

TITLE II—RESEARCH, DEVELOPMENT, TEST, EVALUATION

Subtitle A—Authorization of Appropriations

Authorization of appropriations (sec. 201)

The committee recommends a provision that would authorize the appropriations for research, development, test, and evaluation activities at the levels identified in section 4201 of division D of this Act.

Subtitle B—Program Requirements, Restrictions, and Limitations

Codification and reauthorization of Defense Research and Development Rapid Innovation Program (sec. 211)

The committee recommends a provision that would codify the Rapid Innovation Program and would clarify elements of the program, including funding levels and policy surrounding broad agency announcements.

The committee notes that the Rapid Innovation Program was established to help increase the number of non-traditional vendors in technology and research and to help those innovators bridge the gap between basic research and commercialization. The program has demonstrated benefits to meeting Department of Defense (DOD) needs and should become a permanent facet of the DOD's toolkit for helping to improve acquisition of technologies and support U.S. small business innovators.

Procedures for rapid reaction to emerging technology (sec. 212)

The committee recommends a provision that would direct the Secretary of Defense to prescribe a procedure for the designation and development of urgently needed emerging technology research.

The committee established the position of Under Secretary for Research and Engineering (USD (R&E)) within the National Defense Authorization Act for Fiscal Year 2017 (Public Law 114–328), with the intention that this role would drive rapid innovation across science and technology within the Department. However, the committee recognizes that streamlined processes may need to be established to ensure that the Department is able to keep pace with the current speed of technological change. Therefore, the committee directs the USD (R&E) to establish a streamlined process that would allow the Department to identify areas of rapid technological change and indicate the need for immediate investment. This process could be similar to the Joint Urgent Operational Need process, established based on a similar provision in section 806 of

the Bob Stump National Defense Authorization Act for Fiscal Year 2003 (Public Law 107–314).

Activities on identification and development of enhanced personal protective equipment against blast injury (sec. 213)

The committee recommends a provision that would require joint activities to be conducted in fiscal years 2019 and 2020 by the Secretary of the Army and the Director, Operational Test and Evaluation, in collaboration with academia, to determine the most effective personal equipment to protect against injuries caused by blasts in training and combat with \$10.0 million authorized to be available to carry out joint activities.

The committee notes that the Director of the Department of Defense (DoD) Blast Injury Research Program Coordinating Office established pursuant to Section 256 of the National Defense Authorization Act for Fiscal Year 2006 (Public Law 109–163) has a mission to ensure that effective mechanisms exist for focusing and coordinating DoD blast injury research efforts and collaboration with research expertise outside DoD. The committee recommends that Secretary of the Army, in his role as Executive Agent for Medical Research for Prevention, Mitigation, and Treatment of Blast Injuries ensure that the Office coordinates in the execution of activities mandated and authorized by this section.

Human factors modeling and simulation activities (sec. 214)

The committee recommends a provision that would require the Army, through the Army Research Institute or the Army Futures Command as determined appropriate, to establish human factors modeling and simulation activities. The military departments within the Department of Defense (DOD) seek ways to provide warfighters and civilians with personalized assessment, education, and training tools; to identify and implement effective ways to interface and team warfighters and civilians with machines; to use intelligent, adaptive augmentation to enhance decision-making; and to develop techniques, technologies, and practices to mitigate critical stressors that impede warfighter and civilian protection, sustainment, and performance.

The committee is aware of the significant possibilities that human factors modeling and simulation (M&S) will provide to the DOD when coupled with applied research in human simulation informed by physics-based survivability analysis models. Benefits of this type of M&S include enhancing warfighter performance and protection as well as improving efficiency and effectiveness in the development and procurement of personal protective equipment and weapons while realizing significant cost savings. Human factors M&S can rapidly assess many variables to quickly provide insights to optimize and integrate warfighter-based systems, including predicting injury, mobility, and survivability. These vital analytics contribute to determining the likelihood of mission success, as well as ways to expand training capabilities. The integration of physics-based human simulation, artificial intelligence, and clinical knowledge into systems has the potential to rapidly transform mission readiness and success.

The committee directs the Secretary of the Army to establish activities related to human factors modeling and simulation to maximize the effectiveness of the warfighter in each service, in concert with the warfighter's respective equipment and weapons systems. Such activities would bring together academia, industry, DOD science and technology, and DOD Program Executive Offices to accelerate research and development that enhances capabilities for human performance, human-systems integration, and training for the warfighter.

Expansion of mission areas supported by mechanisms for expedited access to technical talent and expertise at academic institutions (sec. 215)

The committee recommends a provision that would expand the mission areas included in the authority granted in section 217 of the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115–91) to space, infrastructure resilience, and photonics. The statute that this provision would extend gave the Secretary of

Defense the authority to establish one or more multi-institution task order contracts, consortia, cooperative agreements, or other arrangements with universities that do not have similar existing constructs to facilitate expedited access to university technical expertise in support of Department of Defense mission areas. The extension to new mission areas would allow for more connections between universities and the Department of Defense in priority technologies.

The committee originally authorized this effort because of its concern that the Department of Defense was not optimally positioned to capitalize on all cross-functional aspects of emerging technologies that serve multiple purposes. The committee continues to believe a more streamlined construct must be available for expedited access to combine technical expertise and research efforts, reduce costs, and eliminate duplication of effort.

The committee notes and supports the ongoing basic research activities that are funded by the Department of Defense at universities and government labs, which have led to the development of most of the operational capabilities used by the Nation's military today, ranging from stealth to precision munitions to battlefield medicine, aircraft sustainment, and the Internet. The committee intends the authority in the recommended provision to supplement those basic research funding authorities and activities, and it expects the Department to issue guidelines as appropriate that reflect a streamlined, efficient process for components to have increased access to the technical expertise resident in the Nation's universities to help address the technical, engineering, and management challenges facing the Department.

In using the mechanisms established in the recommended provision, the committee urges the Department to expand the number of individual institutions actively pursuing and demonstrating technical expertise in the disciplines that directly support the efforts of the Department of Defense.

Advanced manufacturing activities (sec. 216)

The committee recommends a provision that would direct the Under Secretary of Defense for Research and Engineering and the Under Secretary of Defense for Acquisition and Sustainment to jointly establish activities aimed at demonstrating advanced manufacturing techniques and capabilities in depot-level activities or military arsenal facilities. Broadly, the committee urges the Department to consider these activities as part of more holistic plans to benefit from advanced manufacturing within its own organizations and the commercial sector.

The committee recognizes the transformative potential of additive manufacturing, or 3-D printing, to the industrial supply chain and across disciplines. The ability to use new materials in new ways or to develop new manufacturing processes has the potential to transform how the Department does business and significantly increase system readiness. The establishment of new Defense Manufacturing Innovation Institutes, including one focused on additive manufacturing, as well as the growing prevalence of 3-D printers at tactical levels indicate that the Department sees that potential as well.

The committee recognizes the extensive and growing reach of additive manufacturing within the commercial and defense sectors. However, additive manufacturing could also greatly improve the defense industrial base's ability to respond to military readiness demands when original equipment manufacturers are unable to meet or to fabricate obsolete parts that are no longer manufactured. Substantial room remains across the force to add more capacity for this type of capability, both to repair out-of-date equipment and to speed repair in order to meet urgent operational requirements.

Therefore, this provision would require the establishment of not less than three activities to demonstrate these techniques and capabilities. These activities would include efforts to develop military and quality assurance standards as quickly as possible and leverage current manufacturing institutes to conduct research in the validation of quality standards for additive manufactured parts. To complete these activities, the Department may enter into cooperative agreements and partnerships, based on several specific characteristics. Ultimately, the committee urges the Department to further integrate advanced manufacturing capabilities and capacity.

National security innovation activities (sec. 217)

The committee recommends a provision that would require the Under Secretary of Defense for Research and Engineering to establish activities to develop interaction between the Department of Defense and the commercial technology industry and academia with the goal of encouraging private investment in specific hardware technologies of interest to future defense technology needs with unique national security applications with \$150.0 million authorized to be available to carry out such activities.

Under this provision, the Under Secretary of Defense for Research and Engineering may transfer such activities to a non-profit entity to carry out the program if the Under Secretary can establish that a non-profit entity with sufficient private sector investment and personnel with the sufficient technical and management

expertise can attract sufficient private sector investment, has personnel with sufficient technical and management expertise, and has identified relevant technologies and systems for potential investment in order to carry out the specific activities authorized.

Partnership intermediaries for promotion of defense research and education (sec. 218)

The committee recommends a provision that would authorize Science and Technology Reinvention Laboratories (STRL) to establish partnership intermediary agreements (PIA) with not-for-profit entities or state and local government organizations to enable research and technology development cooperation to promote innovation to support defense missions. A PIA is an agreement, contract, or memorandum of understanding, between the government and an intermediary organization, such as a State or local governmental agency or nonprofit entity. A Partnership Intermediary performs services for the government labs that increase the likelihood of success in the conduct of cooperative or joint activities with small business firms, institutions of higher education, and industry. The PIA facilitates a wide range of licensing and other technology transfer initiatives.

The committee notes that military capabilities are supported by universities and industry in the maturation of technologies and production of materiel solutions. Much of the innovation comes from partnership with small businesses and universities. The commercial market driving the development of technologies is very dynamic. Military capability solutions are unique and often do not have a regular commercial market audience. The STRLs carry out significant basic and developmental research, much of it in collaboration with academia and the private sector. The government-funded research efforts to address military threats are critical to reducing technology development risk, and, if successful, can attract the necessary private sector partners and support to lead to manufacturing and commercialization or production of defense systems. However, traditional federal parameters are not sufficiently agile and flexible to allow military laboratories to respond in a timely fashion to the market-driven needs of its private sector partners, thus discouraging the partnerships that can often accelerate efforts to meet these vital military needs.

The committee believes that working through and in collaboration with partnership intermediaries provides the flexible supporting mechanism to effectively and efficiently interact with industry and academic partners to support better sharing of intellectual property, technical expertise, and research and testing facilities between interested public and private sector partners.

Limitation on use of funds for Surface Navy Laser Weapon System (sec. 219)

The committee recommends a provision that would limit funds to exceed a procurement quantity of one Surface Navy Laser Weapon System (SNLWS), also known as the High Energy Laser and Integrated Optical-dazzler with Surveillance (HELIOS), per fiscal year, unless the Secretary of the Navy submits a report to the congressional defense committees.

The committee understands that Navy officials designated SNLWS/HELIOS as the first rapid prototyping, experimentation and demonstration (RPED) project. The committee further notes that, on January 26, 2018, the Navy awarded a \$150.0 million contract for SNLWS Increment 1, HELIOS systems. Under this contract, the contractor will develop, manufacture, and deliver two test units in fiscal year 2020. The committee further understands this contract includes options for up to 14 additional production units, which, if exercised, would bring the cumulative contract value to \$942.8 million.

If the cumulative contract value is reached, expenditures under this program may exceed the Acquisition Category (ACAT) I-thresholds for research, development, test, and evaluation (RDT&E), including significant production. However, the committee has not yet received sufficient information on the requirements, acquisition plan, test plan, funding profile, and cost estimate to enable appropriate oversight.

The committee supports accelerated acquisition approaches, such as RPED. However, accelerated approaches, especially those that may expend significant resources and enter into production, such as SNLWS/HELIOS, must adhere to sound acquisition principles. Accordingly, this provision would direct the Secretary of the Navy to certify how SNLWS is incorporating those principles prior to exceeding the procurement rate of one SNLWS/HELIOS per year, including: a requirements document, acquisition plan, test plan, funding profile, and cost estimate. The committee encourages the Navy to tailor the certification materials to the extent provided for by existing flexibilities in acquisition law or regulation.

Expansion of coordination requirement for support for national security innovation and entrepreneurial education (sec. 220)

The committee recommends a provision that would expand the list of entities with whom the Secretary of Defense, acting through the Under Secretary of Defense for Research and Engineering, may coordinate and partner in order to support national security innovation and entrepreneurial education.

Limitation on funding for Amphibious Combat Vehicle 1.2 (sec. 221)

The committee recommends a provision that would limit all of the funds authorized for the Amphibious Combat Vehicle 1.2 from being obligated or expended until the Secretary of Defense provides the required report identified in the section titled Report on the Highest-priority roles and missions of the Department of Defense and the Armed Forces.

Defense quantum information science and technology research and development program (sec. 222)

The committee recommends a provision that would authorize a defense quantum information science and technology research and development program aimed at ensuring that the U.S. military is able to most effectively leverage the technological capabilities enabled by quantum science and technology to meet future military

missions. The effort would be led by the Undersecretary for Defense for Research and Engineering. The committee notes that research and development activities in quantum science shows the promise of: (1) Producing computers that will exceed the capabilities of all known traditional computers; (2) Enabling communication systems that enhance cryptography and the speed of communications; and (3) Developing measurement devices and sensors with heretofore unachievable precision and sensitivity. All of these will have significant impacts in the commercial sector, as well as in military systems.

The committee notes that the Department of Defense (DOD) has been investing in research and development in quantum information science and technology for many years, and has recently begun to ramp up those investments. The committee has also increased funding for these efforts in this bill. Private industry has significantly increased their investments in quantum science, in an attempt to pursue commercial applications. The committee's provision is intended to provide a strategic framework for DOD activities in this area, to help ensure U.S. superiority in the field, especially with respect to national security missions and systems.

The provision calls for coordination of quantum science research activities within the Department as well as encouraging robust interagency collaboration. For example, the committee notes that both the Department of Energy national laboratories and the Department of Commerce's National Institute of Standards and Technology have significant capability in quantum science which can contribute to DOD research and development efforts. It further calls for developing procedures for the effective transition of quantum science-enabled capabilities into deployed systems, and to support efforts to establish robust industrial and technical capabilities in the government and private sector, including facilities an infrastructure needed to sustain quantum research.

To focus the research portfolio, the provision recommends the establishment of a set of technical challenges that are consistent with expert analysis of the state of quantum research and its ability to enable advanced military capabilities, such as in data analysis, cryptography, and sensing. Due to concerns with the diffusion of quantum science research knowledge and intellectual property to peer competitors, the provision directs the Undersecretary to develop classification guidance and data management strategies for the appropriate protection on information. The committee notes that the Undersecretary must strike an appropriate balance between protecting national security secrets, and ensuring that the government, industry, and academic community can engage in open research and innovation as is necessary to advance the field.

Joint directed energy test activities (sec. 223)

The committee recommends a provision that would direct the coordination and enhancement of directed energy test activities. The committee notes that next generation directed energy weapon systems are being developed by the Department of Defense (DOD) and industry but the Nation's infrastructure for testing those weapon systems is antiquated and in need of modernization.

The Department established the Nation's first High Energy Laser System Test Facility (HELSTF) in 1975, but the technology has seen significant advancements over the course of four decades. As directed energy weapon systems mature, the need to validate their performance becomes increasingly important. The workload and number of directed energy demonstrations and exercises have increased significantly since 1975 and the projected workload for fiscal years 2018–2022 for HELSTF is large and growing, and has expanded to include high-powered microwave testing. Given these trends, this provision would require the Under Secretary of Defense for Research and Engineering to focus on management and acceleration of directed energy testing activities. Elsewhere in this Act, the committee recommends additional funding to initiate the modernization of directed energy infrastructure and test activities.

The committee applauds the Air Force for proposing plans for joint testing activities, which could potentially focus government expertise and reduce duplication of effort across the DOD, thus supporting more rapid and cost effective testing and fielding of directed energy weapon systems. The committee believes that doing so could also allow for broad, standardized collection and evaluation of data to establish test references and support acquisition and policy decisions in a more reliable fashion.

Requirement for establishment of arrangements for expedited access to technical talent and expertise at academic institutions to support Department of Defense missions (sec. 224)

The committee recommends a provision that would require the establishment of arrangements for expedited access to talent and expertise at academic institutions to support Department of Defense missions.

Authority for Joint Directed Energy Transition Office to conduct research relating to high powered microwave capabilities (sec. 225)

The committee recommends a provision that would expand the purview of the Joint Directed Energy Transition Office to include research relating to high powered microwave capabilities.

Joint artificial intelligence research, development, and transition activities (sec. 226)

The committee recommends a provision that would require the Under Secretary of Defense for Research and Engineering (USD (R&E)) to focus and coordinate Department of Defense (DOD) efforts on artificial intelligence. Focus in these areas should encompass coordination among the Services and the development of a comprehensive strategy for the DOD.

Subtitle C—Reports and Other Matters

Report on comparative capabilities of adversaries in key technology areas (sec. 231)

The committee recommends a provision that would direct the Director of the Defense Intelligence Agency, in coordination with rel-

evant partners, to complete a report that directly compares United States capabilities in near-term emerging technology (e.g., hypersonic weapons, directed energy) and longer-term emerging technology (e.g., artificial intelligence, quantum information sciences) with that of U.S. adversaries. This report should include relative spending information, evaluations of quality and quantity of research, test infrastructure and workforce, evaluations of technical progress, timelines for operational deployment, and an assessment of adversary intent or willingness to use the specified technology.

Report on active protection systems for armored combat and tactical vehicles (sec. 232)

The committee recommends a provision that would require the Secretary of the Army to submit to the Committees on Armed Services of the Senate and House of Representatives a report on the technologies related to active protection systems for armored combat and tactical vehicles no later than 60 days after the enactment of this Act.

