Surveillance (HELIOS), and Layered Laser Defense (LLD). The combination of these fielded systems represent an important milestone in leveraging directed energy for national security. They enhance naval platforms to project power and provide integrated defenses through directed energy weapons S&T advances. The deep magazine, precision engagement, and tracking agility

of laser weapons could make critical contributions to layered defense of Navy ships from high rate cruise missile attacks in the future fight.

Hypersonics



The DON has made significant advancements in hypersonic design that will introduce an entirely new generation of capabilities, rapidly changing the way we fight as an integrated naval force. Working with the Strategic Capabilities Office the Navy has developed a Hypervelocity Projectile (HVP) with the objective of providing a low-cost, deep magazine round for Anti-Air Warfare against various missile threats. In recent tests, the Navy successfully fired unguided HVP from the MK45 MOD 4 gun on the USS *Dewey* (DDG 105). Flight Experiment 2 is scheduled for the second quarter of FY 2020, and will demonstrate the Navy- designed Hypersonic Glide Body. Additional work for guidance and control as well as warhead design will yield a new capability that provides Anti-Air Warfare capability including cruise missile defense in support of ships self-defense as well as Anti-Surface Warfare.

The Department is using Section 804 Middle Tier Acquisition (MTA) for rapid prototyping authority to design an Intermediate Range Conventional Prompt Strike (CPS) common hypersonic glide body. CPS will deliver a conventional offensive strike capability through a depressed boost-glide trajectory to prosecute deep-inland, time-critical targets in contested environments. CPS capabilities are sufficiently mature to allow rapid prototyping to provide a residual operational capability within five years of program start. As weapon system design matures, the Department anticipates being able to rapid field the capability with later configurations.

Artificial Intelligence (AI) and Machine Learning (ML)

The science of AI is the next great fundamental research challenge for the Navy and the nation. Advances in this area will improve decision quality, decision speed, threat evaluation and weapon assignment across all naval warfighting domains. The DON has been active in AI

since inception of the discipline in the 1950s and is a leader in AI S&T, largely through the efforts at NRL. The Department is currently making a concerted and dedicated effort to identify near-term AI and ML application opportunities in warfare areas and mission planning as well as longer term steps that must be taken to improve the Service's ability to man, train and equip for effective AI application and deployment.

In FY 2020 the Department fielded AI systems in support of Naval Special Warfare that were battle proven in Afghanistan and Iraq. In Undersea Warfare we deployed Project Harbinger, prototype technology that expanded AI/ML acoustic discrimination efforts and transitioned algorithms developed by University Affiliated Research Centers and private industry to classified cloud infrastructure. The Department deployed AI/ML mission-planning tools to Maritime Operations Centers for operational assessment and demonstrated ELEKTRA (EMW) algorithms performed better than humans in providing real-time force-level engagement recommendations utilizing modeling and simulation and force-level engagement scheduling.

The FY 2021 budget sustains and builds upon the progress of FY 2020 through efforts to build a data engineering pipeline for AI development and delivery, and support to AI applications that enhance the speed and quality of decision-making in intelligent autonomous systems and in business operations. These investments will enable a more networked and lethal fleet.

Intelligent Autonomous Systems

The Navy's Intelligent Autonomous Systems (IAS) S&T program continues its focus on the seamless integration of IAS into our Naval Force Structure to make it more lethal, survivable, and ready while increasing capacity and operational tempo. Efforts in IAS address all domains, solving unique naval needs while leveraging advances in the commercial sector to increase machine intelligence, and improve human-machine teaming while building trust and producing autonomy that can adapt in the presence of dynamic operating environments and overwhelming data. The Navy continues to engage in multiple at-sea experiments and demonstrations including swarming of unmanned vehicles. The FY 2021 budget request includes funds to research cross-domain unmanned systems, arctic mobile observation systems, encapsulated undersea effectors, and long endurance airborne platform decoys. Project focus areas include swarm system adaptability, USV operations in higher sea states, UUV operations in non-permissive dynamic

environments, and developing techniques and approaches for affordable manufacturing-at-scale for forward/afloat generation of swarm capability.

Cybersecurity

The DON is developing innovative cyber technologies to enhance the resilience, safety, and effectiveness of cyber systems for both legacy and modern naval warfighting platforms. While legacy systems were designed before cybersecurity was a concern, these systems must remain operational for survivability and mission success. Current efforts are focused on cyber resilience of mission-critical systems and methods to lessen or mitigate the impact of cyber attacks.

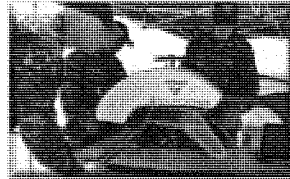
Communications protocols are vectors for enemy exploitation. The DON is developing automated methods to detect and eliminate vulnerabilities to prevent entry into naval systems, such as removing unnecessary code to reduce vulnerabilities and lower software maintenance costs. For example, DON efforts are mitigating vulnerabilities and implants on Field Programmable Gate Array (FPGA) chips, a key real-time processing hardware inherent in naval systems which are now a target for cyber threats. DON's cyber efforts will keep Navy's systems effective and lethal to support the fight of the future.

Cross Platform Naval Tactical Grid

Today, naval research and development is making great strides in developing a routable, message agnostic and resilient network to enable CNO's vision for Distributed Maritime Operations. An example is the Cross Platform Electromagnetic Warfare Technology Accelerator developed, fielded and successfully tested on the USS *William P Lawrence* (DDG 110). This system has an ability to move C2 and ISR data products seamlessly across a routable network comprised of different physical radio links from an airborne platform at significant range. This foundation allows development of distributed combat system applications to control soft-kill and hard-kill across the Naval force in near real time. Building upon the team's early success, the DON intends to expand the testing to a second DDG in FY 2020.

Delivering at the Speed of Relevance

The Department is urgently pursuing the agility we need to assure relevancy in the modern era of technology and competition. The NR&DE is increasing pivot speed to deliver new capabilities to Sailors and Marines by reducing the distance between the technical developer, the buyer and the end user of emerging technologies and innovations. In 2019 the Department sponsored a series of four major Advanced Naval Technology Exercises (ANTX) designed to identify technologies that can be transitioned to the warfighter within 12 to 18 months. Through the collaboration of industry, academia, and government R&D organizations, ANTXs provide an environment for the warfighter to assess the operational utility of technical innovations as well as a forum for informational exchanges and risk reductions for larger Fleet/USMC exercises. Most importantly, ANTX allows innovative and non-traditional industry partners to demonstrate their technologies and concepts in near-operational environments and get direct feedback from naval scientists, engineers, Sailors and Marines. Over 2,700 individuals from industry, academia, and warfare centers participated in the four ANTX events, representing over 140 organizations. Over 300 technologies were evaluated and will be further demonstrated at larger naval exercises or have been directly incorporated into programs of record. The Department plans to sponsor another three ANTX exercises in 2020, one in Newport, RI, focused on developing ocean sciences, and two smaller events in Patuxent River, MD focused on risk reduction for the upcoming Large Scale Exercise 2020 and on long range surface warfare technologies.



Scaling innovation toolsets is key to enhancing the impact of R&D. The NavalX office, established in 2019, consolidates the lessons learned from activities such as ANTX and centrally facilitates rapid adoption of proven agility-enhancing methods across the DON. NavalX guides, empowers, and connects our workforce to achieve pivot speed at an enterprise scale by building workforce capability and hosting workshops, prize challenges, industry events and pitch days to share methods to scale and develop skills. By coalescing talent in networks of collaboration and breaking down silos, NavalX helps accelerate the pace of discovery, learning and experimentation between collaborative partners and the Navy.

Through the creation of regional Tech Bridges across the country, NavalX is building the connections between the DON and the private sector to create vibrant regional innovation ecosystems and reduce barriers between Navy and non-traditional partners, such as start-ups, small businesses, academia, non-profits, and private capital. These regional ecosystems accelerate the delivery of warfighting capability to the DON with the innovation driven by commercial industry. This year, NavalX stood up six locations - in California, Florida, Indiana, Rhode Island, South Carolina, and Washington State - to facilitate rapid adoption of proven agility-enhancing methods across the Department. Additional sites will be announced soon.

A pilot innovation effort, the Naval Innovation Process Adoption (NIPA) was established in early 2018 to implement a common, effective agility process and language across Naval Warfare Centers, laboratories and partnering organizations. The NIPA pilot implements both technology and business best practices, and provides funding under Challenge awards to develop and demonstrate early prototypes, and facilitate follow-on acquisition and production of technologies. Since its inception in 2018, NIPA has attracted over 1,500 naval and private sector participants to training and Challenge workshops at over 20 locations across the U.S., with 12 NIPA Challenge prototypes currently under development.

The DON is leveraging many industry advancements in advanced/additive manufacturing (AM) that enable emerging technology to drive speed and innovation. Through a collaboration with America Makes, a national accelerator for AM and 3D printing supported by the Secretary of Defense's Manufacturing Technology (MANTECH) program, the Navy is developing AM methods, capabilities, qualification standards, and workforce development requirements. The Navy and Marine Corps have established, or are in the process of finalizing, 16 AM related cooperative research and development agreements with industry and academic partners. The Department has expanded polymer and metal AM capabilities at its depot and intermediate level maintenance activities, and has deployed polymer AM capability to eight ships, two expeditionary fabrication facilities and 21 Marine Expeditionary Units. Future efforts with industry include leveraging commodity polymer, industrial polymer and industrial metal printers.

In the past year, the Department also established a Digital Integration Support Cell (DISC) to lead and facilitate digital transformation, integrate capability development, and better enable Distributed Maritime Operations. The DISC is developing the reference architecture and implementation standards for the Digital Warfighting Platform (DWP), a computer environment

and warfighting application ecosystem. The DWP will revolutionize Naval warfare systems by eliminating stove piped architectures and one-off point-solution integration projects, leverage micro services, Application Programming Interfaces, and Software Development Kits to prioritize integration, interoperability, scalability, and modularity in all software design efforts.

In a continuing effort to improve the impact of R&D, the Department has recognized the need to synchronize RDT&E strategies with the essential engineering necessary to expedite technological solutions to the warfighter, to include prototyping and experimentation efforts. A realigned responsibility now falls under the Deputy Assistant Secretary for RDT&E whose core role is to ensure DON RDT&E is not only aligned to naval and DoD priorities but also continues to stress agility in providing technological innovation to the warfighter. In this refocused approach, the University Affiliated Research Centers and Naval Post Graduate School will be included into the collective R&D establishment to maximize the compounding effect of all Department of the DON R&D.

Improving Business Processes

The Navy is leveraging and taking full advantage of authorities granted by Congress to streamline our business processes, increase agility, and drive efficiencies. These authorities are making a significant difference in how the Department both recapitalizes our capital assets and strengthens the workforce.

