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Exhibit R-2, RDT&E Budget Item Justification: PB 2020 Office of the Secretary Of Defense **Date:** February 2019

Appropriation/Budget Activity 0400: <i>Research, Development, Test & Evaluation, Defense-Wide I BA 3: Advanced Technology Development (ATD)</i>	R-1 Program Element (Number/Name) PE 0603648D8Z I <i>Joint Capability Technology Demonstration (JCTD)</i>
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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	859.465	102.769	105.808	107.359	-	107.359	109.925	112.057	114.205	116.627	Continuing	Continuing
648: <i>Joint Capability Technology Demonstration (JCTD)</i>	859.465	102.769	105.808	107.359	-	107.359	109.925	112.057	114.205	116.627	Continuing	Continuing

A. Mission Description and Budget Item Justification

In alignment with the National Defense Strategy (NDS) and the DoD modernization priorities, the Joint Capability Technology Demonstration (JCTD) program conducts prototype demonstrations and experimentation to address Joint and Combatant Commands' (CCMDs) warfighting needs within two to four years of the identification of a need. The program delivers developmental and operational prototypes to the field for military utility assessment (MUA) enabling scale-up of science and technology from the laboratories into defense acquisition programs. The objective is to affordably operationalize prototyped technologies that enable warfighters to explore novel concepts and to facilitate informed transition to formal programs of record (PoR). Based on the results of the MUA, performed under the cognizance of a CCMD sponsor, the products of a JCTD are "left behind" for additional assessments or operational use, transitioned to a PoR, or returned to the technical baseline inventory for further development. The JCTD program serves as a transition bridge between the USD (R&E) and the USD Acquisition and Sustainment offices.

The key tenets of the program fulfill national objectives to build a more lethal force, strengthen alliances, and enable the Department of Defense (DoD) to achieve greater performance and affordability. Following USD(R&E) guidance, the JCTD program seeks to inform new mission capabilities for the Joint Warfighter with a focus on expediting transition timelines to meet critical challenges and operational problems. Investment for FY 2019 and beyond enables independent demonstrations and operational assessments for emerging cross-cutting technologies, including detection and tracking of hypersonic threats; hardening technology that protects systems against directed energy threats; machine learning tools that increase data processing, exploitation, and data sharing for intelligence analysts; demonstration of improved sensors for persistent wide-area surveillance in a global positioning system-denied environment; and demonstration of improved precision guided munitions that enhances missile defense and restricts enemy movements in the multi-domain environment. JCTD outcomes accelerate technology transition by rapidly evaluating technology risk, reliability, interoperability, cyber security, and manufacturing processes. Evaluating prototyped technologies in a relevant operational environment informs acquisition pathways and major acquisition program decisions prior to milestone A or B approvals.

The JCTD program achieves its objectives by engaging the Military Services, interagency, international, and non-governmental partners to expand the DoD's access to prototyping and innovation. JCTDs serve as a vehicle for CCMDs to address Joint Force strategic priority areas that present significant risk and suffer from inadequate investment. JCTDs often address technology needs that fall into the seams between the Military Services and DoD Agencies. JCTD investments are informed by the CCMDs' integrated priority list, the capability gaps assessment provided by the Joint Staff, and the Military Services' science and technology roadmaps.

In FY 2018, the JCTD program successfully completed three MUAs and transitioned three JCTD prototypes. Two JCTDs transitioned all or select components to new or existing PoRs, and one operational prototype was directly fielded and is being sustained by non-JCTD funds in theater operations.

MEASURABLE OUTCOMES:

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A successful JCTD will transition capability for operational use. The historical transition rate for the JCTD program is 85 percent, including: 64 prototypes (55 percent) transitioning to a PoR; 31 prototypes (26 percent) providing “leave-behind” assets for operational fielding; and five prototypes (four percent) placed on the General Services Administration schedule. The remaining 17 prototypes (15 percent) were returned to the technical base for further development or were terminated. Overall, the JCTD program has directly supported multiple key operations while rapidly accelerating game changing technologies/capabilities.