The committee notes that the Army has conducted detailed testing of three active protection systems on the M1A2 Abrams, M2A3 Bradley, and STRYKER. Accordingly, the committee directs the Secretary of the Army to report on the effectiveness of the systems tested, plans for future testing, proposals for future development, and a timeline for fielding. The Secretary should include plans for how the Army will incorporate active protection systems into new armored combat and tactical vehicle designs such as Mobile Protected Firepower (MPF), Armored Multi-Purpose Vehicle (AMPV), and Next Generation Combat Vehicle (NGCV).

Next Generation Combat Vehicle (sec. 233)

The committee recommends a provision that would require the Secretary of the Army to submit to the Committees on Armed Services of the Senate and House of Representatives a report on the development of the Next Generation Combat Vehicle (NGCV) no later than 60 days after the enactment of this bill into law.

The committee is concerned that there is insufficient analysis to support the requirements for the NGCV, including consideration of threats and terrain, and that the requirements may not be relevant to the National Defense Strategy (NDS). Furthermore, the committee views this combat vehicle as a replacement to the aging Bradley fighting vehicle and believes it should be optimized for close combat maneuver, agile exploitation and transport of mechanized infantry as part of an armored, combined arms team.

Therefore, the committee encourages the Secretary of the Army to use all available acquisition authorities, to the fullest extent possible, to build a ground combat vehicle prototype with the potential to be rapidly produced and fielded. The committee expects the Army to exploit modern component technologies that can dramatically change basic combat vehicle design to improve lethality, protection, mobility, range, and sustainment. Such technologies could include vehicle active protection systems, reactive armor, composite armor, thermal signature reduction, noise reduction, fuel cell propulsion, opposed-piston engines, advanced transmissions, suspen-

sion, power generation, voltage management, 3rd generation forward looking infrared sights, integrated hostile fire detection, manned-unmanned teaming, automatic loaders, extended range top attack munitions, and cannons. The committee also encourages the Secretary to pursue an open system architecture to allow for future development. Finally, this prototype should possess sufficient power, design and other capabilities to enable the manned vehicle to control unmanned vehicles, when applicable.

The committee directs the Secretary to fully enable the Army's Tank Automotive Research, Development and Engineering Center (TARDEC) to develop an NGCV prototype based on their work to date. To support this effort, the committee believes TARDEC should be granted needed funds and authorities to develop a separate prototyping effort. The committee would require the amounts authorized to be appropriated for fiscal year 2019 for the Department of Defense by section 201 and available for research, development, test, and evaluation, Army, PE 63645A, for NGCV, not more than 50 percent may be obligated or expended until the Secretary of the Army submits to congressional defense committees the report.

Report on the future of the defense research and engineering enterprise (sec. 234)

The committee recommends a provision that would direct the Under Secretary of Defense for Research and Engineering (USD (R&E)) to conduct a review of the defense research and engineering enterprise.

Section 901 of the National Defense Authorization Act for Fiscal Year 2017 (Public Law 114-328) established the position of USD (R&E) in order to serve as Chief Technology Officer for the Department of Defense and to oversee the research and engineering enterprise. The committee believes that this role should be charged with solving enterprise-wide challenges facing the Department of Defense and so tasks the position with recommending solutions for improving the enterprise's success in a changing environment.

The technological world has changed significantly over the past decades. Commercial investment in technology has increased exponentially, the U.S. government's challenges with recruiting and retaining a qualified technical workforce have grown, the diffusion of technology around the world has occurred rapidly, and the rate at which technology within the Department of Defense moves from discovery to deployment in operational systems has plunged. Given these changes, the committee believes that the Department would benefit from a strategic review of its research and engineering enterprise, including the military department science and technology organizations, the Department of Defense laboratories, the test ranges, the Defense Advanced Research Projects Agency, the Defense Innovation Unit Experimental, the Strategic Capabilities Office, and the Small Business Innovation Research program.

The Defense Science Board (DSB) concluded a thorough and insightful review of this enterprise in January 2017 and found that the labs continue to fulfill vital missions on behalf of the warfighter but that they must also adapt their mission to continue to serve and ready themselves for evolving needs. The report includes a

clear dictate that “OSD [the Office of the Secretary of Defense] must actively champion and support the labs and Congress must continue working with the Department to simplify the regulatory environment in which the labs operate.”

The committee sees this provision as formally endorsing the DSB’s recommendation for attention to the challenges facing the laboratories, but, given the expansive purview of the USD (R&E), recommends that the scope of this study widen. The committee urges the USD (R&E) to identify any current impediments to effectiveness and recommend, where necessary, legislative actions for fixes. The committee is eager to use this report to ensure the relevance of defense research and engineering in a changing world.

Modification of reports on mechanisms to provide funds to defense laboratories for research and development of technologies for military missions (sec. 235)

The committee recommends a provision that would amend the existing reporting requirement for funding provided to defense laboratories under existing authorities to a continuous requirement as opposed to an annual report. The committee remains committed to the use of these authorities but believes that the reporting will be more impactful if continuously collected and disseminated across a broader audience, including senior officials, academia, and industry.

Report on Mobile Protected Firepower and Future Vertical Lift (sec. 236)

The committee recommends a provision that would require the Secretary of the Army to submit to the Committees on Armed Services of the Senate and House of Representatives a report on the requirements for Mobile Protected Firepower (MPF) and Future Vertical Lift (FVL) no later than 60 days after the enactment of this Act.

In light of the National Defense Strategy (NDS), the committee is concerned the Army is making significant investments in advance weapons systems that may not be suitable for a high intensity, combined arms battlefield. Therefore, the committee would like to understand how MPF and FVL would improve offensive overmatch against a peer adversary and how these systems could survive the effects of anti-armor and anti-aircraft networks established within anti-access, area-denial defenses. In addition, if the purpose for MPF and FVL is to support light infantry brigades, the committee requests additional details of these requirements. Finally, the report would detail the total number of systems needed, how these systems will be logistically supported within light formations, and plans to integrate active protection systems into their designs.

Improvement of the Air Force supply chain (sec. 237)

The committee recommends a provision that would allow the Assistant Secretary of the Air Force for Acquisition, Technology, and Logistics to use nontraditional technologies, such as additive manufacturing, artificial intelligence, and other software-intensive capabilities, to increase the availability of aircraft and decrease back-

logs for the production of spare parts for such aircraft. This provision would also allow the Assistant Secretary to advance the qualification and integration of additive manufacturing into the Air Force supply chain, reduce supply chain risk, and define workforce development requirements and training for personnel who implement and support additive manufacturing for the Air Force. The committee notes that the provision would also authorize \$42.8 million as denoted in the funding tables accompanying this Act for such purposes.

Review of guidance on blast exposure during training (sec. 238)

The committee recommends a provision that would require the Secretary of Defense to review the firing limits of heavy weapons during training exercises and provide a report no later than 180 days after enactment of this Act reviewing the cognitive effects of said blast exposure.

List of technologies and manufacturing capabilities critical to Armed Forces (sec. 239)

The committee recognizes that maintaining technological superiority is critical to U.S. military and foreign policy strategy. Each year, the Department of Defense spends billions of dollars to develop and acquire advanced technologies in order to maintain U.S. superiority. While the sale or transfer of these technologies is permitted and facilitated to allies, partners, and other foreign parties in order to promote U.S. national security, foreign policy, and economic interests, these technologies can also be targets for theft, espionage, reverse engineering, or illegal export. In an increasingly globalized and competition-defined world, safeguarding critical technologies from malfeasance and use by our adversaries or competitors is of strategic significance to U.S. national security.

The committee is concerned that the Department has replaced the Militarily Critical Technologies Program with other processes to determine which technologies are critical and how they should be protected to ensure consistency with U.S. interests. The committee also believes that the outcomes from the current processes for determining critical technologies may be underutilized and may fail in their purpose of informing export decisions if not properly utilized or properly integrated with other stakeholder agencies.

Therefore, the committee directs the Secretary of Defense to develop a list of militarily critical technologies and manufacturing capabilities. The primary emphasis of this list should be given to: (1) Research, development, design, and manufacturing expertise; (2) Research, development, design, and manufacturing expertise equipment and unique facilities; and (3) Goods and services associated with or enabled by sophisticated research, development, operation, application, manufacturing, or maintenance expertise, which are not possessed by countries to which exports are controlled and which, if exported or otherwise transferred, would permit a significant advance in the military capabilities of any such country. Upon development no later than December 31, 2019, the committee directs the Secretary of Defense to use the list to guide Department

recommendations in any interagency determinations on exercising export licensing, technology transfer, or foreign investment.

Report on requiring access to digital technical data in future acquisitions of combat, combat service, and combat support systems (sec. 240)

The committee recommends a provision that would require the Secretary of Defense to prepare and submit a report regarding access to digital technical data, to include that which is necessary to support the production of three-dimensional printed parts.

Competitive acquisition strategy for Bradley Fighting Vehicle transmission replacement (sec. 241)

This provision requires the Secretary of the Army to submit to the congressional defense committees, not later than February 15, 2019, a strategy to competitively procure a new transmission for the Bradley Fighting Vehicle family of vehicles, to include the Armored Multipurpose Vehicle and the Paladin Integrated Management artillery system. Additionally, no funds may be appropriated for a Bradley Fighting Vehicle replacement transmission until 30 days after the Secretary of the Army submits its strategy to the congressional defense committees.

Independent assessment of electronic warfare plans and programs (sec. 242)

The committee recommends a provision that would require the Secretary of Defense to enter into an agreement with the scientific advisory group “JASON” to produce an independent assessment of: U.S. electronic warfare strategies, programs, order of battle, and doctrine and adversary strategies, programs, order of battle, doctrine, including recommendations for improvement. The committee recognizes that the United States has a significant comparative military disadvantage against our peer competitors in aspects of the electronic warfare mission and in the conduct of joint electromagnetic spectrum operations.

The provision would require an independent assessment of both U.S. and adversary electronic warfare plans and programs. This should include an assessment of the electronic warfare strategies, programs, resources and doctrine of the U.S. and its potential adversaries. For the U.S. it should also include an assessment of what capabilities non-Department of Defense entities, to include allies and partners, can provide. Finally the assessment should include recommendations for improvements.

The provision would require that the JASON scientific advisory group conduct the assessment but allows for the Secretary to enter into an agreement with an alternate assessment group. The assessment shall be completed with a report of findings and recommendations to the congressional defense committees by October 1, 2019.

Budget Items

Army

Army defense research sciences

The budget request included \$10.2 billion in Research, Development, Test and Evaluation (RDT&E), Army, of which \$276.9 million was for PE 61102A Defense Research Sciences, Army for fundamental scientific knowledge related to long-term national security needs.

The committee notes that basic research activities focused on technical areas of interest to Department of Defense missions lay the foundation upon which other technology development and new defense systems are built. Basic research activities fund efforts at universities, small businesses, and government laboratories. These investments also serve to help train the next generation of scientists and engineers who may work on defense technology problems in government, industry, and academia.

The committee also notes that this particular program builds fundamental scientific knowledge contributing to the sustainment of U.S. Army scientific and technological superiority in land warfighting capability and to solving military problems related to long-term national security needs. It also investigates new concepts and technologies for the Army's future force and provides the means to exploit scientific breakthroughs and avoid technological surprises.

Accordingly, the committee recommends an increase of \$7.5 million, for a total of \$284.4 million, in RDT&E Army, PE 61102A, for basic research. The committee directs that these funds be awarded through well-established and competitive processes.

Army quantum information sciences

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Army, of which \$276.9 million was for PE 61102A Defense Research Sciences, Army, for fundamental scientific knowledge related to long-term national security needs.

The committee notes the transformative potential of quantum information sciences, with potential impacts across disciplines as diverse as cryptography and sensing. In competition with near-peer adversaries, such cutting-edge technology will become increasingly critical.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$281.9 million, in RDT&E, Army, PE 61102A, for research on quantum information sciences.

University and industry research centers

The budget request included \$10.2 billion in Research, Development, Test and Evaluation (RDT&E), Army, of which \$92.1 million was for PE 61104A University and Industry Research Centers, Army.

The committee notes that this basic research program fosters university and industry-based research to provide a scientific foundation for enabling technologies for future force capabilities. In par-

ticular, this program funds collaborative technology alliances, which leverage large investments by the commercial sector in basic research areas that are of great importance to the Army. The committee is specifically encouraged by the efforts associated with the Army Research Laboratory's Open Campus initiative.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$97.1 million, in RDT&E, Army, PE 61104A. The committee directs that these funds be awarded through well-established and competitive processes.

Sensors and electronic survivability

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Army, of which \$32.3 million was for PE 62120A Defense Research Sciences, Army, for sensors and electronic survivability.

The committee notes that this program accelerates the Army's work to enhance industrial base capabilities for improving weapon system performance, speed, fuel efficiency, and force protection. Such innovations ultimately aim to reduce part assemblies, decrease lifecycle costs, and enable point-of need part production.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$37.3 million, in RDT&E, Army, PE 62120A, to support tool and material process development.

Aviation technology

The budget request included \$10.2 billion in Research, Development, Test and Evaluation (RDT&E), Army, of which \$64.8 million was for PE 62211A aviation technology.

The committee notes that several of the programs contained within this program element, such as rotors and vehicle management technology, engine and drives technologies, and platform design and structures technologies, involve research activities that may overlap with aviation research being performed elsewhere in the Department of Defense. Given this potential for redundant work, the committee believes that the level of funds requested for this program element is not entirely justified.

Accordingly, the committee recommends a decrease of \$5.0 million, for a total of \$59.9 million, in RDT&E Army, PE 62211A, in mission systems and engine and drives coordination, and recommends that the Army look for opportunities to increase collaboration and coordination with other Services and research programs on aviation technology.

Weapons and munitions technology

The budget request included \$10.2 billion in Research, Development, Test and Evaluation (RDT&E), Army, of which \$40.4 million was for PE 62624A weapons and munitions technology.

The Nation is being challenged to maintain dominance across all domains as our adversaries have continued to develop and advance their military capabilities that threaten the U.S. homeland. To address these priorities, the Army Armament Research, Development and Engineering Center continues to invest in additive manufacturing technology to rapidly design, prototype, and manufacture critical novel printed armaments components. By advancing print-

ed electronics, energetics, and power sources, size and weight of munition components can be reduced, freeing up valuable internal space for increased lethality payloads, support range, and precision guidance to maximize weapon systems' capabilities while reducing operations and cost. With collaborations across the Services, the long-term goal of this effort is to develop the ability to fully print munitions on a single production line in an ammunition plant, increasing the U.S. Armed Forces' readiness. This effort will also demonstrate the ability to print replacement parts, customizable grenades that will provide both fragmentation and blast, embedded electronics in clothing, and antennae on soldiers' helmets.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$42.9 million, in RDT&E Army, PE 62624A, for advanced warheads technology.

Human factors engineering technology

The budget request included \$10.2 billion in Research, Development, Test and Evaluation (RDT&E), Army, of which \$24.1 million was for PE 62716A human factors engineering technology.

Human factors engineering technology seeks ways to provide warfighters with personalized assessment, education, and training tools; to identify and implement effective ways to interface and team warfighters with machines; to use intelligent, adaptive augmentation to enhance decision making; and to develop techniques, technologies, and practices to mitigate critical stressors that impede warfighter protection, sustainment, and performance. The committee is aware of the significant possibilities that human factors modeling and simulation will provide to the DOD when coupled with applied research in human simulation that utilizes physics-based survivability analysis models. These vital analytics contribute to determining the likelihood of mission success as well as ways to expand training capabilities. The integration of physics-based human simulation, artificial intelligence, and clinical knowledge into the Department's warfighter systems has the potential to rapidly transform mission readiness and success.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$26.6 million, in RDT&E, Army, PE 62716A, for human factors engineering.

Command, Control, and Communications technology

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Army, of which \$55.0 million was for PE 62782A Command, Control, and Communications technology.

The committee encourages the Secretary of the Army to continue supporting the development and advancement of technologies that address: the increasing gaps in position, navigation, and timing architectural and technological development; Global Positioning System vulnerabilities; and adversary navigation warfare capabilities. However, the committee is concerned that the activities described within this program element are duplicative across the Services.

Accordingly, the committee recommends a decrease of \$5.0 million, for a total of \$50.0 million, in RDT&E, Army, PE 62782A command, control and communications technology.

Aviation advanced technology

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Army, of which \$124.9 million was for PE 63003A aviation advanced technology.

The committee notes that, of this amount, the total requested for platform design and structures system represents a more than doubling of this project's budget from past fiscal years. While the committee supports the continued air vehicle demonstration of critical new technologies, the committee is concerned that the large increase in funds is not justified by the project plans.

Accordingly, the committee recommends a decrease of \$5.0 million, for a total of \$119.9 million, in RDT&E, Army, PE 63003A, for platform design and structures systems.

Extended Range Cannon Artillery gun

The budget request included \$10.2 billion for Research, Development, Test, and Evaluation (RDT&E), Army, of which \$102.7 million was for PE 63004A Weapons and Munitions Advanced Technology.

The committee recommends an increase of \$20.0 million, for a total of \$122.7 million, in RDT&E, Army, PE 63004A, for the acceleration of the development of the Extended Range Cannon Artillery gun.

Combat vehicle and automotive advanced technology

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Army, of which \$119.7 million was for PE 63005A combat vehicle and automotive advanced technology.