Other Transaction Agreements (OTAs)

OTAs aid the Navy's agility by accelerating prototyping and bringing in non-traditional companies into the R&D enterprise, allowing the Navy to become a more agile, responsive organization that can adapt to new ideas and emerging challenges, often at a more competitively priced solution. In 2019, the Navy obligated \$101 million via OTAs. For 2020, the Navy is developing a streamlined approval process for non-delegable determinations in support of OTAs in the \$100-\$500 million range, and is executing a pilot to allow non-contracting officers to serve as agreement officers with the authority to enter into, administer, or terminate OTAs. This pilot will inform future policy that may delegate responsibility more broadly thereby increasing agility and allowing for greater scaling.

For example, the Strategic and Spectrum Missions Advanced Resilient Trusted Systems (S²MARTS) OTA at Naval Surface Warfare Center, Crane, IN has awarded seven projects with total obligations of approximately \$44 million and has another four projects in the pipeline. The use of this acquisition toolset is allowing the DON to move faster, reach a broader set of non-traditional partners, and is making a difference for the Navy and the Nation in solving trusted supply chain issues on microelectronics.

Title 10 USC 2363 (formerly Section 219 of Public Law No. 110-417)

The authority provided in 10 U.S.C. 2363 continues to pay dividends to the Department, providing the NR&DE with another mechanism to enhance technology transitions, advance the technical workforce, expand technical knowledge, and improve infrastructure. Examples of innovation that have reached the warfighter include 3-D printed custom earplugs, ocean harvest (multi-band, ultra-wide band synthetic aperture radar), and de-bond detection for *Virginia* class special hull treatment. These research initiatives resulted in 33 patents for new inventions in 2019, and publication of 781 peer-reviewed articles to expand the nation's technical expertise.

Using this authority, the USS *Monterey* Digital Pilot Ship project transitioned valuable technology to the fleet, introducing a shipboard modern cloud architecture for hosting combat system applications, build-to-spec touch screen consoles, and an LED video wall with configurable display functions. The infrastructure hardware/software suite on the *Monterey* will enable unified management of a cyber-secure, expandable, compute/network/storage solution and allows for hardware configuration and application deployment to be scripted, making installation, operation, and maintenance of the shipboard system less complicated and faster for our Sailors. The project provides a digital twin of the system for initial training of the ship's crew and support during deployment and used OTA contracts as a means to rapidly and iteratively prototype combat systems components.

Section 233 of the FY2017 NDAA

Section 233 of the FY2017 NDAA granted DoD the ability to pilot changes in methods for more effective development of technology and management functions at eligible centers. The DON has used this authority to increase flexibilities in many areas including contracting, purchasing, information technology, personnel, facilities management, construction, repair, and

lab revitalization. Over fiscal years 2018 and 2019, the DON has implemented 18 management initiatives which have led to greater effectiveness and efficiencies, decreasing processing time days for procurement, contracts, infrastructure and IT actions by a remarkable half a million days (340,000 processing days in FY 2019).

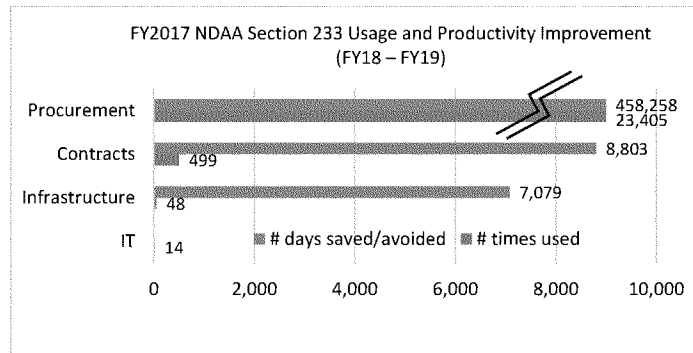


Figure 2. FY2017 NDAA Section 233 Naval Activity

The focus for the coming year will be improving the R&D infrastructure. The Department looks forward to continued collaboration with this Committee to ensure the continued vitality and effectiveness of the NR&DE.

Improving Technology Security

Historically, the Navy and Marine Corps enjoy an overwhelming military capability advantage over adversaries. That advantage is based on the development and delivery of effective systems to the operational Navy. We collaborate with, and depend upon, our defense industrial base to protect and deliver sensitive, classified programs. These mature, sensitive programs are rooted in fundamental research, facilitated by a dynamic, collaborative, fast-paced “open” research environment, exploring principles of basic and fundamental science. While this open approach is an advantage, it also creates a vulnerability. Our international competitors have recognized the exploitability of the open environment and have systematically facilitated a large-scale transfer of knowledge, expertise, and research capital through various extralegal means.

Simultaneously, attempts to steal sensitive Navy technologies using traditional illegal means continue.

To better protect our investment across the entirety of the naval enterprise, the Department is working to understand where capability advantage is created. By instituting policies and tools designed to formally assess our research investments, the DON will evaluate vulnerability, sensitivity, and criticality to focus protection efforts on our capability advantages. While we continue to apply standard security protocols such as OPSEC and classification when warranted, the Navy is also mandating the application of enhanced security and counterintelligence measures where appropriate. We will continue to closely partner with counterintelligence and law enforcement, making timely referrals focused on relevant critical technology areas, to facilitate proactive investigations and operations.

Conclusion

The Department of the Navy continues to search for new technology around the world, to seek out new ways to partner with non-traditional innovators, and emphasize high-velocity experimentation in everything we do in order to deliver at the speed of relevance. With your continued support, the DON and the men and women who work tirelessly and brilliantly on the cutting edge of scientific advancement, will continue to provide our warfighters with the next great technologies, expand the frontiers of knowledge, and work to ensure the nation remains safe, and the ocean commons and open skies remain free.

James F. Geurts
Assistant Secretary of the Navy
(Research, Development and Acquisition)
12/5/2017 - Present

On Dec. 5, 2017, Mr. James F. Geurts was sworn in as Assistant Secretary of the Navy for Research, Development & Acquisition (ASN (RD&A)), following his confirmation by the Senate November 2017. As the Navy's acquisition executive, Mr. Geurts has oversight of an annual budget in excess of \$60 billion and is responsible for equipping and supporting the finest Sailors and Marines in the world with the best platforms, systems and technology as they operate around the globe in defense of the Nation.

Mr. Geurts previously served as the Acquisition Executive, U.S.. Special Operations Command (USSOCOM), at MacDill Air Force Base (AFB), Florida, where he was responsible for all special operations forces acquisition, technology and logistics. In this position his innovative leadership and technological ingenuity provided rapid and affordable acquisition that positively impacted the USSOCOM acquisition work force and the special operations forces capability on the battlefield. These contributions were recognized by both private and public institutions during his tenure to include earning the Presidential Rank Award, USSOCOM Medal, William Perry Award and Federal Times Vanguard Award for Executive of the Year.

Prior to Senior Executive Service, Mr. Geurts began his career as an Air Force officer where he served as an acquisition program manager with engineering and program management leadership positions in numerous weapon systems including intercontinental ballistic missiles, surveillance platforms, tactical fighter aircraft, advanced avionics systems, stealth cruise missiles, training systems and manned and unmanned special operations aircraft.

He has over 30 years of extensive joint acquisition experience and served in all levels of acquisition leadership positions including Acquisition Executive, Program Executive Officer and Program Manager of Major Defense Acquisition Programs.

Mr. Geurts is a distinguished 1987 ROTC graduate from Lehigh University where he received a Bachelor of Science in Electrical Engineering. He holds a Master of Science in Electrical Engineering from Air Force Institute of Technology, Wright-Patterson AFB and in National Security Resourcing from Industrial College of the Armed Forces, National Defense University, Washington, D.C. Mr. Geurts also attended executive leadership and international studies programs at Harvard Kennedy School and George Washington Elliot School.

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HOUSE ARMED SERVICES COMMITTEE
SUBCOMMITTEE ON INTELLIGENCE AND
EMERGING THREATS AND CAPABILITIES
U.S. HOUSE OF REPRESENTATIVES

DEPARTMENT OF THE AIR FORCE

PRESENTATION TO THE HOUSE ARMED SERVICES COMMITTEE
SUBCOMMITTEE ON INTELLIGENCE AND EMERGING THREATS
AND CAPABILITIES

U.S. HOUSE OF REPRESENTATIVES

HEARING DATE/TIME: March 11, 2020, 2:00 P.M.

SUBJECT: Fiscal Year 2021 Air Force Science and Technology Strategy, Policy, and Programs

STATEMENT OF: Dr. William B. Roper, Jr.
Assistant Secretary of the Air Force for Acquisition, Technology and Logistics

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Strategic Environment and Addressing the National Defense Strategy

Chairman Langevin, Ranking Member Stefanik, and distinguished Members of the subcommittee, thank you for the opportunity to provide testimony on the Fiscal Year 2021 Department of the Air Force Science and Technology (S&T) Program and our continued efforts to respond to the warfighter faster, while simultaneously developing the future force.

As the nature and sources of conflict have become more diverse and less predictable, our nation continues to face a complex set of current and future security challenges, including the resurgence of great power competition from China and Russia. The rapid proliferation of global technology means the speed at which we change must increase. It is clear that supremacy in the air and space domains—a given for any U.S. military operation since the end of the Cold War—can no longer be presumed without deliberate investments in leap-ahead technology. Consequently, the National Defense Strategy shifts our priority, including those for S&T, to high-end warfighting.

The Department of the Air Force has fully embraced Secretary of Defense Esper's goal of irreversible momentum toward National Defense Strategy implementation. The Department of the Air Force must be ready to compete, deter, and win in this rapidly changing and increasingly complex security environment; defend the homeland; provide a safe, secure, and effective nuclear deterrent; be able to defeat a powerful conventional enemy while we deter opportunistic aggression in another theater; and continue to disrupt violent extremists.

These missions require that the Department of the Air Force develop innovative technologies more rapidly, and integrate new technologies, both Defense and commercial, onto military systems with unmatched agility. Competing across the entire technology ecosystem is a new challenge for the Department—especially with 80 percent of our nation's R&D now commercial—but it is one on which we have made much progress.

As the Department of the Air Force budget request highlights, we are committed to sustaining

our S&T portfolio and driving innovation across the enterprise. The Department of the Air Force Fiscal Year 2021 (FY21) President's Budget request for S&T is \$2.8 billion. Our investment in S&T for FY21 grew by \$7.0 million over the FY20 President's Budget request. In addition to S&T funding, the Department of the Air Force FY21 budget request includes approximately \$1.3 billion in prototyping and experimentation funding focused on getting technology into the hands of warfighters to determine military utility and inform requirements for future force capabilities. Additionally, we have seen a threefold return on investment increase in our Small Business Innovative Research (SBIR) and Small Business Technology Transition Research (STTR) accounts since implementing what we now call our "Air Force Ventures" process in 2018.

In the FY21 PB, the Department of the Air Force restructured our S&T Program Element structure to increase agility. Today, technology associated with future warfighting must be more integrated across disciplines, providing integrated capabilities vice stand-alone solutions. Twenty-seven Program Elements (PEs) have been merged into 19, including realigning existing projects from the current 13 Budget Activity (BA) 6.3 Advanced Technology Development PEs into five new capability-focused BA 6.3 PEs. We also created a new BA 6.2 Applied Research PE to serve as an incubator for transformational S&T efforts. In only two months, we went from 236 new applied research concepts to 7 we are exploring at max speed. PE consolidation gives our S&T enterprise greater ability both to adapt to change and work across disciplines. We ask for Congress to support this initiative, which we are looking to continue in the future.