B. Program Change Summary (\$ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	105.871	106.049	107.666	-	107.666
Current President's Budget	102.769	105.808	107.359	-	107.359
Total Adjustments	-3.102	-0.241	-0.307	-	-0.307
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-2.898	-			
• FFRDC Reduction	-0.204	-0.241	-	-	-
• Other Program Adjustments	-	-	-0.307	-	-0.307

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Appropriation/Budget Activity 0400 / 3					R-1 Program Element (Number/Name) PE 0603648D8Z / <i>Joint Capability Technology Demonstration (JCTD)</i>				Project (Number/Name) 648 / <i>Joint Capability Technology Demonstration (JCTD)</i>			
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
648: <i>Joint Capability Technology Demonstration (JCTD)</i>	859.465	102.769	105.808	107.359	-	107.359	109.925	112.057	114.205	116.627	Continuing	Continuing

A. Mission Description and Budget Item Justification

JCTD project selection is driven by the ability to accelerate transition of new prototyped capabilities to the Joint Warfighter; strong Combatant Command and Joint Staff interest; cost share commitments from the Military Services and Defense Agencies; mature technical readiness; and a well-defined and affordable transition path for long-term sustainment. Focus areas within the current selection cycle include: joint lethality in contested environments; resilient command, control, communications, computer, intelligence, surveillance, and reconnaissance (C4ISR), and positioning, navigation, and timing; and, survivable and agile logistics. The focus areas were derived from the National Defense Strategy, the Chairman's Capability Gap Assessment, and the DoD modernization priorities. Technology areas under consideration include: detection and tracking of hypersonic threats; hardening technology that protects systems against directed energy threats; machine learning tools that increase data processing, exploitation, and data sharing for intelligence analysis; demonstration of improved sensors for persistent wide-area surveillance in a global positioning system-denied environment; and demonstration of improved precision guided munitions that enhances missile defense and restricts enemy movements in the multi-domain environment.

The final objective for the JCTD program is to maintain the United States' technological superiority across the range of military operations while reducing the cost of operations, facilitating joint interoperability, and allowing for the rapid insertion of new capabilities.

B. Accomplishments/Planned Programs (\$ in Millions)

	FY 2018	FY 2019	FY 2020
<p>Title: Low Cost Cruise Missile (LCCM)</p> <p>Description: Previously funded JCTD. LCCM directly supports the Secretary of Defense's priority for increased lethality. LCCM provides a decentralized autonomy capability for low-cost, conventional air-launched cruise missiles that will enable joint access and maneuver in the global commons. It will be capable of conducting networked integrated attacks, in-flight dynamic retargeting/reallocation and synchronized cooperative/saturation attacks. Flight demonstrations will be conducted using surrogate weapon platforms and will provide residual leave-behind payloads for transition to a full weapon system development program. FY 2018 funds were used to produce the baseline lot of LCCM vehicles and begin flight testing. The technical manager continued the maturation and refinement of the autonomy module's ability to sense the environment and execute countermeasures.</p> <p>FY 2019 Plans: LCCM team will conduct over one hundred sorties utilizing multi-platform formations of surrogate weapons during the technical and operational demonstrations. Missions will focus on ingress formation station keeping and tactics as well as terminal area coordinated, collaborative swarm maneuvers in the presence of jamming. Pending successful operational demonstrations and</p>	5.000	5.000	-

