Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Office of the Secretary Of Defense	Date: February 2019
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
Total Program Element	405.164	64.775	59.490	47.147	-	47.147	48.828	49.600	49.990	51.077	Continuing	Continuing
826: *Quick Reaction Fund*	126.494	18.743	18.499	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
828: *Rapid Reaction Fund*	258.405	42.082	36.998	44.796	-	44.796	46.453	47.201	47.567	48.630	Continuing	Continuing
831: *Joint Rapid Acquisition Cell Support*	9.561	1.649	1.669	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing
833: *Strategic Multi-Layered Assessment (SMA) Support*	10.704	2.301	2.324	2.351	-	2.351	2.375	2.399	2.423	2.447	Continuing	Continuing

Note

The Quick Reaction Special Projects (QRSP) Program Element (PE) will be adjusted to support the priorities of the Under Secretary of Defense for Research and Engineering (USD(R&E)). In FY 2020, this realignment includes a transfer of funding and appropriate project investment areas from the Quick Reaction Fund to PE 0603699D8Z Emerging Capabilities Technology Development. The remaining QRSP funding is focused on prototyping projects that are executed faster and explore higher risk concepts with the potential for immediate impacts to the Combatant Commanders and joint warfighters. Additionally, in FY 2020 the Joint Raid Acquisition Cell Support will be transferred to PE 0903399D8Z within the Office of the Under Secretary of Defense for Acquisition and Sustainment for alignment and execution.

Funding in the QRSP PE enables leadership within the Office of the Under Secretary of Defense for Research and Engineering (OUSD(R&E)) to anticipate and quickly respond to emergent Combatant Command (CCMD) issues and time-sensitive threats by selecting projects within the year of execution and incubating them to rapidly develop potentially game-changing capabilities. QRSP harnesses the national industrial bases by partnering with military Services, interagency partners, Federally Funded Research and Development Centers (FFRDC), academia, and traditional or non-traditional industry.

A. Mission Description and Budget Item Justification

The Quick Reaction Special Projects (QRSP) Program Element funds the development of risk-reducing prototypes and accelerates capability innovation to deliver performance to the joint warfighter at the speed of relevance. QRSP prototypes increase warfighter lethality, affordably counter emerging technological threats, and help address the immediate needs of the Combatant Commands (CCMD). Due to the relatively low average cost of projects, QRSP is able to explore higher-risk opportunities with potentially higher reward. Project selection is guided by Department-level strategies and priorities, such as the National Defense Strategy, the Chairman's Capability Gap Assessment, DoD's modernization priorities, and the Combatant Commands' (CCMD) Integrated Priority Lists (IPLs).

The QRSP Program supports four major project codes that expedite development and transition of new capabilities to the warfighter. These project codes are: 1) Quick Reaction Fund (QRF), 2) Rapid Reaction Fund (RRF), 3) Joint Rapid Acquisition Cell (JRAC) support, and 4) Strategic Multi-Layered Assessment (SMA). Efforts within these project codes align to DoD science and technology priorities, address challenges identified in the National Defense Strategy, and support the DoD's modernization priorities.

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Office of the Secretary Of Defense	Date: February 2019
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*

The QRF develops prototypes in response to emergent needs that take advantage of breakthroughs in rapidly evolving technologies and accelerate these innovations to the warfighter. The QRF program initiates prototyping projects during the execution year to mature technologies critically needed for the CCMDs and rapidly transition those capabilities. QRF projects are identified through current warfighter gaps, solutions proposed by CCMDs, and jointly applicable capabilities identified by the Services and Defense Agencies. In 2020, QRF funding to support prototyping or experimentation will be transferred to PE 0603699D8Z Emerging Capabilities Technology Development.

The RRF develops prototypes to counter emerging threats; anticipate adversaries' exploitation of new technologies; and, expedite delivery of effective, affordable, and critically needed capabilities to the warfighter. RRF initiatives accelerate innovation by rapidly developing high-risk prototypes with the potential for immediate and impactful transition of warfighter capabilities. RRF leverages emerging capabilities, such as machine learning algorithms and software intelligence, to enable novel prototypes with agile technology insertion paths. Funded projects also leverage existing capabilities from traditional industrial bases and non-traditional suppliers in the commercial sector, academia, international arenas, and small businesses.

The JRAC responds, in timeframes acceptable to the CCMDs, to Joint Urgent Operational Needs (JUON) and Joint Emerging Operational Needs (JEON) that are submitted by CCMDs and validated by the Joint Staff. To meet these objectives, JRAC leverages contingency and other rapid acquisition authorities. In 2020, the Joint Rapid Acquisition Cell Support will transfer to PE 0903399D8Z.

The SMA supports senior leadership within the CCMDs, Joint Force Commanders, and other government agencies by assessing complex operational and technical challenges, which require collaborative multi-agency and multi-disciplinary approaches. With input from across the U.S. government, academia, and the private sector, the SMA develops options to Joint Staff and CCMD-generated challenging problems to inform senior leadership. Each assessment is initiated at the request of CCMD senior leadership. Priorities for SMA programs are set by the Joint Staff Deputy Director for Global Operations (DDGO). SMA products are typically generated within six to nine months and directly contribute to the decision-making process of the Joint Staff and CCMD senior leadership.

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	69.203	69.626	71.393	-	71.393
Current President's Budget	64.775	59.490	47.147	-	47.147
Total Adjustments	-4.428	-10.136	-24.246	-	-24.246
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-10.000			
• Congressional Rescissions	-	-			
• Congressional Adds	3.000	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.298	-			
• Congressional Reduction	-5.000	-	-	-	-
• FFRDC Adjustments	-0.130	-0.136	-	-	-
• Other Program Adjustments	-	-	-0.109	-	-0.109

Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Office of the Secretary Of Defense					Date: February 2019
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 3: *Advanced Technology Development (ATD)*			R-1 Program Element (Number/Name) PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*		
• Quick Reaction Fund (QRF) Realignment	-	-	-22.452	-	-22.452
• Joint Rapid Acquisition Cell (JRAC) Realignment	-	-	-1.685	-	-1.685

Congressional Add Details ($ in Millions, and Includes General Reductions)

	FY 2018	FY 2019
Project: 828: *Rapid Reaction Fund*		
Congressional Add: *Solar Energy Research*	3.000	-
Congressional Add Subtotals for Project: 828	3.000	-
Congressional Add Totals for all Projects	3.000	-

Change Summary Explanation

The FY 2018 decrease is the net of a $3.000 million Congressional increase for Solar Energy Research, a $5.000 million Congressional reduction for prior year carryover, and required FFRDC and SBIR/STTR adjustments.

The FY 2019 Congressional decrement was for efficiencies and prior year carryover.

The 2020 baseline reduction is the net of the transfer out of the Quick Reaction fund to Emerging Capabilities Technology Development (Program Element 0603699D8Z) to support Prototyping, and the transfer out of the Joint Rapid Acquisition Cell to an Operations and Maintenance Program Element (0903399D8Z) within the Office of the Under Secretary of Defense for Acquisition and Sustainment (OUSD(A&S)) for proper alignment and execution.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense			Date: February 2019
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*	Project (Number/Name) 826 / *Quick Reaction Fund*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
826: *Quick Reaction Fund*	126.494	18.743	18.499	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

Note

In FY 2020, the Quick Reaction Fund is transferred to Program Element 0603699D8Z (Emerging Capabilities Technology Development).

A. Mission Description and Budget Item Justification

The Quick Reaction Fund (QRF) provides the Combatant Commands (CCMDs), Services and joint warfighters opportunities to capitalize on relatively mature technologies to rapidly prototype and field-test promising new prototypes that can have immediate impact on time-sensitive operational needs. New capabilities address National Defense Strategy priorities and inform programs of record or new acquisition pathways to more effectively and affordably push innovation to the field. QRF focuses on projects that have the potential to address conventional, disruptive, and asymmetric warfare needs. QRF initiatives typically deliver a prototype application within 12 months of being funded.