As part of implementing the NDS, our S&T portfolio also now includes larger initiatives, called Vanguard Programs, meant to accelerate the transition of war-winning capabilities into programs of record. The Vanguard Programs focus on five strategic thrusts meant to dominate time, space, and complexity across all operating domains:

- **Global Persistent Awareness** – continuous and timely knowledge of our adversaries through the operating environment;
- **Resilient Information Sharing** – assured and resilient communications and precise position, navigation, and timing across all Joint Force assets;
- **Rapid, Effective Decision-Making** – use of automation and artificial intelligence to accelerate battlespace knowledge and decision-making faster than our adversary;
- **Complexity, Unpredictability, and Mass** – overwhelming adversaries with complexity, unpredictability, and numbers; and
- **Speed and Reach of Disruption and Lethality** – exploiting new methods to rapidly attack, disrupt and neutralize dynamic and mobile targets with speed and global reach.

Vanguards

This new Vanguard initiative, designed to accelerate technology from the Air Force Research Laboratory into programs of record, is modeled after the rapid-prototyping process used by the Strategic Capabilities Office. Specific Vanguard efforts are approved by the Department of the Air Force Capability Development Council, co-chaired by the Under Secretary of the Air Force and the Vice Chief of Staff of the Air Force, signifying an enterprise commitment for each effort. Warfighters, future force designers, technologists, and program managers ensure technical feasibility, operational utility, and a solid business case to work through the complexities of implementation and facilitate transition into acquisition and fielding. S&T funds will be dedicated to complete the S&T components of each Vanguard effort. To accelerate Vanguard transitions, Program Executive Officers (PEOs) are designated upfront to develop and execute an acquisition strategy in collaboration with the Technology Executive Officer (TEO). Upon successful prototyping and experimentation, the Department of the Air Force will transition the technology into an operational capability. We recently approved the first three Vanguards: Navigation Technology Satellite 3 (NTS-3), Skyborg, and Golden

Horde.

NTS-3 is the first Satellite Navigation (SATNAV) space experiment in 40 years. The program will develop advanced techniques to provide military, civil, and commercial users with a more resilient SATNAV capability. If successful, these techniques will transition to future generations of the Global Positioning System (GPS) satellites and receivers. Launch of NTS-3 is currently projected for 2023 with a planned one-year, on-orbit experimentation program.

Skyborg integrates Artificial Intelligence (AI) with autonomous Unmanned Air Vehicles (UAVs) to enable manned-unmanned teaming. AI technologies, ranging from simple algorithms to fully autonomous flight controls, will be worked in partnership with our AI Accelerator at the Massachusetts Institute of Technology. If successful, Skyborg will transition AI-enabled low-cost attritable aircraft technology (LCAAT) via the NGAD program, or a new program of record. The first LCAAT, the XQ-58A Valkyrie, has already demonstrated high subsonic speeds at operationally relevant altitudes and payload capacities. Its next flight in April 2020 will connect the F-22 and F-35 via the gatewayONE radio link as part of the next Advanced Battle Management System (ABMS) demonstration.

Golden Horde will demonstrate collaborative, semi-autonomous networked weapons that share data, interact, and execute coordinated actions to defeat targets. Golden Horde will leverage onboard radios and algorithms to share data between weapons as well as manned platforms. Flight testing with existing weapons will begin this year, and, if successful, those weapons programs will transition Golden Horde upgrades into their respective programs of record.

Global Persistent Awareness and Resilient Information Sharing

Quantum, Advanced Communications, 5G, and Microelectronics

The Department of the Air Force continues to invest in quantum information science in three specific areas: quantum timing and quantum sensing (e.g., sensors and clocks used for navigation, detection, and force orchestration), quantum communications (e.g., advanced, secure, tamper-evident communications and networking enabled by fundamental quantum effects), and quantum computing (e.g., storage devices, specialized circuits, and algorithms operating on data maintained in superposition). While quantum technologies may have longer development timeframes, their impacts are expected to be far-reaching, allowing local GPS-like accuracy, new scales of computation, and new detection modes that obsolete current ones. We can ill afford to fall behind.

Consequently, we are increasing our outreach to industry and academia to ensure our scientists and engineers remain on the cutting edge of quantum science. For a second year, the Department of the Air Force co-sponsored the Quantum for Business (Q2B) event, where industry leaders gather to hear the latest announcements, explore partnership opportunities, and collaborate on practical applications of quantum science. In May 2019, we formed a partnership with IBM to establish AFRL as an IBM Q Network Hub, which provides the Department of the Air Force and its collaborators access to IBM's commercial quantum computing systems to explore practical applications important to our two Services. The IBM Q Network has established Quantum Hubs across the world to increase access to quantum systems and advanced research, which is critical to accelerate learning, skills development, and implementation of quantum computing. This year we are stepping forward with a two-day Quantum Collider event, offering \$50 million to small businesses to boost the quantum ecosystem by pairing them with university expertise in quantum fields.

5G is an important communications technology being deployed world-wide with heavy commercial investment. 5G provides critical underlying infrastructure for the "Internet of Things" (IoT), where all devices will be connected to a global network. This will be especially important as we work to maintain warfighting dominance through Joint All-Domain Command and Control

(JADC2) powered by the Advanced Battle Management System (ABMS), which builds the digital infrastructure for the Joint Force's IoT. We are exploring ways to exploit 5G in this endeavor and are working with industry to install on three Air Force bases. We would be happy to share more information about these efforts in a classified setting.

Reliance on foreign microelectronics jeopardizes our ability to modernize our military systems in the future. The problem is three-fold: low market share; an expansive range of needs, from boutique and legacy components to state-of-the-art technologies; and a lack of domestic trusted foundries to manufacture trusted microelectronics. In FY20, we are executing over \$300 million to modernize microelectronic design and provide Department of Defense access to the commercial microelectronics supply chain. In FY21, we will leverage the latest digital engineering capabilities to develop a cloud-based microelectronics infrastructure that provides traceability and provenance across the entire microelectronics lifecycle.

Cyber and Big Data Analytics

Every day, we encounter sophisticated and persistent adversaries in cyberspace. The Department of the Air Force's cyber S&T investment is integral to assuring communications across physical and security domains, protecting our legacy and future avionics systems, countering global threats to mission performance, and expanding available bandwidth through dynamic spectrum access. We are enhancing cyberspace resiliency through an effective mix of redundancy, diversity, and distributed functionality that leverages advances in virtualization and cloud technologies.

The Department of the Air Force is focused on securing our weapons systems. We must be vigilant in our cyber hygiene as we are sharing a global hardware supply chain and harnessing more rapid software development best practices. This past year, the Air Force Research Laboratory sponsored an "attack the base" challenge at the DEFCON Security Conference, an annual event which brings together over 30,000 of the world's best security researchers, hackers,

and industry incubators to advance the cyber resiliency of many industries. We identified DEFCON as an ideal open environment to harness the best-of-breed in the security research community. The top prize awarded for our “attack the base” challenge was an internship where time is split between the embedded security industry and the Department of the Air Force. Use of this out-of-the-box approach provided access to the best cybersecurity candidates by leveraging competitive technical challenges. This year, we will be returning to DEFCON to bridge the security and space communities by holding a research challenge to penetrate a satellite (i.e., “hack-a-sat”) and its ground and radio frequency components. The challenge will not only enhance our space system and infrastructure resiliency, it will contribute to the development of relationships with top cybersecurity professionals and build awareness about space cybersecurity as more companies—and more of our economy—depend on it.

We are also leveraging Big Data technology to provide analytic capabilities across multiple modes of intelligence, including virtualization, distributed computing, and machine learning to achieve operational agility through superior decision speed. Our S&T portfolio is investing in prototype development of an expandable cloud processing analytic capability that combines Signals Intelligence, Moving Target Indicator radar, and other data sources. This infrastructure provides the necessary tools for data scientists to engage with large-scale military data sets, so we are excited to see what doors this opens in the future.

Space and Fully Networked C3

Our adversaries have recognized the advantages we gain from operating in space and are developing capabilities to deny us this advantage in case of crisis or war. Consequently, our space S&T portfolio is broad in scope, spanning basic research published in world-renowned scientific journals, to conducting operations on satellites assembled by our government workforce, to classified activities. Our space S&T portfolio invests in five specific disciplines: space environment;

nuclear deterrence operations; space domain awareness; communication, position, navigation and timing; and intelligence, surveillance, and reconnaissance, including missile warning.

We continue to explore and mature a number of space resiliency technologies through on-orbit space experimentation. In June 2019, we launched the Demonstration & Science Experiment (DSX). In July, it successfully deployed two booms at 80 meters to become the largest unmanned structure ever in space. The DSX satellite is now performing a series of basic research experiments, including investigating the physics of radiation belt remediation techniques.

In another effort called “Global Lightning”, AFRL researchers are experimenting with communication pathways that leverage the emerging commercial space internet. Our approach is to be an early adopter and influencer of this commercial technology. In December of last year, we conducted a test in which a SpaceX communications terminal onboard an Air Force Special Operations Command AC-130 was used to communicate target coordinates from Advanced Battle Management System (ABMS) sensors through the Starlink commercial space internet constellation to Army forces. This April, during our next ABMS experiment, we will test communications through the Starlink constellation with a KC-135. This effort will continue to build the connective backbone for ABMS in four-month iterative cycles as we build out the military’s IoT.

Rapid, Effective Decision-Making and Complexity, Unpredictability, and Mass

Autonomy and Artificial Intelligence

The Department of the Air Force is committed to operationalizing Artificial Intelligence (AI) to move inside the adversary decision cycle. To address near-term operational challenges, we initiated an AI accelerator at the Massachusetts Institute of Technology staffed by Airmen from the operational community. The Department of the Air Force looks to connect with the world’s best

scientists and engineers to field practical AI solutions for real-world national security challenges. We are excited about future possibilities our partnership with MIT will enable as world-leading principle investigators are now engaged on technical problems in Vanguard programs, as well as at our Kessel Run software development center-of-excellence.

Last year, Air Force researchers successfully integrated AI into DoD Intelligence Analysis for the Air Force Distributed Common Ground System (DCGS). “FuelAI” is a cutting-edge, AI-enabled, and government-owned Full Motion Video (FMV) crowdsource labeling application that enables the tagging, characterizing, and analysis of a large amount of data at unprecedented speeds. The datasets produced at Air Force DCGS sites enable researchers to train AI algorithms for specific national defense missions. Additionally, AFRL created and deployed the Deep Learning Video Pipeline (DLVP) in conjunction with industry partners. DLVP is a government-owned S&T framework to insert artificial intelligence algorithms into FMV intelligence operations, rapidly. Through FuelAI and DLVP, we have established a higher standard of trust for human-machine partnerships by embedding data labeling directly into our intelligence processes.