The committee understands that Army Tank Automotive Research, Development, and Engineering Center (TARDEC) spends hundreds of millions of dollars annually on improving the performance of vehicles. Fuel reduction is a critical objective to reduce fuel consumption and reduce the requirements for large convoys to deliver fuel to deployed forces. The committee believes that TARDEC should fund an effort to demonstrate leap-ahead technology for fuel reduction.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$122.2 million, in RDT&E, Army, PE 63005A, for modular scalable powertrain.

Army Next Generation Combat Vehicle Prototype

The budget request included \$10.2 billion for Research, Development, Test, and Evaluation (RDT&E), Army, of which \$119.7 million was for PE 63005A Combat Vehicle and Automotive Advanced Technology.

The committee recognizes the importance of the Army's efforts to expedite critical capabilities through rapid prototyping to meet the needs of combatant commanders. The committee believes that the Army must rapidly develop a prototype next generation combat vehicle to replace the aging Bradley fighting vehicle. The committee notes that the Army's Tank Automotive Research Development and Engineering Center (TARDEC) has done significant market surveys of the world's best modern component technologies, fabricated

a prototype hull, and produced a virtual design concept. The committee believes that the TARDEC should be given all needed funding and authorities to continue this prototyping effort with technology developers, operational users, testers, and commercial sector partners.

The committee recommends an increase of \$70.0 million, for a total of \$189.7 million, in RDT&E, Army, PE 63005A, for the Combat Vehicle and Automotive Advanced Technology to prototype the next generation combat vehicle.

High performance computing modernization program

The budget request included \$10.2 billion in Research, Development, Test and Evaluation (RDT&E), Army, of which \$183.3 million was for PE 63461A high performance computing modernization program.

The committee notes that this program is a Department-wide asset used by all of the Services and combat support agencies. Additional funding for this program would increase the research and development budget toward the level of that appropriated in fiscal year 2018. The committee notes that research and development initiatives under this program support Defense supercomputing resource centers, the Defense Research and Engineering Network, and software applications. The U.S. government has spent over \$7.0 billion to develop and implement this unique, world-class national computing asset for the DOD. It delivers approximately 3.2 billion processor hours and over 3.5 quadrillion floating point operations per second, available and configured to support the Department's most challenging problems and analysis of massive and complex datasets.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$188.3 million, in RDT&E, Army, PE 63461A, for high performance computing.

Research, Development, Test, and Evaluation funds for minor Science and Technology military construction

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Army, of which \$25.8 million was for PE 63734A military engineering advanced technology.

In the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115-91), the committee urged the Department of Defense to invest in its military construction accounts for science and technology facilities, as well as those used for test and evaluation. Unfortunately, these projects generally fall victim to low prioritization, despite their major value to the Department's mission.

Accordingly, the committee recommends an increase of \$8.0 million, for a total of \$33.8 million, in RDT&E, Army, PE 63734A, for minor military construction projects for science- and technology-related facilities. The committee adds these funds in order to fund the request for Target Assembly Facility (92422) and Climactic Chamber Building (92344), both minor military construction projects with science and technology uses. The committee strongly encourages the Army to ensure coordination regarding the appro-

priate planning and design occurs so that these projects are executable.

Military engineering advanced technology

The budget request included \$10.2 billion in Research, Development, Test and Evaluation (RDT&E), Army, of which \$25.8 million was for PE 63734A military engineering advanced technology.

The committee notes that centrifuge-based research has allowed the U.S. Army Corps of Engineers to test small-scale physical models of bridges, piers, and other installations and resulted in engineering improvements to new facilities. Additional funding is justified to expand the existing centrifuge capacity, as this research accelerates engineering advances with more efficiency and at lower cost.

Further, the committee recognizes the transformative potential of additive manufacturing, or 3-D printing, to the industrial supply chain and across disciplines. The ability to use new materials in new ways or to develop new manufacturing processes has the potential to transform how the Department does business and significantly increase warfighter system readiness.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$30.8 million, in RDT&E, Army, PE 63734A, for centrifuge research and additive manufacturing.

Position, navigation and timing technology

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Army, of which \$34.9 million was for PE 63772A advanced tactical computer science and sensor technology.

Near-peer adversaries, such as the Russian Federation and People's Republic of China, have taken note of American dependence on Position, Navigation, and Timing (PNT) technology and have heavily invested in navigation warfare technologies that can congest, degrade, jam, spoof, and eliminate Global Positioning Systems (GPS). Advancing assured PNT technologies for operation in a GPS-denied or -degraded environment are essential to the warfighter's ability to maintain overmatch in a multi-domain battlefield. This program element addresses the critical technological gaps that U.S. and coalition operations face in hostile, GPS-denied environments and will mature PNT situational awareness analysis tools that deliver PNT integrity monitoring, dissemination of time-related data, as well as hardware and software solutions to augment PNT for mounted and dismounted platforms.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$37.4 million, in RDT&E, Army, PE 63772A, for PNT research and development.

Command, Control, and Communication advanced technology

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Army, of which \$52.4 million was for PE 63794A Command, Control, and Communication (C3) advanced technology.

The committee encourages the Secretary of the Army to continue supporting the development and advancement of technologies that address: the increasing gaps in position, navigation, and timing architectural and technological development; Global Positioning System vulnerabilities; and adversary navigation warfare capabilities. However, the committee is concerned that the activities described within this program element are duplicative across the Services.

Accordingly, the committee recommends a decrease of \$5.0 million, for a total of \$47.4 million, in RDT&E, Army, PE 63794A.

Anti-Personnel Improved Conventional Munition

The budget request included \$10.2 billion for Research, Development, Test, and Evaluation (RDT&E), Army, of which, \$42.0 million was for PE 63639A tank and medium caliber ammunition.

The committee recommends an increase of \$14.0 million, for a total of \$56.0 million, in RDT&E, Army, PE 63639A, for the test and evaluation of the M999 Anti-Personnel Improved Conventional Munition to verify its compliance with the Department's policy on cluster munition. This request was included on the Army's unfunded priorities list.

Tactical Exploitation of National Capabilities Radio Frequency Exploitation–Electronic Intelligence

The budget request included \$10.2 billion for Research, Development, Test, and Evaluation (RDT&E), Army, of which \$35.7 million was for PE 63766A Tactical Exploitation of National Capabilities Radio Frequency Exploitation (TRFE)–Electronic Intelligence (ELINT).

The committee directs the Secretary of the Army to develop and experiment with prototypes that can be developed into suitable, survivable, and effective intelligence systems for support of the Army Field Artillery. The committee is aware of the plan to modernize the Army Field Artillery. The committee acknowledges that the development and fielding of Long Range Precision Fires (LRPF) is the Army's first priority for modernization. The committee, however, is concerned that Army Intelligence is not actively developing a capability to provide effective, suitable, and survivable intel-

ligence, surveillance, and reconnaissance (ISR) capabilities for the Field Artillery. This ISR must be able to detect, locate, classify, identify, and confirm long-range targets. This is particularly important for engagement by long-range cannon and rocket batteries for attacking enemy targets deep within enemy defensive sectors and support zones. In light of requirements as detailed in the National Defense Strategy, the Army must rapidly field effective, suitable, and survivable ISR capabilities to support the Army Field Artillery.

The committee encourages the Secretary to exploit existing hardware and specialized software to support experimentation and testing. The Secretary should seek to transition as rapidly as possible to a program of record for an accelerated production decision.

Accordingly, the committee recommends an increase of \$8.0 million, for a total of \$43.7 million, in RDT&E, Army, PE 63766A, for TRFE–ELINT.

Indirect Fire Protection Capability

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Army, of which \$51.0 million was for PE 64319A Indirect Fire Protection Capability Increment 2-Intercept (IFPC).

While the Army continues to deprioritize IFPC, critical capabilities, such as cruise missile defense of fixed stations, are nonexistent. In too many respects, the Army Missile Defense (AMD) forces fielded today fall considerably short of being an effective foundation for the kind of conflict envisioned by the National Defense Strategy, and, while air and missile threats have become more capable and complex, U.S. AMD capabilities have undergone only a modest modernization.

In order to accelerate and prioritize the IFPC program, the committee recommends an increase of \$30.0 million, for a total of \$81.0 million, in RDT&E, Army, PE 64319A.

Mobile Protected Firepower

The budget request included \$10.2 billion for Research, Development, Test, and Evaluation (RDT&E), Army, of which \$393.6 million was for PE 64645A Mobile Protected Firepower (MPF).

The committee recognizes the importance of the Army's efforts to modernize and to be better prepared to execute the National Defense Strategy. The Army has made clear its modernization priorities in order to rapidly build capabilities needed for combined arms maneuver against a peer adversary. The committee is concerned that the MPF is not suited for a high-intensity battlefield.

The committee recommends a decrease of \$75.0 million, for a total of \$318.6 million, in RDT&E, Army, PE 64645A, for MPF.

Suite of Vehicle Protection Systems—EMD (Vehicle Protection Suite Project)

The committee is concerned with the Army's repeated decision to ignore the articulated requirement for a vehicle laser warning system as part of the Abrams IB and the Bradley 2B ECP improvements. The laser warning system provides critical protection and enhances current operational capabilities utilized by forward deployed units. Any additional delay in fielding will only continue to undermine effectiveness and prolong an increased risk to the Army's ground combat vehicles. The Committee recommends that the Army realign its procurement plans and integrate the laser warning system onto the M1 Abrams Tank and any other forward deploying ground combat vehicles. The Committee encourages the Army to concentrate on survivability and incorporate a laser warning sensor suite system to adequately address the growing threat of anti-tank guided missiles and laser beam riding guidance systems. The Committee believes that by focusing on mature, field-tested protective technology, the active protection system (APS) will provide a balanced framework that both increases lethality and protection for the warfighter. As the Army transitions APS onto ground combat vehicles through the Vehicle Protection System, it will require the incorporation of a laser warning sensor suite onto the system.

Accordingly, the committee recommends an increase of \$9.0 million to Army Research, Development, Test & Evaluation, line 117 for Suite of Vehicle Protection Systems–EMD, and an additional decrease of \$9.0 million, for a total decrease of \$324.0 million, from Army Procurement of Weapons & Tracked Combat Vehicles, line number 6 for the Bradley Program MOD.

Army contract writing system

The budget request included \$10.2 billion in Research, Development, Test & Evaluation (RDT&E), Army, of which \$41.9 million was for PE 65047A Army Contract Writing System.

The committee is concerned about duplication among the Services in contract writing systems.

Accordingly, the committee recommends a decrease of \$41.9 million, for a total of \$0.0 million, in RDT&E, Army, PE 65047A.

Major T&E investment

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Army, of which \$91.8 million was for PE 64759A major test and evaluation investment.

In the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115–91), this committee urged the Department of Defense to invest in its military construction accounts for science and technology facilities, as well as those used for test and evaluation. Unfortunately, these projects generally fall victim to low prioritization, despite their major value to the Department’s mission.

Accordingly, the committee recommends an increase of \$25.0 million, for a total of \$116.8 million, in RDT&E, Army, PE 64759A, for minor military construction projects for science- and technology-related facilities. The committee adds these funds in order to fund the request for Armament Test Ops and Analysis Facility (58467), Guana Peak Site (63191), EMI RDT&E (87871), HPM Building 21245 (60556), Lift and Tiedown Test Facility Modernization (91080), Guided Missile Building (85286), and Braking and Maneuver Facility (60832), all minor military construction projects with science and technology uses.

The committee strongly encourages the Army to ensure that coordination regarding the appropriate planning and design occurs so that these projects are executable.

High energy laser testing

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Army, of which \$306.0 million was for PE 65601A Army Test Ranges and Facilities.

The committee notes that next generation weapon systems are being developed by the Department of Defense and its defense industry partners but the Nation’s infrastructure for testing those weapon systems is antiquated and in need of modernization. As directed energy weapon systems mature, the need to validate their performance becomes increasingly important. The committee notes that the workload and number of directed energy demonstrations and exercises have increased significantly since 1975 and the projected workload for fiscal years 2018 through 2022 is significant.

Accordingly, the committee recommends an increase of \$15.0 million, for a total of \$321.0 million, in RDT&E, Army, PE 65601A, to accelerate the testing of those weapon systems.

Navy

Navy basic research initiatives

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$119.4 million was for PE 61103N university research initiatives.

Basic research is critical to the development of next generation naval capabilities.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$124.4 million, in RDT&E, Navy, PE 61103N, for basic research. The committee directs that these funds be awarded through well-established and competitive processes.

Navy defense research sciences

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$458.7 million was for PE 61153N defense research sciences.

The committee notes that basic research activities serve to help train the next generation of scientists and engineers who may work on defense technology problems in government, industry, and academia.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$463.7 million, in RDT&E, Navy, PE 61153N, for basic research. The committee directs that these funds be awarded through well-established and competitive processes.

Navy quantum information sciences

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$458.7 million was for PE 61153N defense research sciences.

The committee notes the transformative potential of quantum information sciences, with potential impacts across disciplines as diverse as cryptography and sensing. In competition with near-peer adversaries, such cutting-edge technology will become increasingly critical.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$463.7 million, in RDT&E, Navy, PE 61153N, for quantum information sciences.

Directed energy applied research

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$14.6 million was for PE 62114N power projection applied research.

The committee notes that the National Defense Strategy specifically highlights the importance of directed energy and the potential that it holds for future operational capabilities.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$17.1 million, in RDT&E, Navy, PE 62114N, power projection applied research.

Warfighter sustainment applied research

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$56.1 million was for PE 62236N warfighter sustainment applied research.

The request includes significant growth in Office of Naval Research Global (ONR Global). Though ONR Global's mission is undoubtedly important, the committee urges additional resourcing to go directly toward National Defense Strategy-aligned priorities as opposed to significantly growing this organization.

Accordingly, the committee recommends a decrease of \$7.5 million, for a total of \$48.6 million, in RDT&E, Navy, PE 62236N.

Undersea warfare applied research

The budget request included \$18.5 billion in Research, Development, Test and Evaluation (RDT&E), Navy, of which \$58.0 million was for PE 62747N undersea warfare applied research.

The committee continues to recognize the importance of building strong partnerships between Navy research labs, academia, and shipyards that build our nation's submarines. The committee encourages the Navy to closely coordinate this effort with its industrial base partners to ensure that funded research projects are relevant to specific engineering and manufacturing needs, as well as defined systems capabilities. Partnerships with academia should focus on well-defined submarine and autonomous undersea vehicle research, needs, accelerated technology transition projects, and workforce development to help ensure a sustainable industrial base. The committee encourages projects that aim to reduce manufacturing costs.

Accordingly, the committee recommends an increase of \$20.0 million, for a total of \$78.0 million, in RDT&E, Navy, PE 62747N, undersea warfare applied research.

Innovative Naval prototypes—applied research

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$159.7 million was for PE 62792N applied research in Innovative Naval Prototypes.

The committee notes that this program element is tasked with developing leap ahead technologies in game-changing areas such as cyber, directed energy, electromagnetic warfare, and autonomous systems.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$164.7 million, in RDT&E, Navy, PE 62792N, for directed energy, electronic warfare, and unmanned and autonomous systems.

USMC advanced technology demonstration

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$150.2 million was for PE 63640M United States Marine Corps Advanced Technology Demonstration.

The committee notes that, of this amount, a significant increase is requested for the futures directorate, an organization tasked with identifying future challenges and opportunities, developing

warfighting concepts, and comprehensively exploring options to inform the combat development process to meet the challenges of the future operating environment. The committee is concerned that such an increase is unjustified and cannot be absorbed through the work identified in the project description.

Accordingly, the committee recommends a decrease of \$10.0 million, for a total of \$140.2 million, in RDT&E, Navy, PE 63640M, for unjustified growth.

Innovative Naval prototypes—advanced technology development

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$161.8 million was for PE 63801N advanced technology development in Innovative Naval Prototypes.

The committee notes that this program element is tasked with developing leap ahead technologies in game-changing areas such as cyber, directed energy, electromagnetic warfare, and autonomous systems. The committee notes that undersea warfare capabilities are a key component of Navy modernization plans.

Accordingly, the committee recommends an increase of \$4.5 million, for a total of \$166.3 million, in RDT&E, Navy, PE 63801N, for directed energy, electronic warfare, and unmanned and autonomous systems.

Advanced combat systems technology

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$59.7 million was for PE 63382N advanced combat systems technology.

The committee is encouraged by the projects taken on within the advanced combat systems program element. The Low-Cost UAV Swarming Technology (LOCUST) program involves building a launcher that could send dozens of drones out of a tube in a swarm designed to “autonomously overwhelm an adversary.” The Heterogeneous Collaborative Unmanned Systems (HCUS) demonstration is part of the Effector Grid category for small autonomous systems. HCUS provides autonomous, tactical monitoring of an adversary’s port-sized littoral area for an extended period of time with capability to apply limited offensive effects on-demand. The committee urges the Navy to continue funding these projects and others in this program element.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$62.2 million, in RDT&E, Navy, PE 63382N, for LOCUST, HCUS, and Innovative Naval Prototype Transition.

Surface and shallow water mine countermeasures

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$62.7 million was for PE 63502N surface and shallow water mine countermeasures.

The committee notes that, on April 17, 2018, the Navy awarded an \$83.3 million contract for the design, test, and deployment of the Barracuda mine neutralization system. If all options are exercised, the committee understands that this contract includes op-

tions to design and deliver 750 Barracuda Engineering Development Models (EDMs) with a cumulative contract value of \$362.7 million.

The committee further notes that the Barracuda Preliminary Design Review and Critical Design Review (CDR) are scheduled for fiscal year 2020 and fiscal year 2021 respectively. The committee believes that the award of Barracuda EDMs should be delayed until an approved CDR drawing is achieved.