In FY 2019, QRF identifies and funds prototypes that respond to critical operational needs and emerging threats. QRF projects are selected in the year of execution based on Department, CCMD, Service, and other government organization identified threats and opportunities. In FY 2020, QRF funds will transfer to PE 0603699D8Z Emerging Capabilities Technology Development to facilitate prototyping and experimentation to support the DoD's modernization priorities.

Recent success stories and significant transitions of note include:

• Talon Archer: This project prototyped novel sensors capable of passively detecting nation-state assets at extended ranges. The project demonstrated these novel sensors at key locations to provide indications and warnings in defense of the homeland. The information from the Talon Archer sensors will be sent to national organizations in near-real time to inform decision makers. Talon Archer transitioned to support a classified mission in the U.S. Northern Command area of responsibility. Additional details are classified.

• Isosceles: This project prototyped an on-demand experimentation capability that provides high-fidelity results for understanding whether certain strategic systems meet their performance thresholds and goals. Isosceles removes the need to use dissimilar surrogates during system evaluations, significantly improving the quality and accuracy of the evaluations. Isosceles transitioned to a classified program of record in 2018.

• Sidecast: This project deployed a prototype set of fully customizable government-off-the-shelf tools for network exploitation. The solution leverages government best practices and expands DoD's capability to operate with customized software tools. Sidecast enhances the Combatant Commands' capability to operate and exploit network information in near real time. With this capability, the warfighter has tools designed for open network exploitation for a fraction of the cost of existing programs. Sidecast transitioned to a classified customer within the U.S. Central Command area of responsibility.

• Hammerhead: This project responded to the need for more available courses of action in the event of certain space systems contingencies. The OSD project team and the Space Systems Defense Program (SSDP) transitioned Hammerhead to an operational capability. Additional details are classified.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Dead Center	0.400	-	-

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Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*	**Project (Number/Name)** 826 / *Quick Reaction Fund*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Description: The previously-funded Dead Center project demonstrated advanced, highly tailorable algorithms to meet critical warfighter mission needs in multiple domains, culminating in a user demonstration of the advanced algorithms designed to enhance warfighter effectiveness. The project integrated these algorithms with repurposed commercial-off-the-shelf hardware to demonstrate a flexible, multi-platform functionality in a low size, weight, and power form factor to meet specific, highly tailored mission critical needs. Project deliverables, including prototypes and system documentation, transitioned to a classified DoD partner.			
Title: Vintage Racer ***Description:*** The previously-funded Vintage Racer project matured an advanced capability to prosecute targets of interest. This project validated aerodynamic design with wind tunnel testing. Vintage Racer also prototyped and integrated a guidance subsystem for targeted kinetic effects. Due to a phased program plan, Vintage Racer was completed with FY 2018 funding. Following subsystem integration, FY 2018 funding supported a flight demonstration in FY 2019. The project supported a key modernization cross-functional team, and will transition documentation and prototype technologies to the U.S. Army for additional development and follow-on acquisition activities.	1.200	-	-
Title: Predictive Analytics for Condition Based Maintenance ***Description:*** This adaptive logistics project demonstrated the ability to apply a predicative analytics model for maintenance on ground combat equipment to enhance lethality through improved readiness. The prototype system collects and stores engine performance data and fault codes, applies machine learning principles to collected data, and anticipates required maintenance before issues cause expensive damage to engine hardware. Prototyping focused on building a framework to understand engine data from the M-88 platform and extrapolating actionable steps. The prototype transited to the U.S. Marine Corps for further development and assessment. This prototype also supports the M-1 tank chassis and was leveraged by the Army tank fleet and future systems that have onboard processing to run machine learning algorithms.	1.400	-	-
Title: Quantum Processor (Q-Pro) Chip ***Description:*** This project leveraged work done at the National Institute of Science and Technology and Sandia National Laboratory to create a unique quantum circuit with potential game-changing impact across several crucial DoD applications including artificial intelligence, complex problem optimizations, and big data search and sorting. Using FY 2018 funding, this project will demonstrate the quantum circuit in FY 2019. Additional details are classified.	2.900	-	-
Title: Air Field in a Box ***Description:*** This project demonstrated autonomous multiple UAS delivery, including extra-small variants that have sufficient capacity and scalability to satisfy the demands of future distributed expeditionary operations. The objective of this project	1.200	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense		Date: February 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*	**Project (Number/Name)** 826 / *Quick Reaction Fund*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
is to revolutionize logistics as necessary for survival in a decentralized battle space defined in Expeditionary Advance Base Operations, Distributed Lethality, and the Multi-Domain Battle concepts. Using FY 2018 funding, Air Field in a Box will complete a flight demonstration and user assessment in FY 2019. The resulting prototype demonstrates a concept that will transition into a full scale multi-UAS delivery system to be employed from the universal dimensions of International Organization for Standardization (ISO) containers. The ISO's intermodal and global reach will allow for standardized distribution through global supply chains and rugged field readiness no other unit or container offers.			
Title: Hardware/Software (HW/SW) Assurance and Integrity Analysis ***Description:*** The Department of Defense has developed a trusted systems strategy including focusing efforts on mission assurance, comprehensive protection planning, industry standards, and advancing DoD's capability to identify and mitigate HW/SW vulnerabilities through science and technology. These HW/SW Assurance projects directly support all elements in the 2014 National Defense Authorization Act Section 937. This program established the Joint Federated Assurance Center (JFAC) that federates hardware and software assurance expertise and capabilities throughout DoD and makes the capabilities directly available to programs. The JFAC provides tools, services, best practices, contract language, and other help to programs that detect, assess, prioritize, and mitigate mission critical vulnerabilities to malicious software attacks and supply chain exploitation vulnerabilities. This collaboration helps mitigate existing and emerging critical threats and vulnerabilities in both SW and HW and yields secure architecture and design patterns available to all DoD programs. In FY 2018, JFAC incorporated Defense Advanced Research Projects Agency and Defense Acquisition University products into the JFAC website and developed a software assurance (SwA) guidebook to aid implementation of SwA practices in DoD programs. This project also supports Trusted and Assured Microelectronics Program Elements 0604294D8Z BA4 and 0605294D8Z BA5, which provide funding to demonstrate these capabilities and augment the hardware assurance capabilities of the JFAC.	2.000	-	-
Title: Crossed Arrows ***Description:*** This project demonstrated advanced machine learning (ML) algorithms and tools to address threats from near-peer adversaries. Crossed Arrows supports the increased lethality against a classified threat set by leveraging advances in predictive analytics. Using FY 2018 funds, Crossed Arrows successfully demonstrated ML tools and techniques that will transition in late FY 2019 to a classified customer.	1.543	-	-
Title: Olympus ***Description:*** This classified project demonstrated techniques to address threat finance networks by exploiting network, communication, and protocol vulnerabilities. Using FY 2018 funds, Olympus identified key technologies and demonstrated a	1.600	-	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense		Date: February 2019
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
prototype capability against representative threat networks. Leveraging partner funding, Olympus will transition to a classified customer in FY 2019.			
Title: Rustam Relief ***Description:*** This project demonstrated an advanced analytics and data visualization tool to accelerate key decision making processes for the warfighter. Rustam Relief enables quicker responses and shortens the kill chain for time sensitive targets. Leveraging FY 2018 funding, Rustam Relief demonstrated new prototype tools against a representative threat and transitioned to a classified customer to inform future development.	1.500	-	-
Title: Battle Axe ***Description:*** This nine month effort leveraged existing commercial and mature technologies to prototype and demonstrate a new electronic-attack capability for ground vehicles. Battle Axe significantly reduces size, weight, power, and cost (SWaP-C) to provide a rapidly deployable counter intelligence, surveillance, and reconnaissance (ISR) solution to the warfighter. In 2018, Battle Axe integrated mature technologies in the areas of radar detection and classification and low SWaP-C solutions for electronic attack into a prototype to achieve sensor degradation, denial, and deception. Leveraging FY 2018 and partner funding, Battle Axe will demonstrate over-the-air range test against threat surrogates in FY 2019 and transition to the U.S. Army Vehicle Protection System program.	1.400	-	-
Title: High Performance, Versatile Iodine Platform-Enabled Reference (VIPER+) ***Description:*** This project integrated two molecular iodine clocks for demonstration and immediate deployment in DoD platforms that require precise timing and synchronization in GPS-denied environments. The VIPER+ iodine technology provides superior performance to currently available optical clocks in the same class with reduced SWaP-C resulting from a simplified architecture. The high-performance VIPER+ prototype architecture will support ground-based pseudo-satellites for positioning, coherent radar/LiDAR, electronic warfare (EW), and electronic intelligence in a package compatible with covert operations. Using FY 2018 funding, VIPER+ designed a new optical clock physics package and conducted laboratory testing. Partner funding will support additional system integration in FY 2020 before transitioning for test and validation.	3.600	-	-
Title: Quick Reaction Prototypes to Support DoD Modernization Priorities ***Description:*** This effort provides quick wins through rapidly fielded prototypes to address current or emerging threats and leverage new opportunities. Funded prototypes will provide capabilities critical to the National Defense Strategy and DoD's modernization priorities. Example technology areas include fully networked command, control, and communications; space; autonomy; hypersonics; microelectronics; cyber; quantum science; directed energy; and machine learning systems. Projects under consideration include countermeasures to monitor and, as needed, gain access to, or operate within, geographical areas	0.000	18.499	-