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
military utility assessments, LCCM will provide residual leave-behind autonomy payloads for transition to a full weapon system development program. Complete the JCTD. FY 2019 to FY 2020 Increase/Decrease Statement: Project will complete in FY 2019.				
Title: Port Improvement via Exigent Repair (PIER) Description: Previously funded JCTD. PIER supports the National Defense Strategy's focus on logistics modernization and the need for resilient and agile logistics. PIER will deliver a dynamic, agile, cost effective (non-military construction) expeditionary engineering solution to rapidly repair damaged or degraded ports to a minimum level of serviceability after an attack or natural disaster. Agility is achieved through a smaller footprint, commercial off-the-shelf components, and quick reaction of theater-based repair assets (e.g., pre-packaged, pre-positioned). The intent of PIER is to assure continued logistics resiliency and freedom for U.S. Forces to maneuver and conduct agile strategic sealift and logistics. PIER will allow the Department of Defense to address the doctrine, organization, training, materiel, leadership, personnel, facility, and policy (DOTMLPF+P) concerns about its ability to conduct rapid port damage repair. FY 2018 efforts included an operational demonstration of the pile bracing/bridging and mooring technologies, and a technical demonstration on the Pier Overdecking System (PODS). These technologies allowed secondary components to strengthen the superstructure of the piers. FY 2019 Plans: PIER will conduct a final military utility assessment of technologies in cooperation with U.S. Transportation Command (USTRANSCOM), U.S. Navy, and U.S. Army. Components will transition to USTRANSCOM, U.S. Navy, and U.S. Army. Complete the JCTD. FY 2019 to FY 2020 Increase/Decrease Statement: Project will complete in FY 2019.		2.104	0.500	-
Title: Assured Command and Control using Emerging Nanosat Technology (ACCENT) Description: Previously funded JCTD. ACCENT supports the National Defense Strategy's focus on space domain defense via a modern technology solution that improves space resiliency. ACCENT places an adaptive filter algorithm into a nano-satellite receiver to mitigate radio frequency interference. ACCENT rapidly integrates the filter into a number of radios with an optional path to test in space using existing nano-satellite radios. In FY 2018, ACCENT used both JCTD and partner funds to incorporate and integrate adaptive algorithms and radio modifications to improve performance. ACCENT tested a filter-algorithm in space with the integrated communications extension capability nano-satellite constellation, and produced on-orbit test results and the military utility assessment reports. ACCENT transitioned to Navy Program Executive Office for Space Systems Science and Technology. Completed the JCTD.		0.400	-	-

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
<p>Title: Brilliant Effects Employment Shadow (BEES)</p> <p>Description: Previously funded JCTD. BEES directly supports the Secretary of Defense's priority for increased lethality by enhancing the targeting kill chain. BEES will demonstrate finding, fixing, tracking, and targeting of mobile targets using cooperative, multi-modal intelligence surveillance and reconnaissance (ISR) and electronic warfare (EW) sensors on autonomous, unmanned aerial systems (UAS). BEES will demonstrate autonomous behaviors to synchronize multiple ISR and EW unmanned platforms that responsively find, fix, and track moving high value targets, and update manned strike/command and control platforms. In FY 2018, BEES conducted flight demonstrations of UAS required behaviors, fight demonstrations of EW and ISR autonomous actions and laboratory testing of integrated EW and ISR payloads.</p> <p>FY 2019 Plans: BEES will conduct a joint military utility assessment (MUA) of autonomous EW and ISR behaviors as part of an integrated mission package in an operationally representative environment. The flight phase will conclude at the end of FY 2019. Pending successful operational demonstrations and MUA, the BEES capability will transition to a Service program of record using partner funding.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: Project will complete in FY 2019.</p>		4.000	5.000	-
<p>Title: High-altitude Attributable Link Offset (HALO)</p> <p>Description: Previously funded JCTD. HALO directly supports the Department of Defense's strategic efforts to develop resilient command, control, and communications at the tactical level. HALO uses high altitude, low-cost balloons as communication relays in denied environments. It accomplished this by using the ultra-high frequency (UHF) radio frequency (RF) spectrum and techniques that provide an undisturbed and unrecognizable link to the source of the UHF signals. The advanced technology resides at the user terminals on the ground, which receive data from the balloon-platforms, and perform functions that allow effective two-way communication in a contested RF environment. In FY 2018, HALO completed laboratory testing and two operational flight-test demonstrations with several high-altitude relays against multiple jammers. HALO received procurement funds to complete the concept of operations, conduct military utility assessment, and transition to the USMC program office for production acquisition contracts. Completed the JCTD.</p>		3.861	-	-
<p>Title: Gunsmoke-J (Note: Name changed from Jacob's Ladder)</p> <p>Description: Previously funded JCTD. Gunsmoke-J supports the National Defense Strategy's focus on space domain defense via a technology approach to increase space resiliency. Gunsmoke-J uses emerging advanced electronics to allow the use of dedicated intelligence assets to provide tactically actionable targeting data to warfighters on a responsive and persistent timeline. In FY 2018, Gunsmoke-J conducted mission performance analyses while maturing the cubic satellite (CubeSat) system</p>		2.500	-	-