Accordingly, the committee recommends a decrease of \$26.0 million, for a total of \$36.7 million, in RDT&E, Navy, PE 63502N, for surface and shallow water mine countermeasures.

Advanced submarine system development

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$109.0 million was for PE 63561N advanced submarine system development.

The committee understands advanced submarine propulsion development could be accelerated, if additional funds were available. The committee believes accelerating and expanding the use of composite materials, where appropriate, could enable significant warfighting and acquisition advantages in the construction of submarines.

Accordingly, the committee recommends an increase of \$3.5 million, for a total of \$112.6 million, in RDT&E, Navy, PE 63561N, for advanced submarine system development.

Common Hull Auxiliary Multi-mission Platform acceleration

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$89.4 million was for PE 63563N ship concept advanced design.

The committee notes \$18.0 million of this request is in project 4037 for Common Hull Auxiliary Multi-mission Platform (CHAMP) industry studies, which will lead to a domestic common-hull design to replace aging mission-specific sealift and auxiliary designs. The committee understands that the CHAMP is a key element of sealift and auxiliary ship recapitalization. The committee further notes a March 2018 report to Congress stated, "CHAMP procurement could accelerate to as early as fiscal year 2023 with funding and congressional support." The committee further notes that the Navy has stated that \$18.0 million would be necessary to support such acceleration.

Accordingly, the committee recommends an increase of \$18.0 million, for a total of \$107.4 million, in RDT&E, Navy, PE 63563N, for ship concept advanced design.

Littoral Combat Ship mission modules

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$103.6 million was for PE 63596N Littoral Combat Ship (LCS) mission modules.

The committee believes activities supporting the LCS mine countermeasures mission module should be consolidated in this program element or in a new LCS mine countermeasures mission module program element.

Therefore, the committee recommends the transfer of: \$7.6 million from PE 64127N (surface mine countermeasures), \$10.1 million from PE 64126N (littoral airborne mine countermeasures), and \$16.7 million from PE 64028N (small and medium unmanned undersea vehicles).

Additionally, the committee notes the USS *Jackson* (LCS-6) surface-to-surface missile module test has been deferred and recommends a decrease of \$5.0 million.

Accordingly, the committee recommends an increase of \$29.4 million, for a total of \$133.0 million, in RDT&E, Navy, PE 63596N, for LCS mission modules.

Land attack technology

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$15.5 million was for PE 63795N land attack technology.

The committee notes a program delay and no future years funding for the Gun Launched Guided Projectile, despite plans to publish a Request for Proposals in fiscal year 2019 for Engineering, Manufacturing, and Development.

Accordingly, the committee recommends a decrease of \$15.5 million, for a total of \$0.0, in RDT&E, Navy, PE 63795N, for land attack technology.

F/A-18 infrared search and track

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$108.7 million was for PE 64014N F/A-18 infrared search and track (IRST).

The committee understands that additional funding could reduce risk in operational testing of IRST Block II by restoring lab and flight tests that were deferred due to prior budget reductions.

Therefore, the committee recommends an increase of \$24.0 million, for a total of \$132.7 million, in RDT&E, Navy, PE 64014N, for F/A-18 IRST Block II testing.

Small and medium unmanned undersea vehicles

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$16.7 million was for PE 64028N small and medium unmanned undersea vehicles.

The committee notes that this program element only includes activities related to the Knifefish unmanned underwater vehicle, which is part of the Littoral Combat Ship (LCS) mine countermeasures mission module. The committee believes activities related to LCS mine countermeasures mission modules should be consolidated in PE 63596N (LCS mission modules) or in a new LCS mine countermeasures mission module program element.

Accordingly, the committee recommends a decrease of \$16.7 million, for a total of \$0.0, in RDT&E, Navy, PE 64028N, for small and medium unmanned undersea vehicles and a transfer of the \$16.7 million decrease to RDT&E, Navy, PE 63596N.

Large unmanned undersea vehicles

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$92.6 million was for PE 64031N large unmanned underwater vehicles.

The committee understands that the \$21.2 million is early-to-need based on prior year congressional funding reductions.

Accordingly, the committee recommends a decrease of \$21.2 million, for a total of \$71.4 million, in RDT&E, Navy, PE 64031N, for large unmanned underwater vehicles.

Littoral airborne mine countermeasures

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$17.6 million was for PE 64126N littoral airborne mine countermeasures.

The committee notes this program element includes \$10.1 million in funds related to the Coastal Battlefield Reconnaissance and Analysis airborne mine countermeasures system, which is part of the Littoral Combat Ship (LCS) mine countermeasures mission module. The committee believes activities related to LCS mine countermeasures mission modules should be consolidated in PE 63596N (LCS mission modules) or in a new LCS mine countermeasures mission module program element.

Accordingly, the committee recommends a decrease of \$10.1 million, for a total of \$7.5 million, in RDT&E, Navy, PE 64126N, for littoral airborne mine countermeasures and a transfer of this \$10.1 million to RDT&E, Navy, PE 63596N.

Surface mine countermeasures

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$18.2 million was for PE 64127N surface mine countermeasures.

The committee notes that this program element includes \$7.6 million in funds related to the AN/AQS-20 sonar system, which is part of the Littoral Combat Ship (LCS) mine countermeasures mission module. The committee believes activities related to LCS mine countermeasures mission modules should be consolidated in PE 63596N (LCS mission modules) or in a new LCS mine countermeasures mission module program element.

Accordingly, the committee recommends a decrease of \$7.6 million, for a total of \$10.6 million, in RDT&E, Navy, PE 64127N, surface mine countermeasures and a transfer of the \$7.6 million decrease to RDT&E, Navy, PE 63596N.

AV-8B Aircraft—Engineering Development

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$46.3 million was for PE 64214M AV-8B Aircraft—Engineering Development.

The committee notes that the Marine Corps plans to divest of the AV-8B by 2027 and replace it with the F-35B and that this transition is well underway. The committee also notes that, of the \$46.3 million requested in this budget line, \$13.9 million is for engine safety and reliability improvements and engineering change proposals. The remaining \$32.3 million requested is for weapons and avionics upgrades. The AV-8 platform was first fielded in the Ma-

rine Corps in the early 1970s, and the committee has concerns about continued investment in an aircraft that has limited utility against a peer adversary. Rather than continue to invest in a platform that, even in upgraded form, will not add meaningful capability to the joint force, the committee believes that these funds would be better used elsewhere to support modernization initiatives across the force.

Accordingly, the committee recommends a decrease of \$16.2 million, for a total of \$30.1 million, in RDT&E, Navy, PE 64214M, for AV-8B Aircraft—Engineering Development.

Physiological episode safety improvements

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$21.0 million was for PE 64264N for Air Crew Systems Development.

The committee is concerned that U.S. military aircraft currently do not possess the ability to monitor the physiological status of aircrew and autonomously act to protect them in case of hypoxia or other physiological events. In response to physiological episodes in Navy aircraft, the National Aeronautics and Space Administration has recommended an advanced safety sensor that would monitor and record the composition of gases inhaled and exhaled by the pilot. These types of sensors have been developed by the Air Force Research Laboratory, and the committee believes that the Department of Defense should explore fielding them to all relevant Department aircraft. The committee believes that further integration of these breathing sensors into a fully autonomous life support system, which monitors the pilot's physiological state and automatically reacts to prevent mishaps, should be pursued.

Accordingly, the committee recommends an increase of \$10.0 million, for a total of \$31.0 million, in RDT&E, Navy, PE 64264N, Air Crew Systems Development, for physiological episode safety improvements.

EA-18G cognitive electronic warfare

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$147.4 million was for PE 64269N EA-18 Squadrons.

The committee recognizes the growing importance of electronic warfare and its critical role in any conflict with a peer or near-peer adversary. The committee believes that it is imperative that the United States maintains relevant and effective electronic warfare capabilities. Moving forward, the ability to sense and react to the electromagnetic spectrum will be key to success in any conflict with a peer competitor.

Therefore, the committee recommends an increase of \$95.3 million, for a total of \$242.7 million, in RDT&E, Navy, PE 64269N, for Reactive Electronic Attack Measures. This item was included on the Chief of Naval Operations' unfunded priorities list.

EA-18G offensive airborne electronic attack special mission pod

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$89.8 million was for PE 64270N Electronic Warfare Development.

The committee recognizes the growing importance of electronic warfare and its critical role in any conflict with a peer or near-peer adversary. The EA-18G special mission pod is intended to provide a special purpose mission pod to address emergent PACOM operational gaps. The committee believes that it is imperative that the United States maintains relevant and effective electronic warfare capabilities.

Therefore, the committee recommends an increase of \$31.6 million, for a total of \$121.4 million, in RDT&E, Navy, PE 64270N, for EA-18G offensive airborne electronic attack pod. This item was included on the Chief of Naval Operations' unfunded priorities list.

LPD-17 class systems integration

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$0.9 million was for PE 64311N LPD-17 class systems integration.

The committee understands that *San Antonio*-class (LPD-17) amphibious ships were designed to accommodate a 16-cell Mark-41 Vertical Launch System (VLS), which would increase lethality through employment of a variety of munitions, including Tomahawk, Enhanced Sea Sparrow, and Standard missiles.

The committee notes that the Secretary of the Navy and Commandant of the Marine Corps testified on April 19, 2018, before the Committee on Armed Services of the Senate, that they supported installation of VLS on Flight II LPD-17 class ships.

The committee further understands that approximately \$50.0 million would be required to complete the non-recurring engineering necessary to incorporate VLS on LPD-17 class ships.

Accordingly, the committee recommends an increase of \$50.0 million, for a total of \$50.9 million, in RDT&E, Navy, PE 64311N, for LPD-17 class systems integration.

SM-6 Block 1B 21 inch rocket motor

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$165.9 million was for PE 64366N Standard Missile improvements.

The committee recommends an increase of \$19.0 million, for a total of \$146.9 million, in RDT&E, Navy, PE 64366, for the 21 inch rocket motor. This is on the Chief of Naval Operations' unfunded priorities list.

Amphibious assault ship acceleration

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$60.1 million was for PE 64567N ship contract design and live fire test and evaluation.

The committee remains concerned with the Navy procurement profile for large deck amphibious assault ships, which includes a

span of 7 years until the next large deck amphibious assault ship (LHA-9) is procured in 2024.

The committee notes that efficiencies could be gained by reducing this span, which could enable a steadier workforce with an increased learning curve, material and equipment suppliers on more reliable and fixed delivery contracts, and a more effective continuous improvement schedule.

The committee urges the Secretary of the Navy to accelerate procurement of LHA-9 to not later than 2021 and understands that \$6.0 million is required for planning to support a fiscal year 2021 detailed design and construction award for LHA-9.

Accordingly, the committee recommends an increase of \$6.0 million, for a total of \$66.1 million, in RDT&E, Navy, PE 64567N, for ship contract design and live fire test and evaluation.

Electronic Procurement System

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$268.6 million was for PE 65013N Information Technology Development, including \$26.3 million for Electronic Procurement System.

The committee is concerned about duplication among the Services in contract writing systems.

Accordingly, the committee recommends a decrease of \$26.3 million, for a total of \$242.3 million, in RDT&E, Navy, PE 65013N.

Navy Information Technology Systems Development

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$268.6 million was for PE 65013N Information Technology Development, including \$63.8 million for Navy Personnel and Pay (NP2).

The committee is concerned about the lengthy timeline for delivery of capability to users. The committee encourages the Department of Defense to adopt modern software development practices that deliver capabilities to users in shorter increments and timelines. Best practices for incremental development call for delivering functional capabilities to the end-user at intervals of 6 months or less. The acquisition strategy includes a software development approach using a commercial off-the-shelf solution. However, NP2 does not plan to deliver any capability to users until fiscal year 2020 with the next increment of capability planned for 2 years later. The committee feels that the use of modern, commercial acquisition practices is especially important to support critical management and personnel and pay activities.

Accordingly, the committee recommends a decrease of \$63.8 million, for a total of \$204.8 million, in RDT&E, Navy, PE 65013N.

Management, technical, and international support

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$87.6 million was for PE 65853N management, technical, and international support.

The committee notes several projects contain insufficient budget justification and unjustified cost growth.

Accordingly, the committee recommends a decrease of \$9.0 million, for a total of \$78.6 million, in RDT&E, Navy, PE 65853N, for management, technical, and international support.

Maritime Strike Tomahawk

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$282.4 million was for PE 24229N for Tomahawk missiles and the Tomahawk Mission Planning Center.

The committee recommends an increase of \$8.7 million, for a total of \$291.1 million, in PE 24229N of RDT&E, Navy, to restore full funding and to maintain fiscal year 2021 initial operational capability.

Integrated surveillance system

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$37.0 million was for PE 24311N integrated surveillance system.

The committee notes that, since fiscal year 2015, the Navy has utilized Transformational Reliable Acoustic Path Systems (TRAPS) in anti-submarine warfare missions. The committee understands that these deployable systems have performed satisfactorily and comprise a critical element of the Navy's overall integrated under-sea surveillance system. The committee is concerned capability or capacity gaps will be created if additional TRAPS units are not procured in fiscal year 2019.

Accordingly, the committee recommends an increase of \$35.0 million, for a total of \$72.0 million, in RDT&E, Navy, PE 24311N, for integrated surveillance system.

Advanced Anti-Radiation Guided Missile extended range

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$120.8 million was for PE 25601N for HARM Improvements, of which \$99.2 million is for development of the extended range (ER) version of the Advanced Anti-Radiation Guided Missile (AARGM).

The committee notes that the Navy plans to create an extended range version of the AARGM Block I, with no modification to the missile system except for the rocket motor. The AARGM Block I is currently in production. The committee also notes that the fiscal year 2017 annual report of the Director of Operational Test and Evaluation (DOT&E) recently stated that the AARGM Block I was "not adequate to support an evaluation of operational effectiveness or survivability." Furthermore, the report stated that the AARGM Block I "provides limited employment capability against advanced threat surface-to-air radar systems."

While longer range is an important factor when competing against near-peer adversaries, the committee believes that the Navy should not extend the range of the AARGM until the missile seeker is effective against "advanced threat surface-to-air radar systems." The committee supports the effort to design an anti-radiation missile that is relevant against a peer adversary. However, given DOT&E's findings on the suitability of AARGM Block I, the committee believes that simply extending the range will not be suf-

ficient and recommends that the Navy find a more comprehensive solution to this problem.

Therefore, the committee recommends a decrease of \$99.2 million, for a total of \$21.6 million, in RDT&E, Navy, PE 25601N, in order to pause development of the AARGM ER pending a Navy review of requirements.

Tactical Targeting Network Technology

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$104.7 million was for PE 25604N for Tactical Data Links.

The committee recognizes the increasing importance of data links to our warfighting concepts of operations and combat effectiveness. The Tactical Targeting Network Technology (TTNT) data link supports the Navy's Naval Integrated Fire Control—Counter Air and Offensive Anti-Surface Warfare. The committee believes that it is imperative that the Department accelerate the fielding of technologies, such as TTNT, that enhance our capabilities in any conflict with a peer or near-peer adversary.

Therefore, the committee recommends an increase of \$12.0 million, for a total of \$116.7 million, in RDT&E, Navy, PE 25604N, to accelerate the TTNT capability. This item was included on the Chief of Naval Operations' unfunded priorities list.

F/A-18 E/F engine enhancements

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$121.8 million was for PE 25633N for Aviation Improvements.

The committee recognizes that the F/A-18 E/F Super Hornet will remain a critical element of the carrier air wing for the foreseeable future. The committee supports the Navy's efforts to maintain the Super Hornet's relevance and effectiveness.

Therefore, the committee recommends an increase of \$15.0 million, for a total of \$136.8 million in RDT&E, Navy, PE 25633N, to accelerate the design and development of F/A-18 E/F Super Hornet engine enhancements to address range, speed, efficiency, and survivability improvements. This item was included on the Chief of Naval Operations' unfunded priorities list.

Amphibious Assault Vehicle

The budget request included \$18.5 billion in Research, Development, Test, and Evaluation (RDT&E), Navy, of which \$22.6 million was for PE 26629M Amphibious Assault Vehicles (AAV).

The committee understands that the Amphibious Assault Vehicle (AAV) Product Improvement Program (PIP)/Survivability Upgrade Program (SUP) will produce marginal improvements in the vehicle's overall survivability and that few of the proposed enhancements address threats the vehicle may face in conflict against a peer adversary. The AAV is a decades-old platform with legacy amphibious and combat capabilities that do not meet the needs of modern Marine amphibious forcible entry operations. Rather than continue to invest in a vehicle that, even in upgraded form, will not provide adequate maneuverability, survivability, or ship-to-shore performance, the committee believes these funds would be better

used elsewhere to support modernization initiatives across the force.

Accordingly, the committee recommends a decrease of \$22.6 million, for a total of \$0.0, in RDT&E, Navy, PE 26629M, for the Amphibious Assault Vehicle.

Air Force

Air Force defense research sciences

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$384.3 million was for PE 61102F defense research sciences.

The committee notes that basic research investments serve to help train the next generation of scientists and engineers who may work on defense technology problems in government, industry, and academia.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$389.3 million, in RDT&E, Air Force, PE 61102F for basic research. The committee directs that these funds be awarded through well-established and competitive processes.

Air Force quantum information sciences

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$384.3 million was for PE 61102F defense research sciences.