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense		Date: February 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*	**Project (Number/Name)** 826 / *Quick Reaction Fund*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
that have been strategically denied; prototypes that leverage machine learning to provide advanced indications and warning (I&W); and, ad hoc sensors networks for reliable communications and collaboratively networked electronic effects. These prototypes will be delivered to joint Service users to evaluate operational capabilities and inform requirements and technical feasibility of future acquisition programs. Potential venues for prototype assessment include the Stiletto Maritime Demonstration Program, Thunderstorm integration exercises, and multi-domain demonstration venues across the DoD. Demonstration of advanced prototypes will involve partnerships with the Services, industry, academia, and non-traditional DoD partners. ***FY 2019 Plans:*** FY 2019 QRF efforts will mature concepts and designs to quickly address challenges within the DoD's modernization priorities. While project determinations are generally made in the year of execution, QRF anticipates funding six to nine projects that address gaps in the joint Services' investments. Potential areas to investigate include advanced sensors; machine learning for faster response; and, automated target recognition. Projects will be selected through coordination with the DoD, Federally Funded Research and Development Centers, other government agencies, industry, and academia. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** In 2020, the Quick Reaction Fund (QRF) funding and appropriate focus areas will transition to PE 0603699D8Z Emerging Capabilities Technology Development. FY 2019 projects will be completed and transition within 12 months from project initiation.			
Accomplishments/Planned Programs Subtotals	18.743	18.499	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

QRF leverages the Services' and Defense Agencies' most efficient and effective acquisition approach for rapid prototyping. This includes using Other Transaction Authorities and new or existing contract vehicles.

E. Performance Metrics

Although the Quick Reaction Fund (QRF) will transition to PE 0603699D8Z, previously selected projects support the FY 2020 performance metrics to transition projects that address Joint Force and Combatant Command capability gaps. In FY 2018, QRF transitioned seven prototypes, with an overall transition rate of 100 percent. All QRF projects are monitored for schedule deviation, transition outcome, and deliverables such as advanced algorithms, hardware, and other components.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense											Date: February 2019	
Appropriation/Budget Activity 0400 / 3					R-1 Program Element (Number/Name) PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*				Project (Number/Name) 828 / *Rapid Reaction Fund*			
COST ($ in Millions)	**Prior Years**	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**	**Cost To Complete**	**Total Cost**
828: *Rapid Reaction Fund*	258.405	42.082	36.998	44.796	-	44.796	46.453	47.201	47.567	48.630	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Rapid Reaction Fund (RRF) produces innovative prototypes with a high potential for disruptive improvement, and transitions them to joint warfighters and Combatant Commands (CCMDs). RRF anticipates adversaries' exploitation of technology, including current and emerging commercial capabilities, and rapidly responds to new threats and opportunities. Project selection is guided by department-level strategies and priorities, such as the National Defense Strategy and the DoD's modernization areas. Needs are identified and prototype projects are funded within the year of execution to demonstrate the feasibility of new technologies, enable integration into larger systems, and deliver affordable capabilities faster than standard acquisition cycles. These lower-cost prototypes and innovative business processes give the USD(R&E) the agility to quickly explore new, higher-risk technology areas that have the potential for immediate, game-changing impacts.

In prior years, RRF supported the creation of novel sensing systems; provided low-cost capabilities for small-footprint operations; expanded human, social, and cultural knowledge relevant to military decision making; increased small unit situational awareness; produced advanced biometrics and forensics capabilities; performed strategic multi-layer assessments; and, established a prototyping through non-traditional pathways outreach effort that facilitates better interactions with small, non-traditional companies developing innovative technologies.

In FY 2019 and FY 2020, RRF will continue to support the Under Secretary of Defense for Research and Engineering and provide a hedge against technology risk by identifying and delivering near-term capabilities to support irregular warfare operations. Focus areas for RRF include: disparate data fusion; autonomous systems and behaviors; urban characterization for enhanced lethality; prototypes for interconnected sensors and command networks; novel manufacturing to rapidly field prototypes; and, novel applications of repurposed commercial-off-the-shelf and government-off-the-shelf technologies.

Recent success stories and significant transitions of note include:
• High Accuracy Video Object Classification (HAVOC): A prototype system that provided an automated, machine learning enabled, target recognition capability for expeditionary forces using a desktop computer. HAVOC transitioned to an intelligence community partner in 2018, and HAVOC technologies have been incorporated into Project Maven.
• Wide-area Infrared System for 360-Degree Persistent (WISP) surveillance: WISP prototyped and implemented a long-wave infrared hemispherical sensor for surveillance and tracking of moving objects. This effort supports the counter-unmanned aerial systems mission by expanding the sensor's field of view to 90 degrees elevation and refining the detection algorithms for the new targets. WISP transitioned to the U.S. Air Force.
• Future Infrared Search and Track (FIRST): FIRST created a novel method of building optical sensors capable of staring over a wide field of view with high resolution. The advantages of this method include producing an image with more pixels than the focal plane array, decoupling the field of view from the aspect ratio of the focal plane, and extending the field of view beyond the optical design. The FIRST prototype transitioned to the Air Force Research Laboratory and the Office of Naval Research for follow-on testing, development, and deployment.
• Social Network Aided Geolocation (SNAG): SNAG prototyped a suite of automated machine learning algorithms that accurately estimate geolocations for social media messages from location-indicative terms and metadata features. This capability provides location estimates for the large volume of social media content that is not