Artificial Intelligence applications, such as FuelAI, will be most effective in the future fight if the computing can be done at the tactical edge. In September 2019, we completed a demonstration moving us closer to providing this capability to the warfighter by leveraging Agile Condor, a high-performance computing architecture which can be mounted on various platforms that will be used to demonstrate artificial intelligence and machine learning technologies. The team built upon the Agile Condor’s embedded High Performance Computing open system and neuromorphic computing technologies to deliver on-board advanced computing with superior processing capabilities.

AI and advanced autonomy introduce new opportunities for unmanned air platforms. The Department of the Air Force continues to demonstrate the Low Cost Attritable Aircraft, the XQ-58A Valkyrie. The Valkyrie completed three flights this past year, flying at high subsonic speeds and

operationally relevant altitudes. The XQ-58A Valkyrie is the first instantiation of a class of attritable aircraft, which opens the door to new manned-unmanned concepts being explored in the Skyborg program. This year, we will assess the military utility of various LCAAT through an experimentation campaign focused on reliability, maintainability, sustainment, and life cycle cost. We appreciate the support of Congress on these effort, including the additional \$100 million it appropriated in the FY20 Defense Appropriations Bill.

Disruption and Lethality

Hypersonics

An operational hypersonic air-launched weapon enables the U.S. to put high-value, time-sensitive targets at risk in contested environments. We remain committed to developing an operational hypersonic strike weapon capability by the end of FY22. We have pursued two rapid prototyping efforts to achieve this objective: the Air-Launched Rapid Response Weapon (ARRW), which is based on our joint Air Force/DARPA Tactical Boost Glide S&T demonstrator; and the Hypersonic Conventional Strike Weapon (HCSW), which is based on the Conventional Prompt Strike program.

Over the past year, ARRW successfully fired a new solid rocket motor, completed warhead design verification, and completed several captive carry flights of the Instrumented Measurement Vehicle. These activities have reduced risk, and ARRW is on track to deliver capability in FY22. HCSW also had many successes, including transition of Conventional Prompt Strike technology from the laboratory to industry. The HCSW team pioneered significant advancements, including maturing component technologies that may be used by other Department of Defense hypersonic programs, and was also on track to deliver capability in FY22. The Air Force down-selected to a single concept a year earlier than originally planned, with ARRW being selected as the higher-capacity weapon.

We will take HCSW through Critical Design Review later this month to document its design should it be needed in the design of future solutions. The Section 804 Rapid Prototyping Authorities

granted by Congress accelerated both programs by four-to-five years, allowing this early down-select to be done with greater confidence.

In addition to boost-glide weapons, we are also accelerating our development of hypersonic cruise missiles in partnership with DARPA. The Hypersonic Air-breathing Weapon Concept (HAWC) is maturing and integrating critical technologies for an effective air-launched, scramjet-powered hypersonic cruise missile. First flight will be later this year. To accelerate our ability to prototype such demonstrators, our S&T portfolio includes wide-reaching investments in propulsion technology, advanced materials, manufacturing technology, sensors and algorithms, and aero-structures.

Directed Energy

Directed Energy Weapons (DEWs) offer transformational capabilities to defeat massed attacks effectively, affordably, and rapidly. Disruption and lethality at light speed will have broad impacts on how future wars will be fought and won.

As part of the Department of the Air Force's Directed Energy Experimentation Campaign, we are conducting the first-ever extensive overseas field evaluation consisting of five counter-unmanned aerial systems—three high energy laser systems and two high power microwave systems. In addition, five to six additional systems are in procurement and will ship within 18 months. We are putting DEWs for base protection in the hands of the warfighter to get feedback on training, maintenance, operations and logistics to inform requirements for a future program of record. The Self-protect High-Energy Laser Demonstrator (SHIELD), a podded aircraft-protect laser demonstrator, has validated its lethality models and tracking algorithms by using the ground-based Demonstrator Laser Weapon System to shoot down missiles at White Sands Missile Range. We also continue to partner with the Navy on the High-power Joint Electromagnetic Non-Kinetic Strike (HiJENKS) effort, which is an initiative to integrate a counter-electronic payload on an airborne platform.

Biotechnology

The National Defense Strategy highlights the role of rapid advancements in biotechnologies for national security. Biotechnology tools and technologies are revolutionizing virtually every industrial sector and presents opportunities for defense innovation in a number of domains, including specialty materials manufacturing, novel sensors, warfighter performance optimization, and security. Using synthetic biology, we are developing approaches to secure the supply chain in critical materials for aerospace systems, protect our Airmen from directed energy, and exploit vulnerabilities for directed energy weapons.

For example, our basic research partnership with Australia has resulted in an ultraprecise ultrasound sensor on a silicon chip. The technology is so sensitive that it can hear the miniscule random forces from surrounding air molecules. We will soon have the ability to listen to the sound emitted by living bacteria and cells. In the health and performance area of research, we are focused on advances in cognitive sciences for developing optimized and resilient human-machine teams. Integrated Cockpit Sensing integrates bio-physical sensors with a common data storage platform to provide standalone pilot alerting capabilities. The sensors enhance pilot decision-making and provide in-flight data needed to perform root-cause analysis of physiological events. Integrated Cockpit Sensing will improve operational readiness by preventing mishaps and aircraft groundings, and enable increased pilot awareness during flight.

Accelerating Commercial Technology to the Warfighter

With over 80 percent of our nation's research and development (R&D) now commercial—and our Defense Industrial Base continuing to shrink through mergers and acquisitions—transforming the way we work with commercial tech companies is imperative. In 2018, we began energizing our Small Business Innovative Research/Small Business Technology Transfer Program (SBIR/STTR) to lower barriers for commercial tech companies, speed contracts, and bring private investment into the

Defense market. In 2019 alone, we awarded over 1,000 contracts worth \$240 million to 700 companies, with over half new to the government; conducted 15 “Pitch Days” that awarded \$77 million in same-day contracts; and induced over \$400 million of private investment matching for companies receiving Department of the Air Force awards. Our research laboratories were integral to this success, providing technical expertise to help evaluate commercial technology opportunities and risks.

Given the threefold return on investment increase we have experienced since 2018, we will formally launch this new “Air Force Ventures” process at scale so that tech companies can depend on us as an early innovation partner of choice.

Working with tech startups is only part of how we are working with the commercial technology ecosystem. We recently launched Agility Prime, a non-traditional program run in partnership between our PEO for Mobility and AFRL, seeking to operationalize commercial electric vertical takeoff and landing (eVTOL) vehicles (i.e., “flying cars”) for military missions, and accelerate the emerging commercial eVTOL market in the United States. The Department of the Air Force has unique testing and safety resources—and revenue-generating military use cases—to help mitigate current commercial market and regulatory risks. Agility Prime will use these resources, vice significant R&D funding, to attract investors, build confidence, and hopefully expedite commercialization, all while providing warfighters revolutionary flexibility for numerous missions. We recently released an Innovative Capabilities Opening that establishes the rapid contracting mechanism to explore and potentially field transformative vertical flight aircraft within three years, and the program will host a challenge series this year to select vehicles, certify safety and airworthiness, procure systems for the most promising missions, and reach operational capability by FY23.

Expanding our R&D enterprise from creator to catalyst is key for accelerating dual-use

technology and countering the advantages of state-sponsored industrial bases. We appreciate the support of Congress on this effort, including the additional \$25 million it appropriated in the FY20 Defense Bill.

Supporting Innovation – People, Infrastructure, and Authorities

Our S&T Strategy recognizes that technological superiority depends on the talent and innovative spirit of our workforce. Competition for highly-qualified, technical talent will continue to intensify. We appreciate Congress' support of our ability to recruit, retain, and develop the Air Force science, technology, engineering, and mathematics (STEM) workforce. The National Defense Authorization Acts of the past several years have provided additional personnel authorities to the S&T community. In order to stay competitive, we used direct-hire authorities to gain over 300 personnel from academia and industry in 2019. The authorities allow us to attract the right talent for the right positions in the least amount of time, which is vital to our competitiveness. We will continue to use this critical authority for years to come.

The competition for the right talent drives us to focus on our processes and policies to recruit, hire, and retain top talent—our people are our foundation. The Air Force Research Laboratory is implementing a workforce pilot using executive headhunter recruitment firms for hard-to-fill senior leader positions, resulting in large and diverse candidate pools. In October 2019, we used the enhanced pay authority (EPA) to hire a Data Analytics advisor and more EPA positions are in-the-works for Communications and Networking, Modeling Simulation and Analysis, and Microelectronics. Maintaining our technology advantage also requires hiring technology leaders at industry-comparable speeds. The Air Force Research Laboratory is focused on internal processes to expedite hiring timelines, provide better data to supervisors on their hiring decisions, and generate more dialogue between supervisors and employees. We appreciate the authorities Congress has given us to compete for talent and will implement them to the maximum extent possible.

The STEM K-12 Outreach Program, managed by the Air Force Research Laboratory, is also an important component to building the workforce of the future. STEM K-12 Outreach allows us to attract students to possible Department of the Air Force careers. Making it easy for students to envision a future where they can intern, receive a paid STEM scholarship, and then be hired to design future capabilities our nation needs is of utmost importance to compete for talent.

Laboratory Infrastructure

Science and technology-focused infrastructure is an important innovation multiplier. Last year, we broke ground on two Department of the Air Force laboratory MILCON projects: the Advanced Munitions Technology Complex (AMTC), a \$75 million research facility on Eglin AFB; and the Space Vehicles Component Development Laboratory (SVCDL), a \$13 million research facility on Kirtland AFB. Technologies developed at the AMTC will reduce the size of munitions without sacrificing weapon effects. Lighter munitions allow current and next generation aircraft to carry greater numbers of weapons, increasing mission effectiveness. The AMTC is scheduled for completion in 2021. The Space Control Laboratory (SVCCL) will consolidate efforts being conducted at six different facilities on Kirtland AFB and will advance research in space domain awareness, command and control of space systems, and survivability of space assets. The SCL is also scheduled for completion in 2021.

We continuously assess laboratory infrastructure to determine how to support technology needs. Our recently conducted five-year facility plan identified 533 future infrastructure projects. We look forward to working with Congress to ensure our facilities continue to meet the needs of future warfighters.

Conclusion

The Department of the Air Force's S&T Portfolio is shaped to deliver capabilities that are lethal, resilient, and cost-imposing for our adversaries. While the technologies we invest in are critically

important, the pace at which we must innovate and respond is even more significant. Whatever the next game-changing technology is, we must create or catalyze it faster than our adversaries or risk ceding the dominant tech advantage in air, space, and cyberspace that our nation has relied upon for decades.

Dr. Will Roper

Dr. Will Roper is the Assistant Secretary of the Air Force for Acquisition, Technology and Logistics. As the Air Force's Service Acquisition Executive, Dr. Roper is responsible for and oversees Air Force research, development and acquisition activities totaling an annual budget in excess of \$40 billion for more than 465 acquisition programs. In this position, Dr. Roper serves as the principal advisor to the Secretary and Chief of Staff of the Air Force for research and development, test, production and modernization efforts within the Air Force. In addition to his Air Force responsibilities, Dr. Roper is the Service Acquisition Executive for the Joint Strike Fighter.