The committee notes the transformative potential of quantum information sciences, with potential impacts across disciplines as diverse as cryptography and sensing. In the National Defense Strategy's environment of competition with near-peer adversaries, such cutting-edge technology will become increasingly critical. The committee urges the inclusion of research on the underlying mathematics of quantum enabled systems.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$389.3 million, in RDT&E, Air Force, PE 61102F, for quantum information sciences.

High energy laser research initiatives

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$14.5 million was for PE 61108F high energy laser research initiatives.

The committee notes that the National Defense Strategy specifically highlights the importance of directed energy and the potential that it holds for future operational capabilities.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$17.0 million, in RDT&E, Air Force, PE 61108F.

Materials

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$125.3 million was for PE 62102F materials.

The committee supports the Air Force's efforts to improve structural metallic materials used in high priority aerospace and defense missions. The use of high energy synchrotron x-rays is helping design engineers to better understand which materials are best

suiting for military performance requirements and to develop optimal and efficient manufacturing processes for these novel materials. It is critical that Air Force and other Department of Defense scientists engage in hands-on experiential learning to train more materials scientists and engineers in these capabilities, including the creation and implementation of high-fidelity simulations and advanced data-science methods to support development of next-generation weapons systems.

Accordingly, the committee recommends an increase of \$4.0 million, for a total of \$129.3 million, in RDT&E, Air Force, PE 62102F, in support of the Air Force's efforts to improve materials used in high priority aerospace and defense missions.

Aerospace vehicle technologies

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$130.5 million was for PE 62201F aerospace vehicle technologies.

The committee notes that hypersonic technologies are a key component of the National Defense Strategy but is concerned that investment has been insufficient to support test infrastructure, advanced testing techniques, and the testing workforce. Without these investments, it is unlikely that hypersonic systems will achieve operational status.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$135.5 million, in RDT&E, Army, PE 62201F, for high-speed systems technology, including hypersonic vehicle structures.

Affordable responsive modular rocket

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$190.9 million was for PE 62203F aerospace propulsion.

The committee notes the Air Force's participation in the initiative "Rocket Propulsion for the 21st Century" (RP-21), which serves as a focal point for the rocket propulsion development community. The committee applauds the interagency involvement in this effort. Within this effort, the exploration of next generation liquid rocket engine concepts focused on modularity are particularly valuable.

Accordingly, the committee recommends an increase of \$15.0 million, for a total of \$205.9 million, in RDT&E, Air Force, PE 62203F, for the affordable responsive modular rocket.

Multi-mode propulsion applied research

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$190.9 million was for PE 62203F aerospace propulsion.

One of the efforts within "Rocket Propulsion for the 21st Century" (RP-21) is directed at developing technologies for high thrust chemical and electric thrusters to utilize a common propellant and tank. The committee urges the Air Force to accelerate these efforts for flight demonstration.

Accordingly, the committee recommends an increase of \$3.0 million, for a total of \$193.9 million, in RDT&E, Air Force, PE 62203F, for multi-mode propulsion.

Solid Rocket Motor Produce On-Demand

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$190.9 million was for PE 62203F aerospace propulsion.

The committee notes the importance, within the Air Force's rocket propulsion efforts, of continuous flow processing technology in order to reduce the development time of a new motor. The committee believes that such efforts should be accelerated to the extent practicable.

Accordingly, the committee recommends an increase of \$2.0 million, for a total of \$192.9 million, in RDT&E, Air Force, PE 62203F, for the Solid Rocket Motor Produce On-Demand (SRM-POD) program.

Aerospace propulsion

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$190.9 million was for PE 62203F aerospace propulsion.

The committee notes that the Air Force must continue development of critical next-generation engine programs that require both significant research and development funding and long-lead times for propulsion-system development. Advanced propulsion research is critical to meeting the requirements of advanced weapon systems concepts.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$193.4 million, in RDT&E, Air Force, PE 62203F, for turbine engine technology development.

Aerospace sensors

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$166.5 million was for PE 62204F aerospace sensors.

The committee is concerned with the growth in this year's request for electronic component technology, electro-optical sensors and countermeasures technology and radio frequency sensors and countermeasures. Though the committee recognizes the importance of these technologies for warfare in contested environments, the committee urges the Air Force to take advantage of similar work occurring elsewhere in the Department of Defense.

Accordingly, the committee recommends a decrease of \$7.5 million, for a total of \$159.0 million, in RDT&E, Air Force, PE 62204F.

Skywave Technologies Laboratory

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$141.9 million was for PE 62605F directed energy technology.

In the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115-91), this committee urged the Department of Defense to invest in its military construction accounts for science and technology facilities, as well as those used for test and evaluation.

Unfortunately, these projects generally fall victim to low prioritization, despite their major value to the Department's mission.

Accordingly, the committee recommends an increase of \$4.0 million, for a total of \$145.9 million, in RDT&E, Air Force, PE 62605F, for minor military construction. The committee adds these funds in order to fund the request for the Skywave Technologies Laboratory. The committee strongly encourages the Air Force to ensure that coordination regarding the appropriate planning and design occurs so that these projects are executable.

High energy laser research

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$43.4 million was for PE 62890F high energy laser research.

The committee notes that the National Defense Strategy specifically highlights the importance of directed energy and the potential that it holds for future operational capabilities.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$45.9 million, in RDT&E Air Force, PE 62890F.

High powered microwave research

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$43.4 million was for PE 62890F high energy laser research.

The committee recognizes the importance of high powered microwave research as a component of directed energy technologies. Another provision in this Act specifically authorizes the Joint Directed Energy Transition Office to conduct this research along with its other duties.

Accordingly, the committee recommends an increase of \$10.0 million, for a total of \$53.4 million, in RDT&E, Air Force, PE 62890F for high powered microwave research.

Advanced materials for research

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$34.4 million was for PE 63112F advanced materials for weapons systems.

Though the committee recognizes the importance of materials development for critical systems, the committee believes that alternative approaches may be needed to ensure successful transition of these technologies into operational systems.

Accordingly, the committee recommends a decrease of \$5.0 million, for a total of \$29.4 million, in RDT&E, Air Force, PE 63112F, advanced materials for weapons systems.

Materials affordability

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$34.4 million was for PE 63112F advanced materials for weapons systems.

The Metals Affordability Initiative (MAI) is a public-private partnership that has produced innovative metals technology for use in

a variety of Department of Defense systems over the past 19 years. The MAI has demonstrated significant improvements in the manufacture of specialty metals for aerospace applications for both the government and industry, and it provides the warfighter with metals of improved strength and durability, often at a reduced cost. This highly-successful initiative has resulted in over 100 current or planned insertions of new technology into systems Defense-wide with a tenfold return on total government investment (a total of \$2.4 billion).

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$36.9 million, in RDT&E, Air Force, PE 63112F, for materials affordability.

Sustainment in science and technology

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$15.1 million was for PE 63199F sustainment in science and technology. The committee notes that sustainment science and technology are directed at creating sustainable technologies, improving sustainment-related tools and processes, and developing technologies to fundamentally change sustainment missions. Given ongoing concerns about sustainment costs, the committee endorses this important mission and recommends that the Air Force continue to increase resourcing in this area.

Accordingly, the committee recommends an increase of \$1.0 million, for a total of \$16.1 million, in RDT&E, Air Force, PE 63199F, to develop sustainment technologies to improve component design, replacement, and concepts for performance improvement and reduced maintenance burden.

Aerospace technology development and demonstration increase for operational energy capability improvements

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$121.0 million was for the PE 63211F Aerospace Technology Development/Demonstration.

The committee continues to recognize the urgent requirement to constantly innovate and improve combat capability and operational effectiveness for the warfighter, via targeted and competitive operational energy science and technology investments.

Accordingly, the committee recommends an increase of \$10.0 million in RDT&E, Air Force, for a total of \$131.0 million, in PE 63211F, for Aerospace Technology Development/Demonstration.

Specifically, the committee strongly encourages the Air Force to use the increase to fund design and manufacturing of aircraft finlets, micro-vanes, and high pressure compressor blade coatings that have demonstrated reduced drag, evinced fuel savings, and decreased maintenance requirements.

Aerospace propulsion and power technology

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$115.4 million was for PE 63216F aerospace propulsion and power technology.

The Advanced Turbine Engine Gas Generator project develops and demonstrates core engine technologies for small turbines utilized in current and future aircraft, missile, and remotely piloted aircraft propulsion systems. The project develops and demonstrates technology to reduce cost of ownership by half while improving mission flexibility and fuel consumption to increase range. It will also pave the way for providing much-needed competition where there currently is none. The committee strongly encourages the commander of AFMC to fund technologies that lead to low-cost, high-performance turbofan engines of up to 1,200 pounds of thrust.

Accordingly, the committee recommends an increase of \$9.0 million, for a total of \$124.4 million, in RDT&E, Air Force, PE 63216F.

Multi-mode propulsion advanced technology development

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$115.5 million was for PE 63216F aerospace technology development and demonstration.

One of the efforts within “Rocket Propulsion for the 21st Century” (RP-21) is directed at developing technologies for high thrust chemical and electric thrusters to utilize a common propellant and tank. The committee particularly notes the potential for this work to decrease servicing complexity for on-orbit refueling and to afford space operators maximum mission flexibility to respond to unplanned events.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$120.5 million, in RDT&E, Air Force, PE 63216F, for multi-mode propulsion.

Technology for the sustainment of strategic systems

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$115.5 million was for PE 63216F aerospace technology development and demonstration.

The committee urges the Air Force to continue to perform altitude demonstrations at the Air Force Research Laboratory’s high altitude facility in order to develop integrated post-boost phase technologies. These systems can support strategic systems during storage, transportation, on alert, and during boost, and post-boost launch. Similar technologies are also being developed to reduce lifetime prediction uncertainty for individual rocket motors.

Accordingly, the committee recommends an increase of \$10.0 million, for a total of \$125.5 million, in RDT&E, Air Force, PE 63216F, for technology for sustainment of strategic systems.

Electronic combat technology

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$55.3 million was for PE 63270F electronic combat technology.

The committee supports the collaboration between the Defense Digital Service and the Air Force Research Laboratory to improve Air Force software engineering capabilities and to address high priority technical issues plaguing Air Force information technology acquisition programs and deployed systems.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$60.3 million, in RDT&E, Air Force, PE 63270F, for RF/EO/IR warning and countermeasures.

Demonstrator Laser Weapons System

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$43.4 million was for PE 63605F advanced weapons technology.

The committee is aware that collaboration between industry, the Defense Advanced Research Projects Agency, and the Air Force Research Laboratory has already produced the electric Laser Weapon System to detect, identify, and defeat unmanned aircraft system and cruise missile threats. The Demonstrator Laser Weapon System was designed to be the premier facility for evaluating the efficacy of lasers against a variety of live fire targets. The committee notes that the system can be upgraded to provide a more robust development testbed to prove out the tactics, techniques, and procedures for using a laser weapon for base defense. The testbed will also help the Air Force to refine procedures for defending against adversary unmanned aerial systems and cruise missiles.

Accordingly, the committee recommends an increase of \$10.0 million, for a total of \$53.4 million, in RDT&E, Air Force, PE 63605F, for continued development of the demonstrator laser weapon system.

Prototype Tanker

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$28.4 million was for PE 64776F Deployment and Distribution Enterprise R&D.

The committee is concerned about the growing threat to large high-value aircraft in contested environments. The KC-135 and hopefully the KC-46A in the near future provide greater operational availability and range for a broad swath of the joint force's aerial power projection and mobility portfolios. However, these assets are manned and increasingly difficult to protect. The committee believes, given the increasingly challenging operating environments our potential adversaries are presenting, it is prudent to explore options for optionally unmanned and more survivable tankers that could operate autonomously as part of a large, dispersed logistics fleet that could sustain attrition in conflict. Consequently, the committee directs the Secretary of the Air Force to prototype a contested environment tanker.

Accordingly, the committee recommends an increase of \$10.0 million, for a total of \$38.4 million in RDT&E, Air Force, PE 64776F, for prototyping a contested environment tanker.

Hypersonic Conventional Strike Weapon

The budget request included \$40.2 billion in Research, Development, Test and Evaluation (RDT&E), Air Force, of which \$1.2 billion was for PE 64858F Tech Transition Program.

The committee, in consultation with the Air Force, believes this program can be accelerated.

Therefore, the committee recommends an increase of \$100.0 million, for a total of \$1.4 billion, in RDT&E, Air Force, PE 64858F, Tech Transition Program.

Technology transition program

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$1.2 billion was for PE 64858F technology transition.

The committee supports the Assistant Secretary of the Air Force for Acquisition, Technology, and Logistics intent to accelerate the Air Force Research Laboratory's Low-Cost Attributable Aircraft Technology (using technology from the Strategic Capability Office's Avatar program) for collaborative pairing with manned platforms, potentially including the F-35. The committee views the combined application of commercial "smart" technology, autonomy, and artificial intelligence as imperative for solving current military challenges. Teams of low-cost collaborative systems provide new mechanisms to ensure survivability and mission success without leveraging exquisite technology and its associated high cost and long development timelines.

Accordingly, the committee recommends an increase of \$80.0 million, for a total of \$1.4 billion, in RDT&E, Air Force, PE 64858F, for low cost attributable aircraft prototype transition.

Air Force supply chain innovation

The budget request included \$40.2 billion in Research, Development, Test and Evaluation (RDT&E), Air Force, of which \$1.2 billion was for PE 64858F technology transition.

The committee is supportive of the Assistant Secretary of the Air Force for Acquisition, Technology, and Logistics' initiative to focus resources on increasing innovation within the Air Force's supply chain. Though constituting approximately 70% of the Air Force's budget, sustainment receives few resources for new technology development—predictive analytics, agile manufacturing, digital engineering, and artificial intelligence—to drive down costs. Given current aircraft availability shortfalls, the committee urges the Air Force to focus on the consolidation of technology development, applications to current availability challenges, and transitioning to the depots, all while developing and equipping the sustainment workforce.

Accordingly, the committee recommends an increase of \$42.8 million, for a total of \$1.4 billion, in RDT&E, Air Force, PE 64858F, for Air Force supply chain innovation.

Contracting Information Technology System

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$17.6 million was for PE 91410F Contracting Information Technology System.

The committee is concerned about duplication among the Services in contract writing systems.

Accordingly, the committee recommends a decrease of \$17.6 million, for a total of \$0.0 million, in RDT&E, Air Force, PE 91410F.

Advanced Battle Management System

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$207.7 million was for PE 64281F Tactical Data Networks Enterprise.

As part of its movement towards an Advanced Battle Management System, the Air Force has indicated the need to increase the capability of its communications and data links. The committee strongly supports efforts to increase the capability of our information links. The committee also strongly supports efforts to accelerate capabilities that will make our forces more relevant and effective at deterring, and, if necessary, defeating a peer adversary.

Therefore, the committee recommends an increase of \$50.0 million, for a total of \$257.7 million, in RDT&E, Air Force, PE 64281F, for Agile Communications, High Capacity Backbone and Link 16 Enhancements in order to accelerate the Advanced Battle Management System.

JSTARS recap radar

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$0.0 was for PE 37581F for the JSTARS Recapitalization.

The committee is concerned that the Air Force's decision to cancel the JSTARS Recapitalization program leaves in limbo the continued development of the Recap radar, for which the Air Force has spent years and millions of dollars bringing to its current maturity. The committee supports the Air Force's move to an Advanced Battle Management System but is apprehensive about the Air Force's proposal to divest existing capability in the current JSTARS aircraft while its plan for future capability remains aspirational. The risk, if not likelihood, of a significant capability gap warrants mitigation.

As the Air Force evolves its view of what the Advanced Battle Management System entails and begins to bring capability online, the committee believes that it is prudent to continue development of the Recap radar to explore further potential uses and provide the Air Force with options.

Therefore, the committee recommends an increase of \$50.0 million, for a total of \$50.0 million, in RDT&E, Air Force, PE 37581F, for continued Ground Moving Target Indicator radar development.

Major Test and Evaluation Management

The budget request included \$10.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$91.8 million was for PE 64759F, Major Test and Evaluation (T&E) Investment.

The committee notes the importance of test and evaluation infrastructure to bring mature capabilities to the warfighter.

Accordingly, the committee recommends an increase of \$15.0 million, for a total of \$106.8 million, in RDT&E, Air Force, PE 64759F, to fund improvements for Air Force test infrastructure.

Air Force Integrated Personnel and Pay System

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$47.3

million was for PE 65018F Air Force Integrated Personnel and Pay System (AF-IPPS).

The committee is concerned about the lengthy timeline for delivery of capability to users. The committee encourages the Department of Defense to adopt modern software development practices that deliver capabilities to users in shorter increments and timelines. Best practices for incremental development call for delivering functional capabilities to the end-user at intervals of 6 months or less. However AF-IPPS does not plan to delivery any capability to users until fiscal year 2021. The committee feels that the use of modern, commercial acquisition practices is especially important to support critical management, personnel and pay activities.

Accordingly, the committee recommends a decrease of \$34.1 million, for a total of \$13.2 million, in RDT&E, Air Force, PE 65018F.

B-52

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$280.4 million was for PE 11113F for B-52 system improvements.

The Air Force has requested a transfer of \$14.8 million from Aviation Procurement, Air Force (APAF) to this PE.

Therefore, the committee recommends an increase of \$14.8 million, for a total of \$295.2 million, in RDT&E, Air Force, PE 11113F, for B-52 system improvements.