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense		Date: February 2019
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explicitly geotagged. Geospatial analysis of social media has proven effective for identifying and tracking actors of interest as well as understanding local concerns and sentiments within an area of interest. SNAG transitioned to the Defense Intelligence Agency's GOSSIP architecture, which is widely used across the intelligence community.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Low Cost Innovative Projects (Projects less than one million dollars each)	29.982	-	-
Description: Typical Rapid Reaction Fund (RRF) projects are completed with a single year of funding and at a cost less than $1.000 million to deliver conceptual prototypes for evaluation or assessment by warfighters and interagency users. In FY 2018, RRF selected, executed, and transitioned multiple low cost projects, including: • Miniature Ultra-Wideband (UWB) Radars for Real-Time Through-Obstacle Imaging: A miniature (less than 1 lb.) UWB radar capable of detecting stationary individuals behind walls. The resulting prototypes transitioned to U.S. Army Special Operations Command and the Army Research Laboratory. • Solid Oxide Fuel Cell (SOFC): A 350 watt (W) SOFC suitable as a drop-in replacement for the 245W SOFC currently used in an operational small unmanned aerial system. The prototype fuel cell will provide approximately 40 percent more power with better size, weight, and cost characteristics when compared to the current 245W SOFC. The prototype transitioned to U.S. Army Special Operations Command and U.S. Marine Corps Special Operations Command. • Electromagnetic Metamaterials: An electromagnetic meta-surface for operationally relevant objects. The meta-surface for the demonstration object was designed using electromagnetic modeling, simulation, and performance predictors and allowed the object to be compared to a control item to demonstrate the difference in performance characteristics. This technology transitioned to the U.S. Air Force and U.S. Navy PEO Unmanned Small Combatants. Additional details are classified. • Storm: A mid-body warhead capable of mechanically changing shape in terminal flight to direct all of the fragmentation toward the target. The prototyped warhead uses an airbag inflation system to propel warhead sections to the forward orientation, effectively directing all the fragments forward while bypassing the guidance material. This prototype transitioned to the U.S. Navy Precision Strike Weapon Office (PMA-201) and U.S. Special Operations Command. • Autonomous Sling Load Cargo Delivery: This prototyping project added a sling load capability to the government-owned Autonomous Aerial Cargo/Utility System architecture. This capability was first demonstrated with a Navy Explosive Ordnance Disposal mission and then with a U.S. Marine Corps cargo transport demonstration. This prototype transitioned to the U.S. Navy's PMA-266 for integration into the MQ-8C Firescout program of record. • Extending Communication beyond Line-of-Sight: This project integrated and demonstrated an unmanned parafoil system with an unmanned surface vessel to extend digital communications and sensor connectivity beyond current line-of-sight limitations. This prototype transitioned to the U.S. Navy. • Eminent Tower: This project leveraged advances in mobile cognitive radio frequency technologies to port existing electronic warfare capabilities from large fixed-site facilities to mobile systems. The Eminent Tower prototype transitioned to the Joint Counter Radio-Controlled Improvised Explosive Device Electronic Warfare program.			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense		Date: February 2019
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
• Joint Advanced Video Activity Analytics (AVAA) Workflows: A capability for the rapid exploitation of video imagery. AVAA enables analysts to rapidly assemble automated analysis workflows using custom computer vision algorithms as building blocks. AVAA building blocks include automated video enhancement (stabilization, de-hazing, etc.), scene classification, automatic object identification, and object and anomaly tracking. The capability deployed as an operational prototype in the U.S. Africa Command area of responsibility. • Solid State Pulsed X-Ray Generator: A prototyped compact solid-state pulsed X-ray generator for use by explosive ordnance disposal personnel. The prototype provides detailed images of the interior of IEDs while significantly improving accuracy and speed. The prototype transitioned to Joint Service Explosive Ordnance Disposal program. • Advanced Persistent Malware Threat Intrusion Protection Tool: A prototype computer network intrusion protection system to detect, quarantine, and report attacks on DoD and defense industrial base computer networks before the attack can take effect. This capability transitioned to a DoD Crime Center. • Spatially Selective Electronic Attack: A capability to target electronic warfare effects to a small geographical region, and reduce impact on neutral or partner forces. This prototype transitioned to a classified customer. • Facial Recognition at Extreme Distances (FRED): A suite of algorithms that leverages existing camera systems in the DoD inventory. FRED enables operators to perform non-cooperative surveillance with the ability to detect, track, and recognize persons of interest, and match them against the DoD watch list. This technology transitioned to Product Manager Force Protection Systems. • Single Sweep: Novel algorithms to process raw radar data from existing radars and identify unmanned aerial vehicles in real time. This prototype transitioned to the Navy's Fleet Forces Command. • Automation for Strategic Target Deployability: This prototyping project enabled the automated and timely mapping of key infrastructure at scale using commercial imagery, and transitioned to a classified partner. Further details of this project are classified. • Aqueous Li-ion Batteries: An aqueous lithium ion (Li-ion) battery prototype that is flexible and inherently safe. The battery uses a water-in-salt polymer electrolyte with a wide electrochemical stability window, providing energy storage comparable to conventional organic-based Li-ion batteries with increased safety. The aqueous Li-ion battery prototype transitioned to U.S. Army Special Forces for follow-on development. • Vector GEO: An instantaneous line of bearing system for radio frequency signals from an airborne platform. The front end is a small six-axis electric (E-field) and magnetic (B-field) sensor that can provide geolocation within 100 meters from operational standoffs and altitudes. This prototype transitioned to the U.S. Army Special Operations Command. • Russian Gray Maritime Networks: A prototype capability to identify and track agents and members (vessels, owners/operators, port facilities, cargoes) of the Russian gray maritime network that could be activated during hybrid or gray zone warfare in the Baltic. The prototype transitioned to Sealink Advanced Analysis office at the Naval Research Laboratory. • Concealable Flexible Buoyant Body Armor: A concealable and flexible body armor system using low-cost, commercial-off-the-shelf components that protects the warfighter from small arms rounds up to 7.62x51 mm rifle rounds (National Institute of Justice			