Prior to his current position, Dr. Roper was the founding Director of the Pentagon's Strategic Capabilities Office. Established in 2012, the SCO imagines new—often unexpected and game-changing—uses of existing government and commercial systems: extending their shelf-life and restoring surprise to the military's playbook. Since 2012, SCO has grown from an annual budget of \$50 million to the current \$1.5 billion request in the President's 2018 budget with projects spanning new concepts such as hypervelocity artillery, multi-purpose missiles, autonomous fast-boats, smartphone-navigating weapons, big-data-enabled sensing, 3D-printed systems, standoff arsenal planes, fighter avatars and fighter-dispersed swarming micro-drones which formed the world's then-largest swarm of 103 systems. During his tenure as SCO Director, Dr. Roper served on the Department's 2018 National Defense Strategy Steering Group, Cloud Executive Steering Group and Defense Modernization Team.

Previously, Dr. Roper served as the Acting Chief Architect at the Missile Defense Agency where he developed 11 new systems, including the current European Defense architecture, advanced drones, and classified programs. Before this, he worked at MIT Lincoln Laboratory and served as a missile defense advisor to the Under Secretary of Defense for Acquisition, Technology and Logistics.

EDUCATION

2001 Bachelor of Science in Physics, Georgia Institute of Technology, Atlanta
 2002 Master of Science in Physics, Georgia Institute of Technology, Atlanta
 2010 Doctorate in Mathematics, Oxford University, England

CAREER CHRONOLOGY

January 2006 – June 2010, Missile Defense Advisor, MIT Lincoln Laboratory, Washington, D.C.
 August 2010 – August 2011, Member, Missile Defense Advisory Committee, Missile Defense Agency, Washington D.C.
 June 2010 – August 2012, Acting Chief Architect, Missile Defense Agency, Washington D.C.
 August 2012 – February 2018, Director, Strategic Capabilities Office, Office of the Secretary of Defense, Washington, D.C.
 February 2018 – present, Assistant Secretary of the Air Force for Acquisitions, Technology and Logistics, Headquarters U.S. Air Force, Washington, D.C.

MAJOR AWARDS AND HONORS

Department of Defense Medal for Distinguished Public Service
 Secretary of Defense's Award for Excellence
 USD/AT&L Award for Innovation
 MDA Contractor of the Year
 MDA Innovation and Technology Awards
 Rhodes Scholar

(Current as of March 2018)

**WITNESS RESPONSES TO QUESTIONS ASKED DURING
THE HEARING**

MARCH 11, 2020

RESPONSE TO QUESTION SUBMITTED BY MR. LARSEN

Secretary GRIFFIN. There is currently no completed objective analysis, only preliminary results that are subject to significant change as additional data is acquired. Furthermore, a detailed description of activities and methods, to include preliminary data, can only be made available in a classified response. Unfortunately, the COVID 19 mitigation efforts are delaying information gathering activities and hindering analysis of the gathered material. However, we will ensure any analytic products are shared with you, in the appropriate venue, when they are completed. [See page 12.]

RESPONSES TO QUESTIONS SUBMITTED BY MR. COOPER

Secretary GRIFFIN. The Department recognizes that our future military superiority depends on an industrial base that is postured to produce the technologies of the future. Within my organization, we are focused on advancing technologies, cultivating expertise, and developing the industrial capacity to produce advanced technologies at scale. For a detailed assessment of U.S. industry activities expected to be critical to our National Defense Strategy, please refer to the Department's June 2019 report to Congress on Certain Defense Technologies Critical to the United States Maintaining Superior Military Capability. [See page 27.]

Secretary JETTE. The Army may not be the best source for an authoritative list. However, I would gladly meet with you at your convenience to discuss some of my concerns and offer some recommendations on how to develop a comprehensive list. [See page 27.]

Secretary GEURTS. Technology areas with world-class expertise outside U.S. borders include: artificial intelligence, autonomous systems, battery technology, big data, microwave photonics, machine learning, biomedical technology, quantum, high-end carbon fiber, lasers, energy grids, robotics, microelectronics, 5G telecommunications. [See page 27.]

Secretary ROPER. 1. Quantum Science and Materials a. Space-based Quantum Networks b. Quantum Materials, Cryptography, and Software c. Quantum Technology Component Commercialization 2. Microelectronics Tools and Manufacturing a. Computational Hardware for Artificial Intelligence and Machine Learning (AI/ML) b. Semiconductor Manufacturing c. Integrated Photonic Circuits d. Lithography Tools 3. Directed Energy Components a. Directed Energy (generally) b. High Intensity Laser Research, Development, and Manufacturing c. Optical Glass d. Infrared Materials e. Optics Mass Production (lenses, cell housings, and coatings) f. Commercial Silicon Visible/Near-Infrared Cameras 4. Hypersonics a. Hypersonics System Design, Flight Controls, and Optimization 5. Rocket Propulsion a. Oxygen-rich Staged Combustion Rocket Engines b. Upper Stage Hydrogen Engines c. Extremely High Pressure Engine Testing Facilities 6. Artificial Intelligence, Machine Learning Autonomy, and Robotics a. Application Areas in AI/ML b. Theoretical Computer Science for Autonomy c. Autonomous Vehicles and Robotics d. Commercial Drones [See page 27.]

RESPONSES TO QUESTIONS SUBMITTED BY DR. ABRAHAM

Secretary GEURTS. The Department's FY 2021 S&T program aggressively pursues increased lethality through modernization efforts with the greatest potential to deliver nonlinear warfighting advantages. In order to deliver future naval power and support the National Defense Strategy, the Navy and Marine Corps supports our teams and partners, looks for new ways to speed innovation, and invests in disruptive technology. First, we invest in a diverse set of innovative thinkers and doers, including our technical workforce at the Office of Naval Research, Naval Research Laboratory, and our many warfare centers. This also includes over 341 university partners, 91 nonprofit partners, and more than 20,000 small and large businesses, all working together to support our efforts. Second, we invest in the specific tool sets required to scale innovation and enhance the impact of Navy R&D. The NavalX or-

ganization, established in 2019, creates the networking that accelerates our ability to share best practices, strengthen relationships, and share key ideas across the entire Department. NavalX guides and powers an innovative technical workforce and connects the DON to industry innovators to achieve the pivot speed needed for the entire DON enterprise. Third, the FY 2021 budget includes over \$400 million in funding for disruptive, revolutionary technologies in six major thrust areas: Directed Energy, Unmanned Advanced Autonomy/Swarm, Cyber, Advanced Long-Range Targeting, Hypersonics, and Full Spectrum Undersea Warfare. Within these thrust areas are 18 focused efforts including the next generation laser, future hypersonic boosters, artificial intelligence, and swarming. Finally, we support the following National Defense Strategy Research and Engineering modernization areas: directed energy and electric weapons, hypersonic capabilities, artificial intelligence and machine learning, intelligent autonomous systems, cyber security, networked sensors and weapons, advanced manufacturing, high performance materials and energetics, biotechnology, and quantum science and computing. [See page 15.]

Secretary ROPER. One of the biggest shifts you'll notice in the Department of the Air Force's FY21 S&T budget is an increase in Budget Activity (BA) 6.3 (Advanced Technology Development) funding to support advancement of technologies ripe for transitioning to the warfighter. It is the Department's intent, as cited in our S&T Strategy, to accelerate our efforts to develop and deliver transformational operational capabilities. Our new Vanguard initiative, designed to accelerate technology from the Air Force Research Laboratory (AFRL) into programs of record, is modeled after the Strategic Capabilities Office's rapid-prototyping process. Specific Vanguard efforts are approved by the Department of the Air Force Capability Development Council, co-chaired by the Under Secretary of the Air Force and the Vice Chief of Staff of the Air Force, signifying an enterprise commitment. Warfighters, future force designers, technologists, and program managers ensure technical feasibility, operational utility, and a solid business case to work through the complexities of implementation and facilitate transition into acquisition and fielding. S&T funds will be dedicated to complete the S&T components of each Vanguard effort. To accelerate Vanguard transitions, Program Executive Officers (PEOs) are designated upfront to develop and execute an acquisition strategy in collaboration with the Technology Executive Officer (TEO). Upon successful prototyping and experimentation, the Department of the Air Force will transition the technology into an operational capability. We recently approved the first three Vanguards: Golden Horde, Navigation Technology Satellite 3 (NTS-3), and Skyborg. Golden Horde will develop and demonstrate collaborative autonomous networked weapons, allowing warfighters to observe and react to the enemy in real-time. The NTS-3 flight experiment tests enhancements to space-based positioning, navigation, and timing across space, control, and user segments, to include reprogrammable software-defined receivers able to rapidly respond to new conditions and ensure better security and flexibility. Finally, Skyborg integrates artificial intelligence with autonomous, attritable aircraft to enable manned-unmanned teaming of systems. [See page 15.]

QUESTIONS SUBMITTED BY MEMBERS POST HEARING

MARCH 11, 2020

QUESTION SUBMITTED BY MR. LANGEVIN

Mr. LANGEVIN. Secretary Griffin, for the rapid technological advancements outlined in the NDS, and for your eleven modernization priorities, last year's NDAA tasked the Department to lean forward on strategically developing policies on how we should use and deploy these future technologies, and to consider how these emerging capabilities will contribute to new security strategies. Concurrency in policy and tech development is critical to successful employment of capabilities and being a global leader in establishing norms for use of technologies. Yet, too often the policy lags tech development. In your view, what action does the Department need to take to promote concurrency in policy, employment concepts, training, doctrine, and other matters as technology matures?

Secretary GRIFFIN. My organization is focused on ensuring the technologies and capabilities the Department is developing are those needed to best achieve the objectives detailed in the National Defense Strategy. I agree that concurrency in policy and technology/capability development is critical to successfully employing new and emerging capabilities and our goal is to be first adopters in order to build or maintain advantage, deter and defeat adversaries, as well as establish norms for the use of new capabilities. My office and the entire R&E organization, maintains constant communication with key DOD components as well as the White House Office of Science & Technology Policy (OSTP) to ensure new technologies and capabilities comply with applicable US and International laws and policies. To ensure policy does not lag technology development we are taking the following additional steps: First, as R&E develops these materiel-focused technology roadmaps, they must identify the technology maturation, prototyping/demonstration, and transition paths individually, or into legacy architectures. These roadmaps are essential to focus the research and development across the tech enterprise, synchronize the OSD mission engineering and Service development planning activities, and help the acquisition and sustainment community plan for these new capabilities across the product and sustainment centers. Second, after we develop the materiel roadmaps, we will be working with warfighters on the Joint Staff and in Component training and doctrine centers to identify, align, and synchronize needed non-materiel policy and training activities with the tech development. Third, we plan to put technology and prototypes in the hands of warfighters early to allow time for concept refinement and user feedback before fielding and training development. It is our goal to provide users with opportunities for hands-on experimentation and models for war-gaming as part of this early engagement.