Airborne Early Warning and Control System

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$120.7 million was for PE 27417F for the Airborne Warning and Control System (AWACS).

As part of its movement towards an Advanced Battle Management System, the Air Force has indicated the need to increase the capability of its AWACS aircraft through advanced communications, networking, and sensor capabilities. The committee believes these capabilities should be accelerated.

Therefore, the committee recommends an increase of \$10.0 million, for a total of \$130.7 million, in RDT&E, Air Force, PE 27417F for E-3 Advanced Battle Management and Surveillance Bridge Capabilities.

Maintenance, Repair, and Overhaul System

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$50.9 million was for PE 78055F Maintenance, Repair, and Overhaul System.

The committee is concerned about the lengthy delivery timeline for this program, going multiple years without delivering capability to the end-user. The committee notes that for many IT programs and activities the Department has been slow to adopt modern, commercial “agile” acquisition practices. In many programs the Department is still using dated and slower IT development and deployment practices—which usually end up being more costly and delivering out-of-date software products.

Accordingly, the committee recommends a decrease of \$35.1 million, for a total of \$15.8 million, in RDT&E, Air Force, PE 78055F.

Defense Enterprise Accounting Management System Increment 2

The budget request included \$40.2 billion in Research, Development, Test, and Evaluation (RDT&E), Air Force, of which \$99.7 million was for PE 91538F Financial Management Information Systems Development, including \$11.8 million for Defense Enterprise Accounting Management System Increment Two.

The committee is concerned about the lengthy delivery timeline for this program, going multiple years without delivering capability to the end-user. The committee notes that for many information technology (IT) programs and activities the Department has been slow to adopt modern, commercial “agile” acquisition practices. In many programs the Department is still using dated and slower IT development and deployment practices—which usually end up being more costly and delivering out-of-date software products.

Accordingly, the committee recommends a decrease of \$11.8 million, for a total of \$87.9 million, in RDT&E, Air Force, PE 91538F.

Defense Wide

Defense Advanced Research Projects Agency defense research sciences

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$422.1 million was for PE 61101E defense research sciences.

The committee recognizes that the Defense Advanced Research Projects Agency’s defense research sciences program element provides the technical foundation for long-term national security through the discovery of new phenomena and exploration for defense applications. The committee is especially encouraged by the materials sciences work in this activity.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$427.1 million, in RDT&E Defense-wide, PE 61101E.

Critical materials

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$422.1 million was for PE 61101E defense research sciences.

The committee recognizes the work done by the Critical Materials Institute (CMI) to focus on technologies that make better use of rare earth materials and eliminate the need for rare earth materials that are subject to supply disruptions. Therefore, the committee urges the Defense Advanced Research Projects Agency to work closely with entities such as CMI to further its own research on critical materials related to Department of Defense needs.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$424.6 million, in RDT&E, Defense-wide, PE 61101E, for critical materials research.

Defense-wide quantum information sciences

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$42.7 million was for PE 61110D8Z basic research initiatives.

The committee notes the transformative potential of quantum information sciences, with potential impacts across disciplines as diverse as cryptography and sensing. In competition with near-peer adversaries, such cutting-edge technology will become increasingly critical.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$49.7 million, in RDT&E, Defense-wide, PE 61110D8Z, for quantum information sciences.

Basic research initiatives

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$42.7 million was for PE 61110D8Z basic research initiatives.

The committee notes that basic research activities focused in technical areas of interest to Department of Defense missions lay the foundation upon which other technology development and new defense systems are built. Basic research activities fund efforts at universities, small businesses, and government laboratories. These investments also serve to help train the next generation of scientists and engineers who may work on defense technology problems in government, industry, and academia.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$49.7 million, in RDT&E, Defense-wide, PE 61110D8Z.

Activities to determine more effective personal protective equipment against blast injury

The budget request included \$708.1 million in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, for Basic Research, of which \$47.8 million was for PE 61117E Basic Operational Medical Research Science.

The committee remains concerned about the prevalence of mild and severe Traumatic Brain Injury (TBI) among servicemembers. Servicemembers exposed to repetitive concussive events or severe TBI due to repeated blasts and blast injuries are at high risk for long-term negative consequences to brain health, including the development of chronic neuro-degenerative disease.

Accordingly, the committee recommends an increase of \$10.0 million, for a total of \$57.8 million, in RDT&E, Defense-wide, for Basic Research, PE 61117E, for Basic Operational Medical Research Science to conduct activities to determine the most effective personal protective equipment against blast injury. The provision authorizing such activities is contained in this title.

Joint munitions program

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$19.1 million was for PE 62000D8Z joint munitions program.

The committee is encouraged by the program element's mission of developing joint enabling technologies that can be used by the

Program Executive Officers as they develop their specific weapon programs. As expressed in the National Defense Strategy, future conflicts will increasingly require a joint perspective in these types of technology areas.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$21.6 million, in RDT&E, Defense-wide, PE 62000D8Z, for insensitive munitions.

Applied research for the advancement of science and technology priorities

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$60.6 million was for PE 62251D8Z applied research for the advancement of science and technology priorities.

Though the committee is supportive of prototyping and early launch of science and technology applied research projects to shape investments, the committee is concerned with the large growth for this program element, given that the request was \$11.0 million lower in the previous budget request.

Accordingly, the committee recommends a decrease of \$7.5 million, for a total of \$53.1 million, in RDT&E, Defense-wide, PE 62251D8Z.

Tactical technology

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$335.4 million was for PE 62702E tactical technology.

In accordance with the National Defense Strategy, the committee is supportive of developing new concepts and technologies to enhance the next generation of tactical systems. The committee urges the Defense Advanced Research Projects Agency to continue efforts in Advanced Tactical Technology and Aeronautics Technology.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$337.9 million, in RDT&E, Defense-wide, PE 62702E.

Multi-Azimuth Defense Fast Intercept Round Engagement System

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$335.4 million was for PE 62702E tactical technology.

The committee notes that a number of efforts in this program element are proposed for significant growth at a time when similar activities in the Services and the Strategic Capabilities Office are also growing. At the same time, the committee is concerned that the Defense Advanced Research Projects Agency appears to be undertaking some of these efforts without sufficient coordination with the defense research community.

The committee notes particularly that the Multi-Azimuth Defense Fast Intercept Round Engagement System (MAD-FIRES), while potentially capable, faces an uncertain transition future due to the complexity involved with installation deployment and practical limitations on its use. In addition, the committee notes that

the Navy has not yet signed on as a transition partner despite the potential application to naval warfare.

Accordingly, the committee recommends a decrease of \$5.0 million, for a total of \$330.4 million, in RDT&E, Defense-wide, PE 62702E, for MAD-FIRES.

Materials and biological technology

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$226.8 million was for PE 62715E materials and biological technology.

The committee is concerned with the lack of transition plans for some technologies in Functional Materials and Devices and by the significant growth within Accelerating Discovery and Innovation without a clear justification.

Accordingly, the committee recommends a decrease of \$15.0 million, for a total of \$211.8 million, in RDT&E, Defense-wide, PE 62715E.

Combating terrorism technology support

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$125.2 million was for PE 63122D8Z combating terrorism technology support.

Despite recognizing the immense contributions of this program element to technological advancements over the past decades, the committee recognizes that in order to embrace the strategic goals laid out by the National Defense Strategy, funding for science and technology should move toward potential applications to near-peer adversaries. Further, the committee is concerned with the large growth between the budget request for the previous year and this year's request.

Accordingly, the committee recommends a decrease of \$14.0 million, for a total of \$111.2 million, in RDT&E, Defense-wide, PE 63122D8Z.

Advanced aerospace systems

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$227.6 million was for PE 63286E advanced aerospace systems.

At his confirmation hearing, the recently confirmed Under Secretary of Defense for Research and Engineering emphasized the urgent need for American progress on hypersonic weapons. This program element includes the Hypersonic Air-breathing Weapon Concept as a joint Air Force and Defense Advanced Research Projects Agency (DARPA) effort, in addition to Tactical Boost Glide, another joint Air Force and DARPA effort. Both of these technologies represent promising progress, and the committee urges the DARPA to increase its focus on their development.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$232.6 million, in RDT&E, Defense-wide, PE 63286E.

Blackjack

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$15.0 million was for PE 63287E Blackjack program.

The committee notes that funding for a Blackjack on-orbit demonstration is the Air Force's highest unfunded priority. The committee believes that the successful demonstration of a proliferated constellation of satellites in Low Earth Orbit would have profound implications for the resiliency and survivability of critical space missions.

The committee recommends an increase of \$110.0 million, for a total of \$125.0 million, in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, PE 63287E, to accelerate a cooperative on-orbit demonstration of the co-orbiting military missile warning constellation embedded within the commercial LEO mega-constellation and space-cloud network infrastructure. The committee directs the Air Force and DARPA to work with the Missile Defense Agency (MDA) to assess the potential for meeting MDA's space-based requirements on such a constellation.

Defense Innovation Unit Experimental

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$29.3 million was for PE 63342D8W Defense Innovation Unit Experimental (DIUx).

In its short tenure, DIUx has filled a critical niche between emerging technology firms and the Department of Defense. Over the coming year, the committee urges DIUx to consider the metrics by which it measures its success and its role in the full research and engineering enterprise that the Department operates.

Accordingly, the committee recommends an increase of \$0.5 million, for a total of \$29.8 million, in RDT&E, Defense-wide, PE 63342D8W.

Networked communications capabilities

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$12.7 million was for PE 63662D8Z networked communications capabilities.

Despite the importance of this mission, the committee is concerned about potential duplication of this program element's activities with those of the Services and urges closer coordination with similar programs instead of more funding within this line.

Accordingly, the committee recommends a decrease of \$7.5 million, for a total of \$5.2 million, in RDT&E, Defense-wide, PE 63662D8Z.

Enhancing cybersecurity for small vendors

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$114.6 million was for PE 63680D8Z, the Defense-wide manufacturing science and technology program.

Cyber vulnerabilities faced by the defense industrial base are a threat to national security. If cybersecurity vulnerabilities remain

unaddressed, defense supply chains face a higher likelihood of harboring serious and exploitable vulnerabilities. Moreover, many small firms have a significant lack of awareness of the Department of Defense's (DOD) cybersecurity requirements, which all DOD suppliers must meet.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$119.6 million, in RDT&E, Defense-wide, PE 63680D8Z, for cybersecurity protection of small vendors.

Defense-wide manufacturing science and technology program

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$114.6 million was for PE 63680D8Z Defense-wide manufacturing science and technology program.

The Advanced Electronics and Optics program is a series of efforts addressing advanced manufacturing technologies with a wide range of applications. Additional funds can support development of advanced thin-film filters for eyewear, providing laser protection and rapid adjustment to changing light, improving warfighter visibility and adaptability.

Accordingly, the committee recommends an increase of \$2.0 million, for a total of \$116.6 million, in RDT&E, Defense-wide, PE 63680D8Z, for eye protection systems.

Defense Logistics Agency manufacturing technology program

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$49.7 million was for PE 63680S manufacturing technology.

The committee notes the critical importance of improving manufacturing capability through a product's life cycle and applauds this program for providing low-risk technology implementation for small businesses and defense unique suppliers. The program's focus on maintaining viable supply sources and improving manufacturing processes have resulted in particularly large savings for the Department of Defense.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$52.3 million, in RDT&E, Defense-wide, PE 63680S.

Defense Logistics Agency generic logistics research and development technology demonstrations

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$11.8 million was for PE 63712S generic logistics research and development technology demonstrations.

The committee notes the critical importance of logistics, especially given the National Defense Strategy's assumption that future operating environments will be contested. The committee urges prototyping and demonstrations in order to quickly test capabilities that might hold promise for future operational concepts.

The committee notes that for many years the Department of Defense has been developing various innovative technologies such as

autonomous vehicles, unmanned aircraft systems, additive manufacturing, and robots to help support a wide variety of mission needs. Some of these technologies could significantly improve combat capability and help save and preserve the lives of warfighters by performing similar duties on the battlefield. Autonomous vehicles could be used to move convoys of vehicles carrying water, fuel, and other supplies through dangerous areas without putting warfighters directly at risk. The committee understands that the Services have been working on these and other technologies to also enhance the Department's global supply chain.

The committee encourages the Services to jointly develop and share new technology gains and breakthroughs so that all the Services can benefit from more technologically advanced supply chain capabilities. Additionally, while leveraging the latest technologies can help address global supply chain needs, the committee notes the importance of monitoring, regulating, and managing the potential risks from innovative technologies.

Accordingly, the committee recommends an increase of \$1.0 million, for a total of \$12.8 million, in RDT&E, Defense-wide, PE 63712S.

Strategic Environmental Research and Development Program and Environmental Security Technology Certification Program increases

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$77.7 million was for the PE 63716D8Z Strategic Environmental Research and Development Program (SERDP) and \$58.6 million was for the PE 63851D8Z Environmental Security Technology Certification Program (ESTCP).

The committee notes that both SERDP and ESTCP demonstrate and validate the most promising innovative technologies that can meet the Department's most urgent requirements, provide a return on investment, and are executed through a free and open competition.

Accordingly, the committee recommends an increase of \$10.0 million in RDT&E, Defense-wide, PE 63716D8Z, for SERDP, and an increase of \$10.0 million in RDT&E, Defense-wide, PE 63851D8Z, for ESTCP for respective totals of \$87.7 million and \$68.6 million.

The committee strongly encourages the Department to use the increases in SERDP and ESTCP to address the following: (1) To help ensure the safety and welfare of the servicemembers and their dependents by eliminating or reducing the generation of pollution and use of hazardous materials and reducing the cost of remedial actions and compliance with environmental laws and regulations, specifically as it relates to per- and polyfluoroalkyl substances; (2)

To develop, demonstrate, validate, and field fluorine-free fire-fighting foam; (3) To meet long-term environmental threats and sustain training and testing ranges; (4) To advance sustainable technologies and bio-based products that meet military requirements; and (5) To advance other technologies deemed appropriate.

Microelectronics technology development and support

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$168.9 million was for PE 63720S manufacturing technology.

The committee notes that the Tunable Filter Program focuses on advancement of microelectronic tunable thin film filters to provide greater functionality for wireless communications systems at reduced cost, size, weight, and power demand. The budget request includes insufficient funds to continue this program, critical to development of next-generation communications systems.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$173.9 million, in RDT&E, Defense-wide, PE 63720S.

Advanced electronics technologies

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$111.0 million was for PE 63739E advanced electronics technologies.

The committee understands the importance of microelectronics fabrication, and, in particular, the Beyond Scaling Advanced Technologies project, which focuses on large scale co-development with industry as well as the design and capture of advanced intellectual property (IP) architectures, IP sharing, and access to foundries. The committee urges coordination between this effort and similar ongoing complementary work in the Office of the Secretary of Defense.

Accordingly, the committee recommends an increase of \$7.5 million, for a total of \$118.5 million, in RDT&E, Defense-wide, PE 63739E, for Electronics Resurgence Initiative.

Network-centric warfare technology

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$483.5 million was for PE 63766E network-centric warfare technology.

Though the committee appreciates the importance of network-centric warfare for the future battle environment, the committee is concerned about the potential for transition of some of the projects within this program element. The committee is specifically concerned with tactical exploitation of the acoustic channel.

Accordingly, the committee recommends a decrease of \$10.0 million, for a total of \$473.5 million, in RDT&E, Defense-wide, PE 63766E.

Sensor technology

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$190.1 million was for PE 63767E sensor technology.

The committee recognizes the threat posed by multiple small unmanned aerial systems beyond the line-of-sight. Therefore, the committee is encouraged by the mission and progress of projects like Aerial Dragnet and encourages collaboration with similar efforts occurring elsewhere in the Department of Defense.

The committee recommends an increase of \$1.5 million, for a total of \$191.6 million, in RDT&E, Defense-wide, PE 63767E, for sensor technology.

Quick reaction special projects

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$69.6 million was for PE 63826D8Z quick reaction special projects.

The committee is concerned about the duplication of activities within this program element elsewhere in the Department of Defense. The committee is particularly concerned about the ability of the Rapid Reaction Fund to achieve its stated mission.

Accordingly, the committee recommends a decrease of \$10.0 million, for a total of \$59.6 million, in RDT&E, Defense-wide, PE 63826D8Z.

Test and evaluation science and technology related to hypersonics and directed energy

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$96.3 million was for PE 63941D8Z test and evaluation science and technology.

Given the importance of hypersonic weapons and directed energy to the execution of the National Defense Strategy, establishing high quality testing facilities for these systems should be a high priority for the Department of Defense. Too often, these supporting functions are forgotten and research suffers for lack of test facility capacity.

Accordingly, the committee recommends an increase of \$10.0 million, for a total of \$106.3 million, in RDT&E, Defense-wide, PE 63941D8Z, for hypersonics and directed energy test.

Test and evaluation science and technology workforce development

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$96.3 million was for PE 63941D8Z test and evaluation science and technology.

The committee recognizes the integral importance of test and evaluation to successful science and technology development. The committee urges the Department of Defense to prioritize supporting capabilities that will enable technological progress—namely, investment in the workforce qualified in these disciplines. Research across disciplines depends on the engagement of experienced and qualified personnel.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$101.3 million, in RDT&E, Defense-wide, PE 63941D8Z, for workforce development.

Operational energy capability improvement

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$40.5 million was for the PE 64055D8Z Operational Energy Capability Improvement Fund (OECIF).