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(NIJ) level III threats). The body armor incorporates ceramic spheres encapsulated in a lightweight polyurea foam, resulting in a lightweight solution with flexibility, neutral buoyancy, and a multi-hit capability. After a successful demonstration, the prototype transitioned to the Air Force for further maturation. • Remote Runway Clearing Lidar: A prototyped and demonstrated sensor for scanning potential unimproved runways for gradients, undulations, and obstructions using lidar mounted on a class 1 unmanned aerial system. The system transitioned to U.S. Air Force Special Operations Command. • Tamper Resistance: A standalone anti-tamper chip providing device authentication and encryption using physically unclonable functions. The resulting prototype is a physical security technology for microelectronics, which is highly resistive to reverse engineering. This effort transitioned to U.S. Naval Air Systems Command. • Multistatic Operationally Distributed Sonar System (MODSS): A modeling and simulation capability that uses already-available data to optimize the design of an active sonar system for harbor defense from underwater threats. The resulting prototype system transitioned to U.S. Naval Forces Central Command for field evaluation. • Ordnance Threat/Target Automated Recognition (OTTAR): Computer vision analytics that enable the explosive ordnance disposal (EOD) warfighter to quickly and accurately identify military ordnance during the reconnaissance phase of unexploded ordnance response missions. This capability was successfully demonstrated and transitioned to Joint Service EOD Program. • Soldier Borne Sensor – Autonomy in Complex Environments (SBS - ACE): Autonomy algorithms that enable a very small unmanned aerial system to autonomously avoid obstacles while flying through complex terrain. These government owned algorithms use onboard electro optical/infrared sensors to fit the platform agnostic, multiple fly-off model of the SBS program. After a successful demonstration, this project transitioned to Product Manager – Soldier Maneuver Sensors via integration with the SBS program. • Multispectral Augmented Visually Enhanced Reality Imaging Capability (MAVERIC): A light-weight, multispectral binocular system for long-range intelligence, surveillance, and reconnaissance. The handheld system is built around the state-of-the-art Defense Advanced Research Projects Agency Pixel Network for Dynamic Visualization and integrates augmented reality graphics into the display. MAVERIC interfaces with Android Tactical Assault Kits, enabling the user to transfer tactically relevant graphics while keeping eyes on the target. This capability transitioned to U.S. Special Operations Command Program Executive Office Special Operations Force Warrior. • Multi-Mission Hybrid MRZR-4: This project matured and validated the operational prototype of a Hybrid Tactical All-Terrain Vehicle (ATV) MRZR-4. Early technology demonstrators were developed for fully electric and hybrid technology on a tactical ATV. This effort merged these two tech demonstrators into a final operational design on tactical MRZR-4 using commercial off the shelf parts. This project transitioned to United States Special Operations Command. • Autonomous Tactical Combat Casualty Care Under-Layer: A modular, sensor-infused garment to provide instantaneous notification of penetrating wounds to battlefield medics. The prototype transitioned to United States Special Operations Command.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
• SLING Blade: A low cost hybrid commercial Ka-band satellite terminal that is interchangeable among ground, maritime, and airborne vehicles with little to no adjustments. After a successful demonstration, the prototype transitioned to United States Special Operations Command. • Data Collection / Exfiltration Point for Sensitive Site Exploitation (SSE): This project developed algorithms and targeted integrations into SSE workflows to accelerate the collection, prioritization, and movement of extracted data. After a successful demonstration, this prototype transitioned to United States Special Operations Command's Sensitive Site Exploitation office. • Mobile Power Meter (MPM): A non-intrusive palm-sized electrical load monitor that untrained soldiers can safely install on active power cables. The system is used for real-time power monitoring of multi-conductor cables in tactical microgrids. The prototype transitioned to Project Manager Expeditionary Energy & Sustainment Systems. • Prototype Model for Towed Glider Air Launch System (TGALS): A prototype design for a towed launch system to provide a low-cost, operationally responsive space launch alternative for small satellite payloads or hypersonic test vehicles. The design parameters transitioned to inform for further development addressing missions in the U.S. Indo-Pacific Command area of responsibility. • High Performance Nano-Coating For Diesel Engines: A prototype coating for heat-exchangers in maritime diesel engines and land-based diesel generators. The nano-coating protects against bio-fouling build up and provides an immediate improvement in heat transfer, thereby increasing the engine's efficiency and performance. The prototype was tested at sea on the Stiletto maritime demonstration platform before transitioning to the Navy's PMS 443 Surface Ship Readiness and Sustainment Program. • Concurrent Engineering Interface Testbed Amphibious Combat Vehicle: This effort adapts a concept for concurrent engineering to demonstrate reduced cost and quicker development for complex military systems. The project developed algorithms and integrated models to enable rapid exploration of design trade space and identify potential problems with engineering design choices prior to committing development resources. The concept was tested on a joint-U.S. Marine Corps-Japanese amphibious combat vehicle design. • Malware Defense Applications: This project adapted a commercial endpoint solution as an on-demand malware classifier and evaluated performance on DoD systems. The project also experimented with an automated machine learning model-building solution for classifying events and malware metadata. The capabilities transitioned to the U.S. Navy. • Helios Airborne System: An advanced hyperspectral prototype imaging sensor on a Group 1 unmanned aircraft system (UAS) with sensor outputs integrated into the Android Tactical Assault Kit environment. After demonstrating in a relevant environment the sensor transitioned to Naval Special Warfare Development Group. • Digital Data Linkage Tool Phase 2: A prototype that enables an analyst exploiting a digital device to identify other devices associated with the same user, by identifying common access to cloud-based services. This capability transitioned to the National Media Exploitation Center and DoD forensics components. • Miniature Ultra Wideband (UWB) Radio: A miniature ultra-wideband (UWB) antenna capable of operating from 100 MHz to 50 GHz. The extended frequency range provided by this front-end allows multiple radios to be replaced by a single software defined radio. This prototype transitioned to U.S. Army Special Operations Command.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
• Special Operations Forces (SOF) Combat Diver Communications: A suite of optical and acoustic communications systems that enable high-bandwidth communications for submerged combat divers. This prototype transitioned to U.S. Special Operations Command Program Executive Office Maritime. • Fuel & Coupler for Hard and Deeply Buried Targets: This experimentation demonstrated the suitability of fueling Special Operations Forces operators with a ketone ester, beta hydroxybutyrate, for prolonged mission-critical activities involving hard and deeply buried targets while in full mission oriented protective posture gear. The prototype transitioned to U.S. Special Operations Command. • Magnetic Navigation: A prototype magnetic navigation system that leverages machine learning calibration algorithms to remove interference from an aircraft or missile's major subsystems in real time. The resulting 'clean' platform allows for GPS-denied navigation using magnetometers. After a successful demonstration, the prototype transitioned to the Air Force munitions directorate.			
Title: Strategic Multi-Layered Assessment (SMA) Reach Back Cell	2.000	2.000	2.100
Description: The SMA Cell supports senior leadership in the Combatant Commands (CCMDs) and U.S. government agencies with actionable assessments of complex operational and technical challenges. The assessments help maintain our competitive advantage in an increasingly complex global environment. The SMA Reach Back cell was established by the Joint Staff Deputy Director for Global Operations at the request of the Commander, U.S. Central Command (USCENTCOM). SMA efforts leverage multi-agency, multi-disciplinary approaches to address requirements that are not within the customer organization's core competency. SMA assessments are framed during the year of execution and are in response to specific tasking from senior leadership in the CCMDs. The SMA Cell identifies options from across the U.S. government, academia, and the private sector. SMA efforts are facilitated by the Joint Chiefs of Staff/J-3 Operations and are executed by the Office of the Under Secretary of Defense, Research and Engineering. The SMA Reach Back Cell provides USCENTCOM with population-based and regional expertise in support of ongoing operations in the USCENTCOM area of responsibility.			
FY 2019 Plans: SMA will continue to work with USCENTCOM via the Reach Back Cell to support ongoing operations in Iraq, Syria, and Afghanistan by responding to queries from senior leaders. SMA was asked by the USCENTCOM Commander to pivot to South Asia to evaluate stability factors in Afghanistan; the influence of regional actors; and, prospects for reconciliation. SMA will continue to develop the reach back concept to provide a short-term tool to assist in understanding actor relationships and conducting if/then analyses.			
FY 2020 Plans:			

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The SMA Cell will continue to actively work with the CCMDs and the Joint Staff to identify challenging problems that are not within the traditional areas of DoD expertise. These problems will be in direct support of CCMD senior leadership. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Level of effort is consistent between FY 2019 and FY 2020. Small changes reflect minor budget fluctuations.			
Title: Faster Short Tandem Repeat (FaSTR) Human Deoxyribonucleic Acid (DNA) Profiling System ***Description:*** FY 2018 funds completed development of a previously funded prototype rapid DNA analysis system. Current rapid DNA analysis systems rely on pneumatics and mechanical valves for microfluidic movement, resulting in bulky hardware and DNA analysis times greater than 60 minutes. The FaSTR DNA instrument re-purposes commercial-off-the-shelf electronics and exploits centrifugally-driven microfluidics to conduct sample preparation, polymerase chain reaction, and assessment of the results. This paradigm shift to microfluidic technology radically reduces the form factor, analysis time, and cost of the system. The FaSTR project will produce the first truly portable, rapid DNA analysis instrument capable of generating DNA profiles from "sample in" to "answer out" in less than 30 minutes, while providing a match probability of 1 in 55 billion people. In FY 2018, the project delivered three lightweight (<10 lbs.) prototypes, and 75 consumables for operational testing in theater. Test results, technical and training materials, and initial low rate production manufacturing technical specifications were delivered to the Army's Program Manager Office Biometrics and will support U.S. Central Command (USCENTCOM) and U.S. Special Operations Command (USSOCOM) missions.	0.200	-	-
Title: Biometrics and Forensics Science and Technology for Identity Dominance ***Description:*** Biometrics and Forensics Science and Technology projects develop and field prototypes to address emerging technology gaps that limit our ability to quickly and accurately identify anonymous individuals who threaten our physical and virtual assets. The overall goal of these projects is to reduce future operational risk to warfighters. New technologies demonstrated through this program will allow warfighters to identify threats, and counter our adversaries' attempts to mitigate our technologies. Biometrics and forensics projects will mature emerging technologies that support identity operations, forensic capabilities, and digital multi-media tools required by commanders and warfighters in ongoing and future military activities. These efforts encourage collaboration on biometrics and forensics projects within the DoD, and with interagency, industry, academia, and international partners. This model will help maximize collaborative investment and prevent redundant research. Deliverables are shared throughout the biometrics and forensics communities. ***FY 2019 Plans:*** The portfolio will continue to work on projects scheduled for delivery that include: the Enhanced Access Control for Husbanding Operations using Biometrics project, a web-based enrollment application to enable partnerships; and, Long Range Facial Identification Database, a repository of facial imagery collected at various standoff distances and operational conditions to	3.900	3.900	4.000