QUESTIONS SUBMITTED BY MR. LARSEN

Mr. LARSEN. Please describe your investments in future technical talent. What STEM programs are being funded and increased?

Secretary GRIFFIN. The Department's STEM programs under the National Defense Education Program (NDEP) are vital, and affect a spectrum of students from Kindergarten through College. It ensures that the Department and the Nation has enduring access to a diverse and highly technical workforce. It should be noted that the Components also have agency specific STEM efforts to support DOD's overarching goal of developing the 21st century technical workforce.

Current NDEP programs:

- Science, Mathematics, and Research Transformation (SMART) Scholarship-for-Service Program. SMART provides the Department the ability to recruit top talent from across 21 STEM disciplines critical to the national security functions of the Department of Defense and its workforce. The program's budget increased by \$6.3M from FY19 to FY20, and is projected to increase by an additional \$6M from FY20 to FY21.
- STEM Education and Outreach Program. This program is composed of Kindergarten through College initiatives, which include the Military Child Pilot Program. These efforts are currently executed through the Defense STEM Education Consortium (DSEC). DSEC engages students and educators at multiple entry points across the K-16 continuum. A DSEC cooperative agreement was

awarded in March of 2019, and is a five-year effort of up to \$75M. The program's budget increased by \$3M from FY19 to FY20, and is projected to increase by an additional \$2M from FY20 to FY21 as it expands to implement biotechnology-focused efforts, aligned to one of 11 DOD Modernization Priority Areas.

- Manufacturing Engineering Education Program (MEEP). This program is an effort to develop the Nation's manufacturing workforce, essential to the Defense Research and Engineering Enterprise. Over the past three years, DOD through ONR has awarded 13 MEEP grants to institutions of higher education, community colleges, and not-for-profit organizations for a total of \$49M.

The Department is also committed to strengthening engagement with Historically Black Colleges and Universities and Minority-Serving Institutions (HBCUs/MIs). The DOD HBCU/MI Program plays a significant role in enhancing the STEM pipeline and increasing the research and educational capacity of HBCUs/MIs. We recognize that HBCUs/MIs are integral to our efforts to ensure STEM graduates in fields important to the DOD mission and essential for achieving Departmental priorities to diversify the STEM workforce. The HBCU/MI Program's budget for the FY 2020 includes a \$22M plus up for program expansion and an aerospace education, research and innovation center.

To promote HBCU/MI involvement in DOD research activities and to build the STEM pipeline, the Department established five Centers of Excellence (COE) aligned with the National Defense Strategy—autonomy (North Carolina A&T State University), cyber security (Norfolk State University), research data analytics (Prairie View A&M University), STEM Scholars (Hampton University), and Minority Women in STEM (Spelman College). Collectively, the Centers achieve several objectives including increasing the research capabilities at HBCUs/MIs to perform cutting-edge research involving student support. Additionally, the Centers aid with graduating minorities in STEM disciplines and foster collaborations with other research universities. Each COE is funded at \$1 million per year for six years. The Department continues to provide opportunities for minority students in STEM disciplines and prepare them for careers in science and engineering fields important to the defense mission. The Military Departments (Army, Navy, and Air Force), through their laboratories, offer opportunities for student involvement through a variety of summer programs and internships. These programs are designed to foster student interest in STEM education and careers in DOD, and to support the Department's objective of developing a diverse, motivated, and highly skilled civilian workforce. During the summer of 2019, OUSD(R&E) supported HBCU/MI involvement in STEM and potential research careers in DOD by placing 101 interns and 18 faculty fellows at DOD laboratories.

Mr. LARSEN. The Minerva Research Initiative is a basic research program that services as a connection between the DOD and academic social science communities, providing context for the Department on topics ranging from great power competition, strategic priorities and power projection strategies. Why did the Department decide to cancel this program?

Secretary GRIFFIN. During the Department's Defense-wide Review, R&E scrutinized and revectorized our POM21 budget request to align more directly with the Department's National Defense Strategy technology modernization priority areas. Although the Department appreciates the contribution Minerva provided in the past, difficult choices had to be made among many competing priorities.

Mr. LARSEN. Tell us about the ways you are optimizing the opportunities of the Small Business Innovative Research program (SBIR)/Small Business Technology Transfer program (STTR) to develop and transition technology into your current programs? What are you doing to improve the ability to transition these technologies into programs of record?

Secretary GRIFFIN. Our office is committed to identifying transition and commercialization pathways for SBIR/STTR funded projects that provide solutions to technological challenges.

The Small Business and Technology Partnerships (SBTP) Office, which manages the SBIR/STTR and Rapid Innovation Fund (RIF) programs within OUSD(R&E), recently hired a Technology Portfolio Manager (TPM) who will manage the accelerated transition of SBIR/STTR technologies (as well as existing RIF projects) into military and commercial applications.

The TPM will engage with the Director of Defense Research and Engineering (DDRE) for Modernization and the Assistant Directors for each of the modernization priorities to identify opportunities for insertion of SBIR/STTR technologies into DOD programs of record, fielded systems and other transition pathways as appropriate. Additionally, the TPM will conduct targeted outreach to DOD Program Executive Offices (PEOs) and Program Managers (PMs) to expand and accelerate SBIR/STTR

technologies/capabilities into DOD programs and Prime Contractors. SBTP will work to transition the SBIR/STTR technologies into high-priority systems for DOD programs and will expand small business support for technology maturation and manufacturing capabilities.

To conduct effective technology transition, the SBTP will continue to collaborate among all of the stakeholders, to drive an iterative process of development, implementation, and acceptance. Both the technical team and the product users must be part of the end-to-end decision-making process. An example of this is the SBTP Office is currently working with the DDRE for Advanced Capabilities to develop a “Small Business Technology Transition” funding pipeline for prototypes in the absence of the RIF program.

In addition to the increased emphasis being placed on transition within the SBTP Office, each DOD Component has mechanisms for transitioning and/or commercializing SBIR/STTR funded projects within their mission portfolios. The Army, Navy, and Air Force have formal programs that utilize the Commercialization Readiness Program (CRP) authority, which allows up to 1% of SBIR funds to be used for administration. These programs often include cross-agency Phase II efforts. One of the many possible examples of best practices to enhance transition is the Army’s use of Technical Assistance Advocates (TAAs), stationed within various Army organizations, who provide assistance to SBIR small businesses. The TAAs provide advice to SBIR projects and Government technologists and customers to increase transition and commercialization success. Another excellent example is the Navy’s re-engineered process in FY20 to ensure Navy SBIR execution is fast, agile, and impactful. Two efforts the Navy is piloting include their Technology Acceleration pilot and Accelerated Delivery and Acquisition of Prototype Technologies (ADAPT). Finally, the Air Force’s modernized SBIR/STTR process offers a streamlined approach to providing many product solutions focused on meeting Warfighter needs using innovative and commercially relevant solutions. One example is the Air Force SBIR/STTR Contracting Center of Excellence, which has developed a process in which the PEOs and Technology Executive Officers (TEO) are part of the process through all phases of the SBIR lifecycle.

Mr. LARSEN. How do your respective service S&T budget requests reflect R&E’s 11 modernization priorities, and how have you ensured that your teams are working with Dr. Griffin’s office as his modernization Assistant Directors lay out roadmaps for each?

Secretary JETTE. The Army’s Science and Technology (S&T) program supports the National Defense Strategy (NDS) and the Under Secretary of Defense for Research and Engineering (USD(R&E)) modernization areas by focusing on enabling the Army Modernization Strategy and its priorities: Long Range Precision Fires, Next Generation Combat Vehicle (NGCV), Future Vertical Lift, Network, Air and Missile Defense, and Soldier Lethality. Additionally, these Army S&T efforts are aligned with the eight rapid technological advancements outlined in the NDS. Army Subject Matter Experts—within my office under the Deputy Assistant Secretary (Research & Technology) as well as from Army labs and engineering centers—coordinate directly with the USD(R&E) modernization Assistant Directors and through USD(R&E)’s Communities of Interest to ensure we are working together to solve critical technology problems for the Army and for DOD. Examples of efforts that are aligned with USD(R&E) modernization priorities include the Army Artificial Intelligence Task Force, significant biotechnology basic research, broad robotics work across the ground technology portfolio, and substantial work by the Rapid Capabilities and Critical Technologies Office in directed energy and hypersonics. Also, there are Cross Functional Team (CFT) efforts in Assured Position, Navigation, and Timing and Synthetic Training Environment under the Army’s Network and Soldier Lethality modernization priorities, respectively. Of the \$2.6 billion (B) S&T budget (Budget Activities 1–3), \$0.8B of this funding Secretary JETTE. aligns directly to USD(R&E) priorities. The greatest percentage of this funding falls within Autonomy for the NGCV Army modernization priority (\$100 million in FY21). Investments within the Enabling (non-CFT aligned) and Basic Research areas span the largest number of Office of the Secretary of Defense priorities.

Mr. LARSEN. Tell us about the ways you are optimizing the opportunities of the Small Business Innovative Research program (SBIR)/Small Business Technology Transfer program (STTR) to develop and transition technology into your current programs? What are you doing to improve the ability to transition these technologies into programs of record?

Secretary JETTE. In FY19, the Army restructured the governance of the Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) programs to ensure alignment of research and development focus areas with modernization (Army Futures Command) and acquisition (ASA(ALT)) priorities. The

SBIR program was refocused on technology transition, manufacturability and sustainability challenges, and realigned with the broader Army Research Development Test and Evaluation program. Furthermore, the Army has encouraged early engagement with the Program Executive Offices (PEOs) and Program Managers (PMs) to provide transition opportunities for SBIR and STTR generated technologies into programs of record. The ability to address technology needs from the Army acquisition, PEO and PM community provides additional mechanisms and opportunities to transition small business generated technologies into Army programs of record. To better apportion funding, those funds derived from S&T taxation are managed by and applied to SBIR/STTR efforts which directly support S&T objectives. Similarly, those funds derived from 6.4 and above are applied to more mature SBIR/STTR efforts focused on potential programmatic use. This allows funds to be focused against Army needs while ensuring a full spectrum Research, Development, Test and Evaluation funding plan.

Mr. LARSEN. How do your respective service S&T budget requests reflect R&E's 11 modernization priorities, and how have you ensured that your teams are working with Dr. Griffin's office as his modernization Assistant Directors lay out roadmaps for each?

Secretary GEURTS. The DON S&T priorities are derived from the National Defense Strategy and solidified by the Chief of Naval Operations' "Fragmentary Order 01/2019: A Design for Maintaining Superiority 2.0" and the Commandant of the Marine Corps' Planning Guidance. The DON FY 2021 S&T budget outlines investments that support of these documents and align with USD(R&E) modernization efforts. The FY 2021 S&T investments in fundamental research include continual advancements in the science of artificial intelligence (AI), quantum sciences and computing, advanced autonomy, ocean and atmospheric sciences, and high performance materials and energetics. FY 2021 S&T investments in advanced technologies include next generation hypersonic boosters, full spectrum undersea warfare capabilities, advanced manufacturing techniques for forward logistics, operationalizing artificial intelligence and machine learning, cyber security advanced naval networks for sensors and weapons, advanced operational prototypes for the next generation of directed energy weapons, and autonomous systems focused on swarming missions and independent operations.