The committee continues to recognize the urgent requirement to constantly innovate and improve combat capability and operational effectiveness for the warfighter, via targeted and competitive operational energy science and technology investments.

Accordingly, the committee recommends an increase of \$10.0 million, for a total of \$50.5 million, in RDT&E, PE 64055D8Z, for OECIF.

Specifically, the committee strongly encourages the Department to use the OECIF and increase in funding to address the following urgent concerns: deployable technologies that can harvest water from air, tactical microgrids, sustainable forward operating bases, alternative energy storage in contested environments, waste to energy technologies that are necessary given the continual challenge of open-air burn pits, joint infantry company prototypes, long-endurance unmanned aerial vehicles, and other technologies deemed appropriate.

National Security Innovation Activities

The budget request included \$3.7 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, for advanced technology development.

The committee remains concerned about foreign investment in emerging hardware technologies with potential national security applications that are produced by United States companies.

Accordingly, the committee recommends an increase of \$150.0 million to Research, Development, Test, and Evaluation (RDT&E), Defense-wide, line number to be determined, to conduct activities to establish interactions between the Department of Defense and the commercial technology industry and academia with the goal of encouraging private investment in specific hardware technologies of interest to future defense technology needs with unique national security applications. The provision authorizing such national security innovation activities is contained in this Act.

Corrosion control and prevention funding increase

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$3.8 million was for the PE 604016D8Z Department of Defense (DOD) Corrosion Program.

The committee continues to be concerned that the Department has consistently underfunded the DOD Corrosion Program since fiscal year 2011. The DOD estimates that the cost to prevent and mitigate corrosion of its assets, including military equipment, weapons, facilities, and other infrastructure, is approximately \$22.9 billion.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$8.8 million, in RDT&E, Defense-wide, PE 604016D8Z, for the DOD Corrosion Program.

Trusted and assured microelectronics

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of \$233.1 million was for PE 64294D8Z trusted and assured microelectronics.

The committee remains concerned about manufacturing supply chain assurance against counterfeit parts and ensuring ready access to trusted microelectronics. The committee notes its desire for a long-term strategy for the development of trusted microelectronics that can withstand any future problems with an international supply chain.

Accordingly, the committee recommends an increase of \$5.5 million, for a total of \$238.1 million, in RDT&E, Defense-wide, PE 64294D8Z, for new trusted approach development.

Defense Contract Management Agency information technology development

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$12.0 million was for PE 65013BL, Information Technology Development.

The committee is concerned about the lengthy delivery timeline for this program, going multiple years without delivering capability to the end-user. The committee notes that for many information technology (IT) programs and activities the Department has been slow to adopt modern, commercial “agile” acquisition practices. In many programs the Department is still using dated and slower IT development and deployment practices—which usually end up being more costly and delivering out-of-date software products.

Accordingly, the committee recommends a reduction of \$12.0 million, for a total of \$0.0 million, in RDT&E, Defense-wide, PE 65013BL.

Deputy Chief Management Officer policy and integration

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$2.1 million was for PE 65075D8Z Deputy Chief Management Officer (DCMO) Policy and Integration.

The committee recognizes that the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115–91) gave the Office of the Chief Management Officer significantly increased responsibilities for data management and integration across the Department of Defense. Based on this new mission, the committee encourages the Department to invest in improved data processing and analytics tools to fulfill its expanded responsibilities.

Accordingly, the committee recommends an increase of \$1.0 million, for a total of \$3.1 million, in RDT&E, Defense-wide, PE 65075D8Z, for data and advanced analytics.

Defense-wide electronic procurement capabilities

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$6.4 million was for PE 65210D8Z for Defense-wide Electronic Procurement Capabilities.

The committee is concerned about duplication among the Services in contract-writing systems. The committee encourages the program to consolidate requirements for contract-writing systems across the department.

Accordingly, the committee recommends a decrease of \$6.4 million in RDT&E, Defense-wide, PE 65210D8Z, for a total of \$0.0 million.

Trusted and assured microelectronics engineering and manufacturing development

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$56.2 million was for PE 65294D8Z trusted and assured microelectronics.

The committee remains concerned about manufacturing supply chain assurance against counterfeit parts and ensuring ready access to trusted microelectronics. The committee notes its desire for a long-term strategy for the development of trusted microelectronics that fulfill Department of Defense needs.

Accordingly, the committee recommends an increase of \$2.5 million, for a total of \$58.7 million, in RDT&E, Defense-wide, PE 65294D8Z.

Hypersonic experimentation facilities

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$258.7 million was for PE 64940D8Z, Central Test and Evaluation Investment Development (CTEIP).

The committee is encouraged by the priority the Department of Defense has placed on hypersonic capability development. However, the committee remains concerned that the United States may face a shortfall in advanced hypersonic experimentation facilities. The committee recognizes the important role that wind tunnels play in research development, and believes that the Department should make investments in hypersonic test and experimentation facilities that leverage the capabilities of academic institutions, government laboratories, and Industry teams to perform the necessary applied research.

Accordingly, the committee recommends an increase of \$10.0 million, for a total of \$268.7 million, in RDT&E, Defense-wide, PE 64940D8Z, for hypersonic experimentation facilities.

Joint mission environment test capability

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$84.2 million was for PE 65100D8Z joint mission environment test capability.

The committee shares the view, repeatedly cited across the Department of Defense, that the lack of cyber range capacity, connectivity, and adequate interoperability is negatively impacting the military's ability to train in seamless, operationally realistic cyberspace environments and poses one of the greatest cyber challenges to the joint force.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$89.2 million, in RDT&E, Defense-wide, PE 65100D8Z, for cyber range capacity and development. These funds will allow for the construction of additional cyber range capacity and connectivity and support the Department's cyber ranges by im-

proving their cyber range architectures, instrumentation, standards, and workforce.

Technical studies, support and analysis

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$22.6 million was for PE 65104D8Z technical studies, support and analysis.

The committee urges the Department of Defense to make use of a broader set of analytic capabilities, including those at not-for-profit research organizations and think tanks, universities, and in-house laboratories to support these types of analyses.

Accordingly, the committee recommends a decrease of \$5.0 million, for a total of \$17.6 million, in RDT&E, Defense-wide, PE 65104D8Z.

Developmental Test and Evaluation

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$20.2 million was for PE 65804D8Z, Developmental Test and Evaluation.

The committee notes that software is becoming an increasingly important part of weapons systems and requires matching test capabilities.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$25.2 million, in RDT&E, Defense-wide, PE 65804D8Z, to improve software testing capabilities.

Policy research and development programs

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$6.3 million was for PE 35186D8Z policy research and development programs.

The committee urges closer coordination with similar efforts elsewhere in the Department of Defense and across the intelligence community. The committee is also concerned about the growth in this request over past years.

Accordingly, the committee recommends a decrease of \$3.0 million, for a total of \$3.3 million, in RDT&E, Defense-wide, PE 65186D8Z.

Personnel security and continuous evaluation innovation

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$5.6 million was for PE 35327V insider threat.

The committee notes that the National Defense Authorization Act for Fiscal Year 2018 (Public Law 115–91) directed the Defense Security Service to undertake an additional mission of background investigations and personnel security for Department of Defense (DOD) personnel. Elsewhere in this Act, the committee directed the DOD to engage with cutting-edge technology entities in order to advance existing capabilities related to personnel security, and this funding is meant to complement that directive.

Accordingly, the committee recommends an increase of \$5.0 million, for a total of \$10.6 million, in RDT&E, Defense-wide, PE

35327V, for personnel security and continuous evaluation innovation.

Director, Operational Test and Evaluation cyber projects

The budget request included \$22.0 billion in Research, Development, Test, and Evaluation (RDT&E), Defense-wide, of which \$71.0 million was for PE 65814OTE, Operational Test Activities and Analyses.

The committee notes that cybersecurity is an increasingly important matter for programs. As technologies and systems become more complex, the Department must augment investments in test and evaluation technologies.

Accordingly, the committee recommends an increase of \$10.9 million, for a total of \$81.9 million, for PE 65814OTE, Operational Test Activities and Analyses.

Items of Special Interest AC-

130J High Energy Laser

The committee recommends full authorization of the \$34.0 million requested in fiscal year 2019 for the U.S. Special Operations Command (USSOCOM) AC-130J High Energy Laser (HEL) program intended to deliver a 60 kilowatt laser for operational assessment during fiscal year 2022. However, the committee is concerned that the future year's defense program for fiscal years 2020 through 2022 does not project sufficient funds for the completion of this effort and an additional \$62.0 million will be required to integrate, test, and assess the laser weapons system in the coming years.

As noted in testimony before the committee, the advanced state of the HEL technology may permit an expedited schedule of integration, testing, and operational assessment of this weapon system. The committee believes that the Department should make the investment necessary to field this potentially transformative capability as soon as possible.

For fiscal year 2018, the committee notes that the Air Force and the Rapid Reaction Technology Office has committed to providing a total of \$29.0 million to complement the \$15.6 million allocated by USSOCOM for the AC-130J HEL effort. The committee strongly supports continued joint funding of this program given the significant potential application of HEL capabilities beyond special operations missions and the need to ensure integration with other HEL-related efforts across the Department.

Therefore, the committee directs the Under Secretary of Defense for Research and Engineering, in coordination with the Assistant Secretary of Defense for Special Operations and Low-Intensity Conflict, to submit a plan for fully funding the AC-130J HEL program in fiscal years 2020 to 2022 with the Department's budget request for fiscal year 2020.

Acoustic Threat Detection

The committee supports ongoing efforts by the Army to develop and operationally test acoustic threat detection technologies and is supportive of the continued deployment of these systems in Afghan-

istan and other locations to aid of combat operations. However, the committee is concerned about increased threats from unmanned aerial systems to forward operating bases. The committee encourages the Army to develop and operationally test sensor systems that can accurately detect and geo-locate both ground and air threats.

Therefore, not later than 60 days after the enactment of this Act, the committee directs the Secretary of the Army to provide to the congressional defense committees a briefing on existing threat detection technologies and capabilities, results of exercises and deployed operational testing, technologies available to detect both ground and air threats using a single integrated system, and the ability to accelerate the development and fielding of this technology to a program of record.

Active Protection System for Abrams, Bradley, Stryker

The committee notes that the Army's M1 Abrams Tank will be upgraded with the Trophy Active Protection System (APS), which has already been used in battle to protect the Israel Defense Forces Merkava tanks.

The National Defense Authorization Act for Fiscal Year 2018 (Public Law 115–91) provided \$138.7 million in funding for one brigade in Europe and another \$171.0 million in an unfunded requirement for more APSs that could be used for Trophy for the Korean theater. The budget request included \$617.5 million that would support funding the procurement of 282 APSs and countermeasures for the Abrams tanks.

The Committee strongly supports the President's Budget Request for APS for Abrams, Bradley, and Stryker.

Additive manufacturing within the military departments

The committee remains strongly supportive of the Department of Defense's efforts to leverage additive manufacturing (AM) processes and applications in order to improve the Department's capabilities and materiel readiness. The committee strongly encourages the Department to pursue AM in order to augment the current supply chain, achieve shorter lead times compared to traditional manufacturing methods, negate the impact of obsolete or out-of-production sources of supply, and reduce costs and weight at the point of need.

The committee recognizes that the requirement to certify and qualify AM parts and components remains a fundamental challenge to broader and more rapid use of AM capabilities across the military departments. The committee is encouraged by the formation of the Joint AM Steering Group and Joint AM Working Group and encourages them to work with the Services to identify AM best practices. The committee also encourages the Services to continue advancing the qualification, certification, and integration of AM parts into the supply chain. The committee believes that the Services should continue to develop requirements and training necessary at the levels of warfighter, artisan, and acquisition officer. The Department must also ensure that any technical data and intellectual property related to AM parts are appropriately protected.

Advanced countermeasure dispenser system for 4th generation/legacy aircraft

The committee is aware that potential adversaries are making significant improvements in their ability to detect, target, and engage U.S. tactical aircraft across the infrared (IR) and radio frequency (RF) spectrum. Fourth-generation, “legacy aircraft”, are particularly vulnerable and, as they will form a significant portion of our tactical aircraft inventory for decades to come, their survivability will be increasingly challenged.

Legacy aircraft must include the ability to counter these emerging threats through readily-available and quickly-integrated means, including advance IR/RF expendable countermeasures and more capable dispensing systems.

Therefore, the committee strongly supports investment to sustain the survivability of our 4th generation tactical aircraft, including advanced countermeasures and their associated dispensing systems.

Advanced hull technology

The committee understands that the Navy may be making greater use of small planing boats to counter asymmetrical threats. The committee has supported the Navy’s investment in sophisticated computer hydrodynamic modeling and simulation tools for design, testing, and analysis of high-performance and high-efficiency hull forms.

The committee encourages the Navy to increase its investment in an advanced hull form development and prototype demonstration initiative and at sea testing to accelerate the development and transition of advanced hull designs, particularly hull forms that reduce injury to small craft operators and warfighters.

Advanced low-weight body armor report

The committee is aware that next generation body armor technology, including ultra-high molecular weight polyethylene, may provide maximum protection against a wide range of ballistics threats in a lighter, more flexible application that enhances comfort, mobility, and safety. Furthermore, high performance lightweight body armor technology could successfully protect warfighters, and with a range of modern lightweight, low-profile material grades, next generation body armor may offer a practical solution for all soldiers. The Under Secretary of Defense for Research and Engineering, in conjunction with the service secretaries, is directed to submit a report to the congressional defense committees not later than 90 days after the enactment of this Act. The report should describe the Department’s efforts to make available ultra-high molecular weight polyethylene and other next generation body armor technologies, including for vests, helmets and inserts. The report should also review technologies across the Services and highlight those that provide exceptional protective performance without compromising comfort, agility, or function.

Aerospace sensors

U.S. Air Force (USAF) and U.S. Navy front-line fighter aircraft are equipped with the Active Electronically Scanned Array (AESA)

radar with all services actively pursuing back fit of AESA radars on legacy aircraft. The USAF has identified threats from adversaries operating at frequencies where AESA's capabilities can be further improved and the USAF has tasked the Air Force Research Lab to lead the development of technologies that address these capability gaps. The Air Force's objective is to develop hardware that can be used across the services to address spectrum threats not only to AESA radars but threats to weapons, missile seekers, and other airborne platforms. The committee believes that dedicated resources to this program will result in newer, more capable arrays which will provide significant performance advantages, with wider frequency coverage. The committee encourages the Air Force to continue these efforts and provide resources as needed to develop newer, more capable arrays which will provide significant performance advantages.

Airless Tire Technology Demonstration

Special operations and other forces are heavily deployed across the world and will continue to be, in increasingly asymmetrical and unconventional warfare environments. The committee supports technology that will dramatically improve the mobility and safety of military personnel operating in hazardous environments, like non-pneumatic or airless tire technology. Airless tires can be superior to conventional tires in specific locations because they remain consistent in different atmospheric pressures and austere environments, are low maintenance, and require no additional inflation gauges or tools, saving weight and space for other essential equipment. The committee notes that an airless tire technology prototype has been developed and patented commercially and could be deployed in the next 18–24 months.

Army Assured Mobility in Northern Regions

Given the National Defense Strategy's emphasis on great power competition, the Committee is interested in the Army's plans for ensuring the mobility of Army ground vehicles in northern terrain environments to include the Arctic region and similar cold weather terrain. The Committee encourages the Secretary of the Army to ensure that ground vehicles are adequately prepared by conducting a series of experiments, if necessary, in these harsh northern environments, to include snow, ice, and muskeg. Such experiences could demonstrate science and technology capabilities to support future acquisition. Furthermore, the Secretary may develop a test plan to assess the current vehicle fleet and, if required, develop potential vehicle upgrades to support maneuver in northern regions that incorporate new hardware and software technologies.

Combat Vehicle Light Weight Development Program

The committee understands that legacy ground combat vehicles are struggling to meet performance requirements, especially survivability, due to the increasing threat and resulting armor applique weight increases. Developing lightweight combat vehicles is critical to warfighter effectiveness, fuel management, and mobility.

Therefore, the committee encourages the Department of Defense to accelerate research, development, and partnership activities in-

volving industry, government laboratories, and academia to accelerate development of lightweight materials and manufacturing methods for next generation ground combat vehicles.

The focus of the program should be on new, stronger, and lighter materials, multi-material manufacturing processes, innovative lightweight design methods, and technology transfer to develop a robust industrial base.

Comptroller General review of Department of Defense industry Independent Research and Development funding

The committee directs the Comptroller General of the United States to undertake a review of the Department of Defense's (DOD) industry Independent Research and Development (IR&D) funding. For nearly 80 years, the Department of Defense (DOD) has relied on industry IR&D as a key source of innovation to help maintain U.S. superiority on the battlefield. IR&D is initiated and conducted by defense contractors without direct DOD funding. Rather, IR&D costs are allowable as indirect expenses on contracts to the extent that they are allocable, fair, and reasonable.

To qualify as IR&D, the work must fall within the four following areas: (1) Basic research; (2) Applied research; (3) Development; and (4) Systems and other concept formulation studies. Further, the work must not be sponsored by a grant, required in the performance of a contract, or include technical effort expended in developing and preparing technical data specifically to support a submitted bid or proposal. The Defense Federal Acquisition Regulation (FAR) outlines additional IR&D requirements. Importantly, DOD's IR&D program offers participating industry firms the independence to decide which technologies to pursue, as long as these efforts are of potential interest to the DOD, as required by the Defense FAR Supplement. In recent years, however, the DOD and industry have cited communication gaps as having undermined their ability to validate that this linkage exists. Specifically, industry participants have lacked consistent visibility on DOD's investment priorities, and the DOD has lacked insight into industry IR&D projects.