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enable the rapid adoption of commercial-off-the-shelf technologies. Additional projects for biometrics and forensics portfolios will be selected after coordination throughout DoD and across other U.S. government departments and agencies to maximize collaborative investment and prevent unnecessary redundant research. ***FY 2020 Plans:*** RRF investment decisions for the biometric and forensic portfolio will emphasize on fostering new technologies that counter emerging threats. Projects will leverage new commercial technologies in the forensic landscape, institutional forensic laboratories, and other biometric and forensic stakeholders. New projects under consideration will be thoroughly coordinated across the biometric and forensic enterprises to minimize duplication, maximize cooperative funding, and identify the most promising projects with the strongest path for transitioning the technology. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Level of effort is consistent between FY 2019 and FY 2020. Small changes reflect minor budget fluctuations.			
Title: Prototyping Through Non-Traditional Pathways	3.000	3.000	3.100
Description: Prototyping Through Non-Traditional Pathways leverages technologies and emerging products developed by small, innovative businesses in the commercial sector including information technologies, internet-of-things sensors and adaptive networks, bio-medical advances, emerging quantum applications, and novel microelectronic/microelectromechanical system innovations. Ideas from non-traditional emerging technology companies are matched against DoD, Combatant Command, Service, and other government priorities. Promising solutions are selected for further test and evaluation and, if successful, rapid prototyping or fielding to transition commercial ideas with military utility. These efforts support the Department's objectives of leveraging commercial innovation to maintain technology superiority, increasing rate of technology innovation, exploring alternative and faster pathways for acquisition, and fielding affordable and effective capabilities. In FY 2018, Prototyping Through Non-Traditional Pathways conducted reviews focused on priorities of the multi-Service Science and Technology (S&T) Communities of Interest, the Office of the Under Secretary of Defense for Intelligence, and the Joint Improvised-Threat Defeat Organization. ***FY 2019 Plans:*** Prototyping Through Non-Traditional Pathways anticipates three to five reviews in FY 2019, and 15 to 20 resulting evaluations with potential for future prototypes. Each review focuses on identifying ideas in a specific topic area that can transition to meet joint operational needs through rapid prototyping. These reviews will be executed with DoD users and interagency partners such as Service program offices, U.S. Special Operations Command science and technology community, the DoD-wide S&T communities of interest, the Joint Improvised-Threat Defeat Organization, the Defense Health Agency, and the Department of Homeland Security. ***FY 2020 Plans:***			

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Prototyping Through Non-Traditional Pathways anticipates three to five reviews in FY 2020, and 15 to 20 resulting tests and evaluations with potential for future prototypes. Topics areas will be informed by DoD users and interagency partners based on priorities identified in the execution year. These reviews will be executed with DoD users and interagency partners. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Level of effort is consistent between FY 2019 and FY 2020. Small changes reflect minor budget fluctuations.			
Title: Disparate Data Fusion, Analysis, and Applications for Networked Systems Focus Area	-	5.985	7.190
Description: Disparate Data Fusion, Analysis, and Applications for Networked Systems prototypes validate new approaches to managing and capitalizing on the increase of data volume, variety, variability, and velocity from our networked communications and sensors. Growth in social media, big data analytics, and large dynamic sensor networks requires new tools for aggregation, processing, exploitation, and dissemination. Projects include the development of capabilities, software, and tools to fuse, analyze, and infer information from a wide variety of structured or unstructured datasets from a broad spectrum of sources. Where possible these projects will exploit advanced machine learning systems and commercial technologies to provide solutions to emerging challenges in tracking targets, big data analytics, and extracting indications and warnings. Technologies developed within this focus area will reduce cost and analyst requirements to provide meaningful intelligence in support of areas such as counter-missile/counter-weapons of mass destruction, gray-zone near-peer competition, human terrain mapping applications, and operations in denied areas. ***FY 2019 Plans:*** The Rapid Reaction Fund (RRF) investment decisions are made during the execution years in response to DoD, Combatant Command, Service, and other government priorities and as new threats emerge or new opportunities are presented. RRF will support development of prototypes and new disparate data fusion, analysis tools, and applications to provide a hedge against emerging, irregular, and asymmetric threats. The program anticipates supporting six to eight projects in FY 2019. Deliverables will leverage emerging technologies to exploit wide variety of information sources and reduce analyst requirements to provide actionable intelligence. ***FY 2020 Plans:*** The RRF investment decisions are made during the execution years in response to DoD, Combatant Command, Service, and other government priorities and as new threats emerge or new opportunities are presented. The program anticipates supporting six to eight projects in FY 2020. Deliverables will leverage emerging technologies to exploit disparate data and reduce analyst requirements to provide actionable intelligence. ***FY 2019 to FY 2020 Increase/Decrease Statement:***			

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The FY 2018 and FY 2019 funding levels are lower than the baseline for this focus area, which is listed under FY 2020. This is because once projects are selected and funded during the years of execution (FY 2018/2019), the funds for these projects are reported elsewhere in this R-2. Projects have not been selected for FY 2020.			
Title: Autonomous Learning Systems and Behaviors Focus Area ***Description:*** Autonomous Learning Systems and Behaviors prototypes demonstrate capabilities to enhance the lethality of the joint force, reduce the time to make critical decisions, and protect warfighters through increased use of autonomous and human-machine collaborative systems. Autonomous Learning Systems and Behaviors projects leverage advances in machine learning to transfer cognitive burden closer to the point of collection/action. Example projects include agile computer vision systems, enhanced capabilities for multiple autonomous systems to cooperatively interact, autonomous task discrimination and prioritization, autonomous operation in complex terrain, data preprocessing to improve ex-filtration from unmanned sensors, human-machine collaborative decision making, and experiments to counter emerging unmanned threats from potential adversaries. These projects will also examine common software platforms and modular open architecture systems to reduce development cost, increase collaboration among manned and unmanned vehicles, increase agility through rapid customization, and inform requirements. ***FY 2019 Plans:*** Rapid Reaction Fund (RRF) investment decisions for Autonomous Learning Systems and Behaviors are made during the execution years in response to DoD, Combatant Command (CCMD), Service, and other government priorities. Selected projects will support development of components, payloads, and autonomous aerial, surface, and subsurface systems. RRF anticipates supporting six to seven projects in FY 2019. ***FY 2020 Plans:*** RRF investment decisions for Autonomous Learning Systems and Behaviors are made during the execution years in response to DoD, CCMD, Service, and other government priorities. RRF anticipates supporting six to seven projects in FY 2020. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2018 and FY 2019 funding levels are lower than the baseline for this focus area, which is listed under FY 2020. This is because once projects are selected and funded during the years of execution (FY 2018/2019), the funds for these projects are reported elsewhere in this R-2. Projects have not been selected for FY 2020.	-	5.508	6.721
Title: Enhanced Lethality in the Contested Urban Environment Focus Areas ***Description:*** Future military operations will likely occur in a broad range of urban environments with complex radio frequency, topological, situational awareness, and mobility challenges. Enhanced Lethality in the Contested Urban Environment Focus Area prototypes will identify, analyze, and describe typical urban areas for modeling, simulation, and planning purposes. These efforts	-	3.720	4.995