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
<p>designs and matured a data dissemination architecture. Gunsmoke-J finalized the concept of operations and evaluation plan for the military utility assessment (MUA); completed the CubeSat system assembly, integration and test work; and finalized the dissemination ground segment. The JCTD successfully conducted its critical design review, flight readiness review, and delivered four flight units to the launch provider for integration and launch. Three ground stations were installed for the MUA which was conducted by U.S. Indo-Pacific Command (USINDOPACOM) in 2018. Gunsmoke-J residuals transitioned to USINDOPACOM for operational use and sustainment. Completed the JCTD.</p>				
<p>Title: Mobile Unmanned Air Vehicle Distributed Lethality Airborne Network (MUDLAN)</p> <p>Description: Previously funded JCTD. MUDLAN supports the National Defense Strategy's focus on command, control, communications, computers, intelligence, surveillance and reconnaissance (ISR) and fully networked command, control and communications modernization. In FY 2018, MUDLAN demonstrated resilient networking that supports high data rate communications across multiple airborne and surface platforms operating in contested environments.</p> <p>FY 2019 Plans: MULAN will perform flight testing on air, land, and sea platforms to demonstrate military utility of high data rate communications nodes, and demonstrate over-the-horizon, distributed communications capabilities at scale.</p> <p>FY 2020 Plans: MUDLAN will incorporate and demonstrate a spectrum agility capability to autonomously shift frequency bands to ensure continuous air, land, and sea connectivity in contested electronic warfare environments. MUDLAN will transition the technologies to a U.S. Air Force Air Combat Command program of record. Complete the JCTD.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: Funding decreases in FY 2020 because the primary design, testing, and integration will have concluded. Operational testing and transition efforts will be supported by increased funding from partner organizations.</p>		2.800	2.600	1.500
<p>Title: Predictive Human Intelligence (HUMINT) Crisis Model (PICK'EM)</p> <p>Description: Previously funded JCTD. PICK'EM addresses capability needs identified in the U.S. Special Operations Command (USSOCOM) and U.S. Africa Command (USAFRICOM) integrated priority lists. PICK'EM will leverage machine learning and cognitive computing to provide USSOCOM, USAFRICOM, and the Defense Intelligence Agency (DIA) the capability to forecast crisis events, provide courses of action, and identify operational candidates to carry out missions in support of joint warfighters. In FY 2018, PICK'EM delivered a prototype test bed, source code, and data sets. PICK'EM started to ingest live data from multiple sources and conducted system level testing, security validation, and system accreditation. PICK'EM also delivered an operational prototype that used live scenarios.</p>		3.000	3.800	-