Mr. LARSEN. Tell us about the ways you are optimizing the opportunities of the Small Business Innovative Research program (SBIR)/Small Business Technology Transfer program (STTR) to develop and transition technology into your current programs? What are you doing to improve the ability to transition these technologies into programs of record?

Secretary GEURTS. In FY 2019 the SBIR/STTR program engaged with DON stakeholders and senior leadership to implement a reengineered process for FY 2020 that encourages wider participation, and increases relevance and speed. The reengineered process ensures Navy SBIR execution is fast, agile, and impactful, and encourages the use of SBIR as a tool to rapidly discover, develop, and deliver technology to the Fleet and Force. To make it easier for small innovative businesses to participate, the last DOD SBIR Broad Agency Announcement in 2019 included three broad topics for the Navy. The proposal requirement was simplified from 20 pages to five pages, and resulted in nearly 10 times as many proposals received. The evaluation and selection processes were streamlined and resulted in 79 Phase I awards in 28 calendar days, 66% faster than our traditional process. The Navy used a flexible contract vehicle to allow multiple Phase I, II, and III awards under a single agreement, demonstrating an innovative approach to encourage small business to work with the Navy. Successful Phase I proofs of feasibility may receive Phase II awards, worth up to \$1.6 million. When conditions allow, those awardees will have the opportunity to demonstrate their technology to industry, acquisition, and the investment community at a Navy SBIR Technology Acceleration Demonstration Day that will be scheduled at a date to be determined. SBIR is also piloting an Accelerated Delivery and Acquisition of Prototype Technologies (ADAPT) initiative intended to accelerate the delivery and scaling of viable operational prototypes using startup and venture capital principles. Key characteristics of ADAPT include: utilization of NDAA prototype authorities; use of milestone-driven award execution to accelerate delivery of operational prototypes and strengthen small business and DON engagements; use of Other Transaction Authority business practices to reduce barriers to prototype scaling and acquisition; incorporation of a business accelerator to access private investments and facilitate prototype scaling; and employment of flexible SBIR solicitations to include in-cycle special topics and out-of-cycle accelerated solicitations. The ADAPT pilot is being evaluated in FY 2020.

Mr. LARSEN. How do your respective service S&T budget requests reflect R&E's 11 modernization priorities, and how have you ensured that your teams are working

with Dr. Griffin's office as his modernization Assistant Directors lay out roadmaps for each?

Secretary ROPER. The Department of the Air Force increased FY21PB S&T funding to perform additional research in support of the following USD(R&E) modernization priorities: 5G; Space; Networked Command, Control, and Communications (C3); Autonomy; Positioning, Navigation, and Timing (PNT); Nuclear; and Microelectronics. We also increased experimentation and prototyping investments for Networked C3 and Autonomy to accelerate transition of key technologies. Over the past two years, we have focused extensive efforts and resources to invigorate the Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) programs to increase both the speed and probability of transition of into programs of record. These valuable S&T dollars are moving small business technologies forward in priority mission areas. For example, in support of the OUSD(R&E) Space modernization priority, we held a first-ever "Space Pitch Day" in November 2019. This event had acquirers, warfighters, and technologists from across the Air Force listen to pitches from 30 separate companies and make the selections of potentially game-changing concepts. The Air Force awarded 30 contracts at \$750,000 apiece, a total of \$22.5 million, with some of the companies going on to compete for even larger awards. Additionally, more than 100 private investors attended the pitch day which provided the small businesses unprecedented opportunities for matching investments. This June, we are hosting a virtual "Quantum Collider" event to bring together government, industry, academia, and the small business community in this important technology area. We're looking to make up to 36 awards at \$150,000 per award to enable small business innovation to quickly transfer advanced quantum technologies to our warfighters. These Pitch Day-type events create a faster, smarter method to evaluate cutting edge technologies, award contracts to small businesses, and provide them an accelerated path to commercial success.

Mr. LARSEN. How is the Air Force working with the Strategic Capabilities Office (SCO) and the Defense Innovation Unit (DIU)? How are these organizations working with your organization, including labs, your Small Business Innovation Research office, and others, to promote and transition technological innovation?

Secretary ROPER. The Department of the Air Force works closely with both the SCO and DIU on a wide range of initiatives to promote and rapidly transition technological innovation. The Air Force Research Laboratory (AFRL) works closely with SCO on various ventures, including experimentation with a hyper velocity projectile system for countering the cruise missile threat. The AFRL team is also collaborating with SCO's Avatar program to share lessons learned on pairing manned fighter jets with unmanned systems in the rapid development of Skyborg. As a Department of the Air Force Vanguard initiative, Skyborg is integrating artificial intelligence (AI) with autonomous unmanned air vehicles to enable manned-unmanned teaming with a focus on accelerated transition to a program of record. We also work closely with our counterparts at DIU to promote and transition technological innovation. For example, in collaboration with DIU's National Security Innovation Network (NSIN), NavalX, and Army Futures Command, we ran the first-ever joint Small Business Innovation Research (SBIR) Open Topic in February 2020. This joint effort yielded tremendous results, with 1,000 SBIR applications for a single topic, and the award of contracts to 500 companies in less than 30 days from solicitation. There is also significant overlap of people and informal relationships between the Air Force and DIU because so many of the military members working at DIU come from the Department of the Air Force.

Mr. LARSEN. Tell us about the ways you are optimizing the opportunities of the Small Business Innovative Research program (SBIR)/Small Business Technology Transfer program (STTR) to develop and transition technology into your current programs? What are you doing to improve the ability to transition these technologies into programs of record?

Secretary ROPER. Competing across the entire technology ecosystem is a new challenge for the Department—especially with 80 percent of our nation's R&D now commercial—but it is one in which we have made great progress. Over the past two years, the Department of the Air Force has focused extensive efforts and resources to invigorate the Small Business Innovative Research (SBIR)/Small Business Technology Transfer (STTR) programs and increase both the speed and probability of transition to programs of record. Since many of our past efforts were disparate and ineffective at helping build tomorrow's commercial-tech-enabled Air Force and Space Force faster and smarter, we've developed Air Force Ventures (AFVentures) as our much needed process for tapping into the commercial innovation eco-system. The AFB Ventures model improves opportunities and access to small businesses to solve Department of the Air Force technology challenges using existing commercial solutions. It provides a simple pathway for U.S. small businesses to go from first con-

tract with the Department to a program of record in as little as 24 months. Our open-door approach improves access to small businesses solving problems using existing commercial solutions and incentivizes private capital investment in national security interests. We've already demonstrated remarkable success. We've grown the industrial base by bringing 1,000 new small businesses into the SBIR/STTR fold. With five dollars of commercial investment matching every one SBIR dollar—and 85 percent coming from private capital—we're seeing over three dollars from private capital for every taxpayer dollar invested. The program has leveraged over \$1 billion in private capital in just two years. We look forward to continued communications with Congress on the innovative AFVentures process and how we're making great strides in optimizing SBIR/STTR opportunities to meet the priorities of the National Defense Strategy.

QUESTIONS SUBMITTED BY MR. SCOTT

Mr. SCOTT. In a March 6, 2018, Breaking Defense article, you are quoted as saying, "The Chinese love our acquisition system. They are the biggest fans of our acquisition there possibly could be." Do the Communist Chinese still love our acquisition system today? If they still do love our acquisition system, what can Congress do to make them stop loving our acquisition system?

Secretary GRIFFIN. Thanks to the hard work of Congress and the Department, I would like to think the Chinese are loving us a little less these days. That being said there is still much work to be done and we are engaging with our colleagues across the Department to continue to add speed and flexibility to our acquisition process, so that we don't just pace the Chinese threat but achieve and maintain a distinct advantage. We ask that Congress continue to work with us to identify and repeal acquisition roadblocks and add authorities as needed.

Mr. SCOTT. Hypersonic threats are beyond the ability of any current U.S. systems to engage. Why did the Department of Defense allow this to happen despite decades of research? What lessons can be learned?

Secretary GRIFFIN. The U.S. has been a world leader in hypersonic research for decades, however, we have consistently made the decision to not transition that technological advantage to the warfighter. We have not pursued hypersonic technologies with a sense of urgency or clear direction, which has led to a slower rate of progress compared to China and a lack of sufficient investment in the necessary infrastructure and workforce needed to support multiple acquisition programs. There are many reasons for that and opinions differ, but one could argue that with the fall of the Soviet Union and the rise in the global war on terror (GWOT) there has not been a strong threat driven demand for the sophisticated capability enabled by hypersonic systems. In the global war on terror, we have enjoyed battlefield dominance on land, in the air, at sea and in space without the need for developing hypersonic capabilities. With our focus directed to the GWOT, a resurgent Russia and an aggressive China studied our capabilities and the systems that enabled our domain dominance on the battlefield, and systematically developed capabilities to challenge that dominance in every domain, including in the case of China, a highly capable portfolio of hypersonic systems. Until the most recent National Defense Strategy and the pivot from an almost complete focus on GWOT to a focus on Great Power Competition, we simply did not have a priority on paying attention to, and countering, the strategy and buildup of our great power competitors. At the same time, China, and to a lesser extent, Russia, have been able to capitalize on our early advances in hypersonics across the board, and saw this as an area in which they could match or exceed our capabilities. They read our literature, watched our experiments, and invested heavily in people, infrastructure, and programs. As a result we find ourselves in a competition where our adversaries are fielding advanced capabilities, including hypersonic systems, at an alarming pace and we are having to greatly accelerate our pace of modernization. To that end, we have created DOD Modernization Priorities, including one for Hypersonics, to accelerate our competitive posture with a renewed focus on China and Russia. The Hypersonics modernization priority includes development of offensive hypersonic systems to provide capability to defeat the range of adversary high end systems that challenge our battlefield domain dominance, as well as, systems to defend against adversary hypersonic capabilities. Relative to lessons learned, the primary lesson is that we need to continue to balance our investments, keep our attention on the full range of challenges to our National defense, and have the vision and fortitude necessary to ensure we always have technical advantage against our current and future potential adversaries.

Mr. SCOTT. Given the rise of 3-D printing, should future procurement contracts include a clause that the military be entitled to standardized, printable designs?

Secretary GRIFFIN. The Department is evaluating how best to employ technological advances in 3-D printing to improve sustainment and product support for its weapon platforms and other critical systems. This evaluation is part of a broader review of advanced digital manufacturing capabilities that contribute to the Department's implementation of its digital engineering strategy. The Department's procurement practices will require updating to keep pace with our needs to employ 3-D printing. The revision and addition of standardized terms and conditions will be part of this update. The specific application of these requirements to the procurement of printable designs will be driven by appropriate business case analysis that balances the costs, benefits and risks of acquiring this technical data, rather than through Department-wide fiat. Our approach is focused on identifying requirements for acquiring such data in a manner that can be integrated smartly into the acquisition strategies and product support strategies. Business case analysis will allow us to understand when it is appropriate and cost-effective to acquire and license such data. Alternatively we may encounter cases in which 3-D printable product design has been developed without DOD funding and must be treated as proprietary data of the original designer/vendor. In such instances it may not be cost-effective to acquire the necessary license rights for that data. The Department will seek to employ a consistent approach that can also be adapted to address specialized needs of different programs and platforms.