The DOD has taken some steps to address the aforementioned gaps, including the creation of a Defense Innovation Marketplace website to facilitate IR&D communication. Nonetheless, the committee remains concerned that these actions may not provide sufficient guidance to maximize the impact of industry's IR&D investments for the DOD. The committee notes that the 2018 National Defense Strategy also highlights the need for additional changes to industry culture and investment sources in order to maintain DOD's technological advantage. Accordingly, the committee directs the Comptroller General of the United States to review DOD's IR&D efforts. This review should address: (1) DOD's policies and processes for managing IR&D, including how it structures contracts with industry partners to facilitate IR&D; (2) The levels and types of investment the DOD and industry have made in IR&D; (3) The benefits and incentives that IR&D offers to its industry participants; and (4) The innovation outcomes that the DOD and industry have obtained through IR&D. The review should also recommend improvements to DOD's IR&D efforts, as appropriate.

Defense Advanced Research Projects Agency Gremlins Air-Recoverable Unmanned Aerial Vehicle System

The committee is aware of the Defense Advanced Research Projects Agency (DARPA) led “Gremlins” research project focused on technologies enabling aircraft to launch volleys of affordable and reusable unmanned air systems (OAS), while reliably recovering them in mid-air. The committee is familiar with the persistent anti-access area denial (A2/AD) threat and believes that the project may develop a strategic tool in countering such tactics. The committee remains encouraged by the ongoing research and progress of the project, noting the award of a Phase 3 contract to support a feasibility demonstration in fiscal year 2019.

The committee encourages the Air Force to review and evaluate the Gremlins Program as the demonstrated capabilities mature, and develop a coordinated strategy with DARPA for potential transition of systems or technologies into Air Force programs. Considering the importance of overcoming A2/AD tactics by our adversaries, the committee expects the Air Force to keep the congressional defense committees updated on the Department’s plans for potential transition of this critical technology into a formal acquisition effort.

Department of Defense Laboratory talent management and succession planning

The committee shares concerns raised by the Defense Science Board that the Department of Defense laboratories should invest in succession planning, in order to ensure quality high-level staff. This concern is especially acute given the near-constant need to adapt to emerging technology. Laboratory directors should conduct a strategic planning process to ensure that high level personnel are serving in appropriate positions and that an adequate succession plan exists.

Diamond transistor technology for power conversion in combat infrastructure

The committee recognizes the Army’s ongoing need to reduce the size and weight and increase the power and efficiency of electrical power conversion and distribution systems used in combat and field deployable operations. The committee understands that diamond semiconductors offer the potential to potentially reduce the size and weight of these systems, provide significant gains in power and efficiency, and increase system survivability through enhanced electromagnetic pulse protection. The committee is encouraged by the interest shown by the U.S. Army Engineer Research and Development Center Combat Engineering Research Laboratory in investigating new techniques to build on previous efforts to produce diamond transistors, in trying to mature the technology to support potential device and product development, and believes more research effort in this field is warranted.

Fielding of radiation detection devices

The committee is encouraged by the Army’s efforts to field additional modern radiation detection devices, specifically AN/PDR-75A Radiac Sets (Personal Dosimeters), in order to reduce the current

readiness gap within the Active Army force structure. Although nearly fifty percent of Active Army forces do not yet have this relatively inexpensive, yet critical item of equipment, funding provided in fiscal year 2018 will allow the Army to reduce that shortfall significantly. The committee is further encouraged by the Army's efforts in fiscal year 2019 to develop and field the next-generation Joint Personal Dosimeter-Individual (JPDI). An individual dosimeter that includes immediate visual alert, measurement of radiation dose, and inclusion of a comprehensive, legal record and definitive proof of radiation exposure over a soldier's entire career is highly beneficial.

The committee encourages the Army to conduct a rigorous, fair, and open competition for this new system to ensure the very best dosimeter is developed and selected for deployment to soldiers worldwide in order to increase unit and individual survivability.

Hyper Velocity Projectile

The committee is aware that the Strategic Capabilities Office (SCO) is testing a Hyper Velocity Projectile (HVP), a next generation, common, low drag, guided projectile capable of completing multiple missions for Navy 5-inch guns, Army and Marine Corps 155-mm howitzers, and future electromagnetic (EM) railguns.

The committee understands that the development and fielding of HVP is a priority to address mission requirements for conventional cannon artillery, naval surface fire support, cruise missile defense, anti-ship warfare, and anti-aircraft warfare. The HVP will also be critical to future EM railguns, which could achieve projectile speeds of Mach 6, double that of conventional naval cannons and artillery.

The committee believes that the increased velocity, precision and extended range of the HVP will provide the Navy, Army, and Marine Corps with the capability to address a variety of current and future threats. Coupled with accurate guidance electronics, HVP could provide low cost mission effectiveness against current threats and the ability to adapt to future air and surface threats.

Therefore, the committee directs the Director of the Strategic Capabilities Office, in consultation with the Secretary of the Navy, the Secretary of the Army, and the Commandant of the Marine Corps, to submit a report to the congressional defense committees by December 31, 2018, on the status of the HVP program. The report should include when testing will complete and a description of how HVP could be fielded on current and future naval guns and cannon artillery, including the Extended Range Cannon Artillery (ERCA) Program.

Improved Turbine Engine Program

The committee commends the Army for moving forward with research and development for the Improved Turbine Engine Program (ITEP). The committee notes the importance of this critical program, which is intended to develop a more fuel-efficient and powerful engine for the current UH-60 Black Hawk and AH-64 Apache helicopter fleets. This new engine will substantially increase operational capabilities by increasing range and improving fuel efficiency, while reducing the logistics footprint, resulting in dramatically reduced operating and support costs.

Given the positive progress of this key program, the committee fully supports ITEP in fiscal year 2019.

Land-Based Anti-Ship Missile

The committee is concerned that the United States has no mobile, land-based anti-ship missile capability. The committee supports the Army's Long-Range Precision Fires modernization effort, in particular its Land-Based Anti-Ship Missile (LBASM) development. The ability to engage and sink enemy ships from as many domains as possible can be a critical capability in a contested maritime environment. The committee strongly encourages the Army to collaborate with the other Services on compatible sensor technology, fire control systems, and networks to maximize the joint force's ability to locate and successfully engage sea-based weapon systems. The committee directs the Secretary of the Army to brief the appropriate defense committees by December 31, 2018, on this program, including how the Services are cooperating and collaborating on this effort.

Military applications for Graphene

The committee understands that graphene is a promising material that possesses very significant levels of tensile strength, flexibility, transparency, conductivity, and other properties. The committee also understands that initial research demonstrates promising applications for graphene. The committee believes that the Department of Defense (DOD) should pursue research into materials that may provide competitive advantages, particularly against near-peer potential adversaries. The committee believes that the Department should evaluate potential military applications of graphene.

Not later than 180 days after the enactment of this Act, the Under Secretary of Defense for Research and Engineering, in consultation with the Director, Army Research Laboratory; Director, Navy Research Laboratory; and Director, Air Force Research Laboratory, shall provide to the congressional defense committees a report on potential military applications of graphene. The report shall include the following elements: (1) A description of DOD efforts to study graphene; (2) An assessment of the maturity of basic and applied research on graphene; and (3) The potential military applications of graphene for ship and aircraft coatings, land-based and space-based sensors, individual protective equipment, facility blast protection, water and fuel filtration, energy storage, and energy generation in photovoltaic cells.

Modernizing Towed 105 Artillery Systems

The committee understands that the Army is considering the procurement of a self-propelled 105mm howitzer that could increase the lethality and maintain the mobility of Infantry Brigade Combat Teams. The committee remains concerned about the proliferation of sophisticated quick-fire counter-battery systems, and believes that the system under consideration could provide a substantial improvement to the Army's deterrent posture in Europe. The committee is aware that the system under evaluation incorporates artillery soft recoil technology with existing 105mm artil-

lery systems and then further integrates these technologies onto a light tactical vehicle platform. This approach could enable the Army to achieve significant improvements in combat capability with only modest reinvestment of funding for current or future planned M119 modifications. The committee encourages the Army to continue to review this capability through the Army's cross-functional team or urgent operational needs processes.

Next Generation Health Monitoring System (NGHMS)

The committee is aware of the Army UH-72 Light Utility Helicopter (LUH) testing of the Next Generation Health monitoring system (NGHMS). The committee understands that initial testing shows the potential for NGHMS to collect maintenance intelligence and prognostics to enable early warning of failing mechanical systems. This information could reduce emergency maintenance costs, provide predictable maintenance schedules, and increase readiness for the LUH fleet.

The committee is aware that recent Army bench testing of the technology was successful. Installation onto LUH platforms for operational testing will begin in March 2018. Specifically, the U.S. Army will install NGHMS on 8 Lakota platforms. This initial operational testing is intended to validate increases in readiness and reductions in operating costs. However, to assure proper evaluation across a variety of missions and terrains, the committee encourages the Army to outfit an additional 20 LUH Aircraft with NGHMS and include them with the current test schedule. The committee believes that additional testing will provide critical information and allow for near-term decisions to achieve efficient maintenance structures that foster quality and well-organized fleet management.

Policy issues surrounding emerging technologies for combat and non-combat use

The committee notes increasing public debate from policymakers and civil society regarding the employment of emerging technologies. The committee applauds technological advancements in fields such as artificial intelligence, unmanned aerial vehicles, facial recognition software, surveillance capabilities, and biological enhancements but encourages the Department of Defense (DOD) to designate an entity to thoroughly examine the policy questions surrounding their use in combat and non-combat scenarios, including potential political, legal, and ethical impacts.

The Department should outline methods of technological usage for new technologies, especially capabilities that utilize the privacy and data of U.S. citizens. For instance, cautionary reports from civil society, academia, and industry warn of the potentially harmful effects of artificial intelligence in the national security space. With the proliferation of drone use and artificial intelligence, the DOD has yet to proactively address questions of application and use. The committee urges the Under Secretary of Defense for Research and Engineering to consider the anticipated application of emerging technologies in combat and non-combat scenarios.

Rapid-charging hybrid energy storage fuel cells

The committee acknowledges the availability of advanced hybrid energy storage systems that rapidly charge, allowing more time in the field, providing more effective use of alternative energy sources, and supporting the use of micro-grids for more robust capability. The committee encourages further research of these technologies to enhance system capability.

Report on Metal Matrix Composites for Army Vehicles

The committee recognizes the versatility and broad application that Metal Matrix Composite (MMC) Technology provides for the armed services by reducing the weight of parts by fifty percent and increasing the service life by three to four times over traditional steel. The committee recommends that the U.S. Army Tank & Automotive Research, Development, and Engineering Center (TARDEC) continue to test, develop, and field components that can reduce vehicle weight, reduce fuel consumption, increase payload capacity, and extend service life.

The committee further directs the Assistant Secretary of the Army for Acquisition, Logistics, and Technology to provide the congressional defense committees a report on the progress of development and implementation of MMC components that can be fielded in Army Ground and Tactical Wheeled Vehicles in order to reduce vehicle weight, reduce fuel consumption, increase payload capacity, and extend service life. This report should be received no later than March 31, 2019.

Research, development, and procurement of wearable and mobile remote power capabilities

The committee understands the advantages that remote power capabilities provide to warfighters in the field, especially renewable power sources such as wearable solar panels. Further, the committee understands the benefits this type of combat capability provided through dedicated research and development funding, along with procurement and sustainment resources, to not only the military services, but also improve the mission capabilities of Federal and state law enforcement entities.

Additionally, the committee recognizes the ability of academic and private entities to research and develop remote power capabilities due private sector applications of the technology. Therefore, the committee strongly encourages the Department of Defense to continue to invest resources in academic, private, government entities to research, develop, and deploy portable power capabilities across the military services in support of warfighter needs.

Soldier Borne Sensor (SBS) Program

The committee supports the Secretary of the Army's recent emphasis on modernization, particularly the efforts to increase the lethality of our soldiers. Further, the committee is aware that small unit intelligence, surveillance, and reconnaissance capabilities can provide soldiers with critically needed situational awareness particularly in subterranean and Global Positioning System-denied environments. The committee understands that the Soldier Borne Sensor (SBS) program is key to these efforts. Therefore, the

committee directs the Secretary of the Army to provide a report to the Senate Committee on Armed Services by September 30, 2018 on the SBS program. At a minimum, this report shall include a detailed assessment of threshold requirements, objective requirements, and other factors under consideration as the Army makes a determination for the SBS program.

Surrogates for operational testing of torpedoes and torpedo defensive systems

The committee understands that the Navy routinely conducts in-water operational testing of its anti-submarine torpedoes against manned U.S. Navy submarines. The Director of Operational Test and Evaluation (DOT&E) has indicated that test range safety rules, combined with the inability of U.S. nuclear attack submarines to appropriately emulate threat-representative submarines, limit the operational realism of these test events. The committee notes that since 2013, the Navy, in coordination with the DOT&E, has worked to define the requirements for a mobile set-to-hit torpedo target, but has yet to procure such targets. The committee is concerned that U.S. defenses are not being tested using test assets representative of many highly capable and proliferated threat torpedoes.

Therefore, the committee directs the Secretary of the Navy to deliver to the congressional defense committees not later than March 1, 2019, a plan for the use of threat-representative surrogates for torpedoes and torpedo defensive systems. For fiscal years 2020 through 2024, the plan shall include threats being addressed, test and evaluation activities, budgeted funding, additional funding requirements, and the associated schedule.

Technology and transition accelerators

The committee recognizes the potential and benefits of the Technology and Transition Accelerators established by the Department of Defense. Technology accelerators, including those efforts under the Under Secretary of Defense for Acquisition and Sustainment and the Under Secretary of Defense for Research and Engineering, are aimed at providing opportunities for the Department to leverage public-private partnerships in order to build a network connecting national security challenges with innovators and entrepreneurs. Technology transition accelerators, like the Defense Advanced Research Project Agency's Microsystem Technology Office Transition Accelerator and the Small Business Innovation Research program, strive to improve the business models of small high-tech companies and support researchers in moving technologies from concept to commercialization in order to position them for impact in both the defense and commercial markets. The committee encourages the Undersecretary of Defense for Research and Engineering to review these and other similar activities and assess their potential application to other parts of the research and engineering enterprise.

Trusted and assured microelectronics

The committee is aware of the importance of the Department of Defense's long-term strategy to ensure trusted and assured supply

chains for defense systems. The committee also recognizes that the Joint Federated Assurance Center (JFAC) provides a bridge between science and technology programs and defense programs, enhancing the Department's ability to rapidly transition microelectronics technology to the joint force. Not later than February 1, 2019, the Assistant Secretary of Defense for Systems Engineering shall provide to the congressional defense committees a briefing on a strategy to optimize and formalize the technology transition process utilizing the JFAC.

Ultra Low Power Deployable Radar

The committee is aware of efforts undertaken by U.S. Special Operations Command to develop an ultra-low power, rapidly deployable radar to enhance surveillance and reconnaissance missions and to provide small team force protection in austere locations. The committee understands that the military services are exploring the utility of this capability to meet their requirements and looks forward to the results of their review.

Ultra-Lightweight Camouflage Net System

The U.S. Army and U.S. Marine Corps rely on multispectral camouflage nets to cloak U.S. and allied weapon systems from enemy visual detection, radars, and sensors. Foreign detection devices such as sensors and radars now are overmatching the current camouflage nets and pose an imminent threat to U.S. forces. The committee notes the long standing success of our allied partner nations who employ mobile camouflage systems on their combat vehicles, especially within NATO and the European theater. These relatively inexpensive camouflage net systems provide enhanced signature management protection, reduce heat and temperature inside and around combat vehicles, and yield fuel savings without interfering with the operation of the vehicles.

Army commanders have expressed an immediate operational need for mobile camouflage systems, in woodland, desert, and arctic variants in particular. The committee is aware of the Army's ongoing operational testing of mobile camouflage systems at the National Training Center and elsewhere and encourages further acceleration of those efforts. Given the potential significant advantages of developing this capability, with specific interest towards enhancing interoperability, the committee directs the Secretary of the Army to provide the congressional defense committees, within 90 days of enactment of this Act, with a report which outlines the mobile camouflage system test results and the Army's plan and timeline to fund development, testing, and fielding of these systems to the warfighter.

Workforce and infrastructure for National Defense Strategy priority technologies

The committee recognizes that the National Defense Strategy identified certain priority emerging technologies (for example, advanced computing, "big data" analytics, artificial intelligence, autonomy, robotics, directed energy, hypersonics, and biotechnology) as having the potential to change the very character of war. The committee has followed this designation with the authorization of

investments in research within these categories within other portions of this Act.

However, the committee urges the Department of Defense (DOD) to prioritize those supporting capabilities that will enable technological progress in these areas—namely, workforce and infrastructure. Too often, these supporting functions are forgotten and research suffers for lack of qualified personnel or test facilities within the DOD laboratories and the Major Range and Test Facility Base.

Therefore, the committee directs the Secretary of Defense to submit a report on workforce and infrastructure needs for the development of each of these priority technologies over the coming five years. The report should include specific shortfalls in each category, if they exist, and recommendations for legislative action if necessary. The report must be submitted by 019, to the relevant congressional defense committees.