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will inform and enable development of intelligence, surveillance, and reconnaissance; electronic warfare; kinetic and non-kinetic effects; and, other capabilities needed for future military operations in a wide range of urban areas. ***FY 2019 Plans:*** The Rapid Reaction Fund (RRF) investment decisions for Enhanced Lethality in the Contested Urban Environment projects are made during the execution years in response to DoD, Combatant Command (CCMD), Service, and other government priorities. As new threats emerge and new opportunities are presented, RRF will select projects to demonstrate capabilities for Urban Characterization. RRF anticipates supporting four to five projects in FY 2019. Deliverables will include conceptual prototypes, modeling, and simulations to support planning efforts. ***FY 2020 Plans:*** The RRF investment decisions for Enhanced Lethality in the Contested Urban Environment projects are made during the execution years in response to DoD, CCMD, Service, and other government priorities. RRF anticipates supporting four to five projects in FY 2020. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2018 and FY 2019 funding levels are lower than the baseline for this focus area, which is listed under FY 2020. This is because once projects are selected and funded during the years of execution (FY 2018/2019), the funds for these projects are reported elsewhere in this R-2. Projects have not been selected for FY 2020.			
Title: Rapid Prototyping for Systems and Applications of Interconnected Sensors and Command Networks Focus Area	-	5.320	6.671
Description: Intelligence, surveillance, and reconnaissance (ISR) sensor networks are critical for providing asymmetric compensation against larger, near-peer adversaries. Advances in distributed, interconnected sensors with fully networked command, control, and communications provide opportunities for new solutions to anti-access/area denial and persistent surveillance challenges. Efforts in this focus area will increase the speed of innovation and technology adoption for dynamic, inhomogeneous, fully networked sensors and develop new tools to more effectively analyze or visualize ISR data. Projects include improved sensor hardware; new capabilities enabled by networking sensor systems; sensor network protection and assured communications; validation of low-cost, robust persistent surveillance capabilities; and, establishment of more effective processing, exploitation, and dissemination capabilities. Rapid Reaction Fund (RRF) sponsored prototypes will facilitate integration of advanced ISR and communication capabilities into new and existing systems. These prototypes will help increase the effectiveness of ISR architectures and reduce the human analyst requirement to produce actionable intelligence. ***FY 2019 Plans:*** RRF investment decisions for sensor network prototypes are made during the execution years in response to Department, Combatant Command (CCMD), Service, and other government priorities and as new threats emerge or new opportunities are			

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presented. Research and coordination with organizations throughout DoD and other government agencies will help identify areas critical to developing future capabilities. RRF anticipates supporting five to seven projects in FY 2019. Deliverables will include prototype systems, analytical capabilities, and software for a variety of platforms. ***FY 2020 Plans:*** RRF investment decisions for sensor network prototypes are made during the execution years in response to Department, CCMD, Service, and other government priorities. RRF anticipates supporting five to seven projects in FY 2020. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2018 and FY 2019 funding levels are lower than the baseline for this focus area, which is listed under FY 2020. This is because once projects are selected and funded during the years of execution (FY 2018/2019), the funds for these projects are reported elsewhere in this R-2. Projects have not been selected for FY 2020.			
Title: Novel Manufacturing Focus Area	-	5.325	6.486
Description: This focus area will develop the enabling capabilities and key prototypes required to advance and secure new manufacturing technologies including additive manufacturing, emerging microelectromechanical systems (MEMS), and tailored integrated circuit architectures to meet specific warfighter needs. New manufacturing technologies are enabling revolutionary advances in existing capabilities such as hand held deoxyribonucleic acid (DNA) sequencing; advanced wearable devices; tailored metamaterials; advanced MEMS radio frequency circuits; and integrated photonic devices. Many novel manufacturing processes allow for rapid prototyping and iterative innovation, removing barriers for technology insertion. These manufacturing technologies provide a unique capability for maintaining a U.S. competitive advantage through order of magnitude size, weight, and power reductions; increased speed from design to prototype; reduced cost; and reduced waste. This focus area will leverage swiftly-developing commercial innovation and emerging capabilities of the Federally Funded Research and Development Centers, government laboratories, and academia to develop conceptual prototypes focused on warfighter needs. Projects will also investigate security of additive manufacturing technologies, digital schematics, MEMS devices, and custom integrated circuit architectures. Deliverables will also inform enhancement decisions and concept of operations development. ***FY 2019 Plans:*** Rapid Reaction Fund (RRF) investment decisions are made during the execution years in response to Department, Combatant Commands (CCMD), Service, and other government priorities and as new threats emerge or new opportunities are presented. For novel manufacturing projects this agility supports leveraging new capabilities developed by commercial industry. Research and coordination with organizations throughout DoD and other government agencies will help identify needs that could be addressed by future capabilities within the additive manufacturing field. RRF anticipates supporting five to seven projects in FY 2019. ***FY 2020 Plans:***			

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RRF investment decisions are made during the execution years. The selection of future novel manufacturing projects will be based on priorities throughout DoD and other government agencies, and new opportunities for additive manufacturing. RRF anticipates supporting five to seven projects in FY 2020. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2018 and FY 2019 funding levels are lower than the baseline for this focus area, which is listed under FY 2020. This is because once projects are selected and funded during the years of execution (FY 2018/2019), the funds for these projects are reported elsewhere in this R-2. Projects have not been selected for FY 2020.			
Title: Prototyping Through Novel Reuse of Government/Commercial-Off-the–Shelf (G/COTS) Technologies Focus Area ***Description:*** This effort increases impact and responsiveness of prototyping efforts through the reuse and repurposing of existing commercial and governmental technologies. Frequently, systems developed for a separate application provide a partial solution to new emerging challenges. By building new prototypes around a core of proven technologies, this effort reduces development and adoption risk in addition to controlling cost. This focus area provides RRF with agility by leveraging existing technologies to develop new prototypes and demonstrate new capabilities more quickly. ***FY 2019 Plans:*** The Rapid Reaction Fund (RRF) investment decisions for G/COTS-based prototypes are made during the execution years in response to Department, CCMD, Service, and other government organization priorities and as new threats emerge or new opportunities are presented. Projects identified include efforts to repurpose commercial communication protocols into an electronic warfare capability, advances in microelectronic circuits, airport radar systems for bird alerts repurposed for counter-unmanned aircraft system (UAS), advances in quantum sensors and programming for quantum processers, and commercial network security platforms. RRF anticipates supporting three to four projects in FY 2019. ***FY 2020 Plans:*** The RRF investment decisions for G/COTS-based prototypes are made during the execution years in response to Department, CCMD, Service, and other government organization priorities. RRF anticipates supporting three to four projects in FY 2020. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The FY 2018 and FY 2019 funding levels are lower than the baseline for this focus area, which is listed under FY 2020. This is because once projects are selected and funded during the years of execution (FY 2018/2019), the funds for these projects are reported elsewhere in this R-2. Projects have not been selected for FY 2020.	-	2.240	3.533
Accomplishments/Planned Programs Subtotals	39.082	36.998	44.796

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	FY 2018	FY 2019
Congressional Add: Solar Energy Research	3.000	-
FY 2018 Accomplishments: The Solar Energy Research project is an FY 2018 Congressional program increase to produce risk-reducing prototypes that rapidly mature innovative concepts and immature technologies into tangible capabilities for the warfighter. Selected projects matured advanced solar cell chemistries; innovative form factors; and, new manufacturing processes. In 2018, this project initiated development efforts including stakeholder coordination, system design, and test planning. Using FY 2018 funds, this project will mature a hardware prototype and demonstrate the advance solar cells on a military relevant system in 2019. This project will be executed in accordance with Congressional intent.		
Congressional Adds Subtotals	3.000	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

RRF leverages the Services' and Defense Agencies' most efficient and effective acquisition approach for rapid prototyping. This includes using Other Transaction Authorities and new or existing contract vehicles.

E. Performance Metrics

The Rapid Reaction Fund (RRF) supports the FY 2020 performance metrics to transition projects that address Joint Force and Combatant Command capability gaps. In FY 2018, RRF transitioned 33 prototypes with an overall transition rate of 80 percent. All RRF projects are monitored for schedule deviation, transition outcome, and deliverables such as advanced algorithms, hardware, and other components.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense			Date: February 2019
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*	Project (Number/Name) 831 / *Joint Rapid Acquisition Cell Support*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
831: *Joint Rapid Acquisition Cell Support*	9.561	1.649	1.669	0.000	-	0.000	0.000	0.000	0.000	0.000	Continuing	Continuing

Note

In FY 2020 JRAC will be transferred to an Operations and Maintenance Program Element (0903399D8Z) within the Office of the Under Secretary of Defense for Acquisition and Sustainment for proper alignment and execution.

A. Mission Description and Budget Item Justification

This funding includes support for the Joint Rapid Acquisition Cell (JRAC) to enable management and tracking of Combatant Command (CCMD) identified and Joint Staff validated immediate warfighter needs. The JRAC is responsible to:

(1) Coordinate review of validated Joint Urgent Operational Needs (JUON) and Joint Emergent Operational Needs (JEON) and assign responsibility to appropriate DoD Components for timely funding and resolution.