Mr. SCOTT. DOD invented the new geographic domain of warfare known as cyber. What assurances can you give this committee that should DOD invent another new domain of warfare that it won't be shared with our enemies to weaponize against us?

Secretary GRIFFIN. R&E defers to the Joint Staff.

QUESTIONS SUBMITTED BY MS. HOULAHAN

Ms. HOULAHAN. It seems there is a new area of concern we have entered with China regarding advanced biomanufacturing. As China looks to advance their biomanufacturing capability, I understand they've signaled willingness to use biotechnology and other emerging technologies against their opposition and adversaries without respect for protocols, conventions, or human rights.

What is the Department is doing to ensure we remain ahead of China in biotechnology?

Secretary GRIFFIN. To maintain biotechnological overmatch capabilities, the Department of Defense named biotechnology a modernization priority. Each modernization priority is led by an Assistant Director or Technical Director, who is responsible for unifying and advancing the Department's investments and capabilities in that area. Biotechnology modernization is focused on developing critical resources and capabilities to field biotechnology-enabled products. Under these modernization efforts, the Department started a Biotechnology Community of Interest (COI) in December 2019. The purpose of this COI is to: 1) coordinate, roadmap, and prioritize biotechnology research, development, testing, and evaluation (RDTE) efforts across the Department components and 2) advance biotechnology capabilities towards applications in varied mission domains, including material and systems, human performance, military medicine, and chem-bio defense. Recognizing critical gaps in U.S. biomanufacturing, DOD is establishing a Bioindustrial Manufacturing Innovation Institute (MII). The Bioindustrial MII will accelerate emergent biomanufacturing technologies and processes with the goal to successfully transition science and technology research into defense and commercial products within a globally competitive U.S. manufacturing ecosystem. The Bioindustrial MII will serve as a bioindustrial innovation hub, providing the infrastructure to support biomanufacturing enterprises of all sizes and ensuring that the U.S. biomanufacturing industry is a key pillar in an enduring and thriving bioeconomy. Standing up a MII for biomanufacturing will establish U.S. technical leadership, greatly expand U.S. capacity, provide key capabilities to ensure DOD biotechnology modernization, and lead to commercialization of biomanufactured products. Concept papers for the MII are due May 4, 2020 and the DOD anticipates making an award in Fall 2020.

Ms. HOULAHAN. Are there any programs within the DOD that allow mid-level serve members the opportunity to go out and work in STEM academia for a designated amount of time, and then bring their expertise back to the Department?

Secretary GRIFFIN. There are programs with the Department that allow mid-level civilian members the opportunity to work in STEM academia. Specifically, the Science and Technology Reinvention Laboratories (STRs) have sabbatical-like pro-

grams. These sabbatical-like programs allow the employees within the STRLs to work with academic institutions to benefit their organization's mission. These programs require a service agreement and must demonstrate value to the organization's mission. Included below are excerpts from the internal operating procedure from an Army and Air Force STRL that describe their programs.

Combat Capabilities Development Command (CCDC) Armaments Center (AC)

Sabbatical. The CCDC AC Director has the authority to grant paid or unpaid sabbaticals to all career employees. The purpose of a sabbatical will be to permit employees to engage in study or uncompensated work experience that will benefit the organization and contribute to the employee's development and effectiveness. Each sabbatical must result in a product, service, report, or study that will benefit the CCDC AC mission as well as increase the employee's individual effectiveness. Various learning or developmental experiences may be considered, such as advanced academic teaching, research, self-directed or guided study, and on-the-job work experience. One paid sabbatical of up to twelve months in duration or one unpaid sabbatical of up to six months in a calendar year may be granted to an employee in any seven-year period.

Air Force Research Laboratory (AFRL)

Developmental Opportunities Program. The AFRL Developmental Opportunities Program (DOP) is available for all employees at a Science and Technology Reinvention Laboratory (DEMO Employees). This program provides a process for personnel to acquire knowledge and expertise that cannot be acquired in the standard working environment. These activities should enhance the employee's contribution upon his or her return to the organization. Each developmental opportunity must benefit both AFRL and the individual employee. The spectrum of available activities under this program is limited only by the constraint that potential contribution to AFRL's mission exists. The program can be used for training/educational opportunities, such as training with industry or on-the-job work experience with government, public, private, or nonprofit organizations. It may enable an employee to spend time in an academic environment such as advanced academic teaching or research. An individual may also take advantage of this program to devote full-time effort to writing technical papers, articles, books, entrepreneurial opportunities, etc.

In addition to the STRL sabbatical program, the Basic Research Office within the Office of the Under Secretary of Defense for Research and Engineering manages the Laboratory-University Collaboration Initiative (LUCI). This program facilitates and competitively funds leading DOD-service Laboratory scientists in a three-year basic research collaboration with prominent University professors who participate in the Department-wide fundamental research programs, specifically Vannevar Bush Faculty Fellows (VBFF), and current and previous Principal Investigators (PI) and COPs of the Multidisciplinary University Research Initiative (MURI) program. The partnerships between the competitively selected DOD Laboratory researchers, members of their team, and the university researchers are designed to enhance the Service Laboratories' primary objectives of bringing better capabilities and expertise to the Warfighter, while enhancing and sustaining prominent academic researchers' interest in defense technology development. The topical areas these funds and efforts support include, but are not limited to; quantum information, bio-engineering, and materials sciences, as well as applied mathematics, artificial intelligence, and cognitive neuroscience.

Ms. HOULAHAN. Following on the importance of developing the Department's policies and understanding the implications of these many emerging threats, we are disheartened that this year the Department decided to terminate the Minerva program. Minerva is a unique social science basic research program that has helped DOD understand nontraditional threats to national security—from the rapid growth of China's technological prowess; to the human systems underlying the cyber threat; to the behavior of populations involved in conflicts; and to the mind of a suicide bomber. How can the Department continue to build out its policies without having the tools, techniques, and frameworks to understand the dramatically changing landscape of our future threats?

Secretary GRIFFIN. During the Defense Wide Review, R&E conducted a rigorous prioritization of its RDT&E activities and identified where funds could be reinvested in lethality and readiness. Key DOD investments made possible by this reprioritization included: quantum science, biotechnology, artificial intelligence, and 5G. While the Department remains committed to drawing on the contributions of the social sciences to address the broad range of threats we face difficult choices had to be made among many competing priorities.

Ms. HOULAHAN. According to a Defense Science Board report, "most Lab Directors feel they are unable to maintain their facilities and infrastructure at a reasonable standard." The FY20 NDAA directed the Secretary to develop an infrastructure

master plan to support research, development, test, and evaluation missions in the Department. How are you working to support this requirement? And can each of you please discuss the state of your research laboratories and how the budget addresses your concerns about maintaining the labs at the standard necessary to conduct cutting edge research and attract the same level of talent?

Secretary GRIFFIN. As directed by Section 252 of the FY2020 NDAA, my staff is working with the Military Departments to draft the Infrastructure Master Plan. It will be submitted to Congress by the mandated date of January 1, 2021. As conveyed in this year's Report to Congress on Unfunded Requirements for Laboratory Military Construction Projects: Section 2806 of the NDAA for Fiscal Year 2018 (Public Law 115-91), funding DOD laboratory military construction is a critical issue. The current state of the research laboratories is reflected in the large number (126) of unfunded laboratory MILCON requests submitted by the Military Departments. Up-to-date facilities increase mission readiness and attract top talent, ensuring the Department is able to meet future capability and preparedness efforts. However, maintaining the laboratories is an ongoing problem, as the Military Departments are prioritizing readiness with the scarce MILCON funding available. Despite this, the Military Departments are slowly modernizing their facilities and there are ongoing projects within the Army, Navy, and Air Force.

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Secretary JETTE. Army laboratory facilities have an average age of more than 50 years. The Army requires modern buildings, equipment and other resources to continue developing cutting-edge technology that supports the Soldier and continue to attract, recruit, and retain the most talented science, technology, engineering, and math (STEM) personnel. In accordance with Section 252 of the Fiscal Year 2020 National Defense Authorization Act, the Army is revising, developing, and implementing the master plan to address infrastructure (physical and intellectual) and modernization requirements across the department. The Army is currently evaluating baseline competencies, including function, capacity and quality in technology areas that support the National Defense Strategy and Army Modernization Strategy to ensure our current facilities can address emerging and future needs. Funding for mission-specific facilities maintenance, e.g., labs, and general modernization is based on the Army's Research, Development, Test and Evaluation budget and, when specific needs are identified, additional funding is requested through the budget process.

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Secretary GEURTS. Ensuring the Navy R&D community executes their mission in state-of-the-art facilities is a priority for the DON. We have established a new Facilities Operating Model (FOM) that has the labs develop strategic infrastructure plans. The DON is fully leveraging Title 10 Section 2363 investments for repair and revitalization of our laboratory facilities and we anticipate this authority to be a major tool in the future strategy. The DON continues to maximize the use of Section 233 authority from the FY 2017 NDAA that provides enormous flexibility to our Sustainment, Repair, and Modernization program to promote speed of execution through both public and private service providers.

Ms. HOULAHAN. According to a Defense Science Board report, "most Lab Directors feel they are unable to maintain their facilities and infrastructure at a reasonable standard." The FY20 NDAA directed the Secretary to develop an infrastructure master plan to support research, development, test, and evaluation missions in the Department. How are you working to support this requirement? And can each of you please discuss the state of your research laboratories and how the budget addresses your concerns about maintaining the labs at the standard necessary to conduct cutting edge research and attract the same level of talent?

Secretary ROPER. The Air Force Research Laboratory (AFRL) developed a 5-year facility master plan, which supports the Secretary's requirement. The plan identifies facility requirements from various funding programs (e.g., MILCON, RDT&E, O&M) and was recently reviewed for its alignment to the National Defense Strategy. While our laboratory facilities are capable of meeting current requirements, they will require updates to conduct the cutting edge research necessary to compete with a near-peer adversary and meet the long-term requirements in the National Defense Strategy. The AFRL Commander uses the authorities given in 10 U.S.C 2363(a) and 10 U.S.C. 2805 [Unspecified Minor Construction] to help address laboratory improvements, including revitalization of laboratory facilities. As authorized in 10 U.S.C. 2363(a), up to 4% of the funding available to the AFRL Commander is used to support state-of-the-art research facility improvements in line with strategic research and development. In recent years, this amount has totaled about \$32 million per year spent on AFRL facilities. Additionally, AFRL fully uses the special Unspecified Minor Construction laboratory authority which provides for increased single project construction thresholds of \$6 million. This helps address some of the lower cost facility projects, and increases AFRL's ability to maintain facilities at the standard necessary to conduct cutting edge research and attract top-tier talent.