(2) Serve as the review and approval authority for the DoD Components' strategy to fund and mitigate the identified JUON/JEON capability gaps.

(3) Continually assess actions taken by the DoD Components to resolve JUONs/JEONs and recommend to the Under Secretary of Defense for any changes determined appropriate to improve their responsiveness to JUONs/JEONs.

(4) Provide periodic reports to the Secretary of Defense on new and outstanding JUONs/JEONs.

(5) In coordination with Under Secretary of Defense Comptroller (USD(C)), manage the Rapid Acquisition Fund (RAF) to allocate resources to priority unfunded JUONs/JEONs.

(6) In coordination with the Office of the Chairman of the Joint Chiefs of Staff and the USD(C), make programmatic, budget, and acquisition recommendations for JUONs and identify capability gaps to the Secretary of Defense.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Joint Rapid Acquisition Cell (JRAC) Management Support	1.649	1.669	0.000
Description: This funding is used to support the staff manning of the JRAC to enable management and tracking of CCMD identified and Joint Staff validated immediate warfighter needs.			
FY 2019 Plans: Continue support for the JRAC management and tracking of CCMD initiatives. Continue validation of the warfighter needs by the Joint Staff.			
FY 2020 Plans: Using FY 2019 funding, JRAC will continue support for management and tracking of CCMD initiatives.			
FY 2019 to FY 2020 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense		Date: February 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*	**Project (Number/Name)** 831 / *Joint Rapid Acquisition Cell Support*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
As part for the FY 2020 realignment, Joint Raid Acquisition Cell support will be transferred to Program Element 0903399D8Z within the Office of the Under Secretary of Defense for Acquisition and Sustainment for alignment and execution.			
Accomplishments/Planned Programs Subtotals	1.649	1.669	0.000

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A – Capabilities acquired to fulfill Joint Urgent Operational Needs (JUON) and Joint Emergent Operational Needs (JEON) are provided by other DoD components.

E. Performance Metrics

Joint Rapid Acquisition Cell performance metrics are specific to each JUON/JEON and include measures identified in the management approach for each action. In addition, JUON/JEON completions and successes are monitored against schedules and deliverables stated in the management approach. The metrics that JRAC support correlates to is the number of full time personnel identified in the JRAC support contract with associated pay rates and shall not exceed the specified amounts or hourly rates and/or firm fixed price.

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense			Date: February 2019
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*	Project (Number/Name) 833 / *Strategic Multi-Layered Assessment (SMA) Support*	

COST ($ in Millions)	Prior Years	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total	FY 2021	FY 2022	FY 2023	FY 2024	Cost To Complete	Total Cost
833: *Strategic Multi-Layered Assessment (SMA) Support*	10.704	2.301	2.324	2.351	-	2.351	2.375	2.399	2.423	2.447	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Strategic Multi-Layered Assessment (SMA) branch supports all Combatant Commands (CCMDs), Joint Force Commanders, and other government agencies by assessing complex operational and technical challenges, which require collaborative multi-agency and multi-disciplinary approaches. With input from across the U.S. government, academia, and the private sector, SMA develops options to CCMD-generated challenging problems and informs the command's senior leadership. Each SMA effort is initiated at the request of senior CCMD leadership. Priorities for SMA problems are set by the Joint Staff Deputy Director for Global Operations (DDGO). Products are typically produced within six to nine months and directly contribute to the decision making process of CCMD's senior leaders. SMA is also supported by the Rapid Reaction Fund (RRF).

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Strategic Multi-Layered Assessment (SMA)	1.240	2.324	2.351

Description: The SMA Cell supports the Combatant Commands (CCMDs) and U.S. government agencies with actionable assessments of complex operational and technical challenges, to help maintain our competitive advantage in an increasingly complex global environment. Challenges addressed with SMA efforts require multi-agency and multi-disciplinary approaches that are not within the customer organization's core competency. SMA started a strategic analysis effort at the request of the United States Security Coordinator for Israel and the Palestinian Authority. The effort evaluated strategic risks and identified knowledge gaps to provide an increased understanding of potential security environments and their implications for Palestinian security sector reform. U.S. European Command (USEUCOM) subsequently asked SMA to apply the same methodology to identify emerging Russian threats and opportunities in Eurasia. SMA efforts are facilitated by the Joint Chiefs of Staff/J-3 Operations and are executed by the Office of the Under Secretary of Defense, Research and Engineering.

FY 2019 Plans:
In support of U.S. Indo-Pacific Command and U.S. Army Pacific, SMA's follow on Gray Zone effort, Strategic Outcomes in the Korea Peninsula, will continue to analyze near-term and long-term strategic outcomes resulting from alternative U.S. political-military options for addressing the nuclear and ballistic missile programs of the Democratic People's Republic of Korea. SMA will continue to actively work with the CCMDs and the Joint Chiefs of Staff to identify challenging problems that are not within the traditional areas of DoD expertise.

FY 2020 Plans:
SMA will actively work with the CCMDs and the Joint Chiefs of Staff to identify challenging problems that are not within the traditional areas of DoD expertise. These problems will be in direct support of CCMD senior leadership and may include areas

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense		Date: February 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*	**Project (Number/Name)** 833 / *Strategic Multi-Layered Assessment (SMA) Support*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
such as: counter terrorism, transnational criminal organizations, counter weapons of mass destruction (state and non-state), counter global or regional social and cultural assessments, regional stability assessments, and individual state or national level deterrence studies. ***FY 2019 to FY 2020 Increase/Decrease Statement:*** Level of effort is consistent between FY 2019 and FY 2020. Small changes reflect minor budget fluctuations and growth consistent with inflation.			
Title: Gray Zone Conflicts: Contested Space Operations Continued for Air Force Space Command (AFSPC) and Strategic Outcomes in the Korean Peninsula ***Description:*** Building on prior SMA efforts, U.S. Special Operations Command requested that SMA assess how the U.S. government can diagnose, identify, and assess indirect strategies, and develop response options against associated types of Gray Zone challenges. SMA completed several actor and social media analyses including Virtual Think Tank Assessments (ViTTa) that provided summarized subject matter expert (SME) analyses to USSOCOM. At the request of AFSPC, the FY 2017 and FY 2018 Gray Zone efforts focused on contested space operations. Among other issues, this effort addressed the implications (rewards and risks) of the U.S. adopting a policy of space as a joint, combined, and inter-agency warfighting domain. At the request of U.S. Indo-Pacific Command (USINDOPACOM) and U.S. Army Pacific (USARPAC), FY 2018 funding also initiated an assessment of plausible political-military options regarding North Korea and near- and long-term implications of these for the U.S. and regional stakeholders. These two follow-on Gray Zone efforts will apply the concepts and insights derived during the first phase to the realm of contested space operations in support of AFSPC, and implications of various U.S. actions towards North Korea. Analysis will highlight the indications and warnings and the U.S. response options.	1.061	-	-
Accomplishments/Planned Programs Subtotals	2.301	2.324	2.351

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

SMA performance metrics are specific to each effort and include measures identified in the specific project plans. In addition, project completions and successes are monitored against schedules and deliverables stated in the execution documents. Each project's results are reviewed by a senior review group that is comprised with representatives from the Office of the Secretary of Defense, the Joint Chiefs of Staff, the Combatant Commands, and outside subject matter experts. The ultimate

Exhibit R-2A, RDT&E Project Justification: PB 2020 Office of the Secretary Of Defense		Date: February 2019
Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603826D8Z / *Quick Reaction Special Projects (QRSP)*	**Project (Number/Name)** 833 / *Strategic Multi-Layered Assessment (SMA) Support*

measure of success is adoption and transition of SMA products by the CCMD and supporting entities. In FY 2018, SMA products were delivered to senior leadership and staff at U.S. Special Operations Command, U.S. Central Command, and U.S. European Command.