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
<p>FY 2019 Plans: PICK'EM will validate its prototype using live scenarios. After operational demonstrations, an independent assessor will conduct a military utility assessment. PICK'EM will transition to the DIA, USSOCOM, and USAFRICOM.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: Project will complete in FY 2019.</p>				
<p>Title: Pseudolite Synthetic Aperture Radar (PSAR)</p> <p>Description: Previously funded JCTD. PSAR supports the National Defense Strategy's focus on command, control, communications, computers, intelligence, surveillance and reconnaissance (ISR). PSAR will mature a small form-factor synthetic aperture radar (SAR) to provide all weather ISR from a high altitude (pseudolite) platform. The small light low power system will provide high ground resolution. The PSAR capability will be demonstrated on a high altitude long endurance (HALE) unmanned aerial system. In FY 2018, PSAR designed and fabricated antennas and power amplifiers for two SAR prototypes; repackaged prototypes to meet the HALE size, weight, power and cooling constraints; and, integrated a down-link communications system for transfer of SAR data.</p> <p>FY 2019 Plans: PSAR will fly prototypes on a surrogate manned aircraft; complete integration of SAR prototypes on a pseudolite aircraft; and conduct technical and operational demonstrations, and military utility assessment. A fully operational capability will transition to U.S. Navy Program Executive Office, Space. Complete the JCTD.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: Project will complete in FY 2019.</p>		1.750	0.971	-
<p>Title: Quickstrike MK64 – Extended Range (QS64-ER)</p> <p>Description: Previously funded JCTD. QS64-ER supports the National Defense Strategy's focus to enhance joint lethality in contested environments. QS64-ER will provide U.S. Indo-Pacific Command a low-cost wing kit and munitions guidance package to allow for the delivery of maritime mines to a precise location, from a safe stand-off distance. In FY18, QS64-ER conducted aircraft integration and verified airworthiness of the QS-ER mine, and successfully demonstrated a flight test of a baseline prototype.</p> <p>FY 2019 Plans: QS64-ER will conduct a demonstration from a B-52, assess mine survivability, conduct a military utility assessment and transition to the U.S. Navy Program Manager, Ships (PMS-495).</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement:</p>		3.250	2.567	-

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
Project will complete in FY 2019.				
Title: Semi-Automated Counter-Propaganda Platform (SCP)		3.000	-	-
Description: Previously funded JCTD. SCP addresses capability needs identified in the U.S. Central Command (USCENTCOM), U.S. Special Operations Command (USSOCOM) and U.S. Southern Command (USSOUTHCOM) integrated priority lists and directly responds to a task for this capability in the National Defense Authorization Act for 2016. SCP will provide USCENTCOM, USSOCOM, USSOUTHCOM, and U.S. Indo-Pacific Command the ability to conduct critical military information support operations (MISO) at an unparalleled scale. In FY 2018, SCP conducted two technical demonstrations and delivered the SCP concept of operations, and the SCP training documentation. USCENTCOM conducted a military utility assessment and completed the JCTD. SCP transitioned to the MISO component within USSOCOM that provides support functions to all Combatant Commanders.				
Title: Talon Tactical Mobile Over-the-Horizon Radar (TACMOR)		3.500	-	-
Description: Previously funded JCTD. Talon TACMOR will support air and maritime domain awareness over the Western Pacific region. The project will demonstrate a sub-scaled over-the-horizon radar (OTHR) that is one quarter the size of traditional OTHR systems. In FY 2018, Talon TACMOR developed a system integration laboratory to test operational code based on foreign partner algorithms. In FY 2019, Talon TACMOR will conduct an operational demonstration of the radar and complete the JCTD. Talon TACMOR will use partner funds to complete transition in FY 2020 to a U.S. Air Force program of record.				
Title: Wingman		3.000	3.000	-
Description: Previously funded JCTD. Wingman supports the National Defense Strategy's focus on advanced autonomous systems and forward force maneuver. Wingman will project lethality by utilizing unmanned ground vehicles (UGVs) that can maneuver effectively with a mounted formation and engage ahead of and along with manned platforms. The integration of weaponized UGVs into combat elements will provide initial operational stand-off for manned vehicles, enhanced situational awareness, and mitigate the risk of casualties at first contact. In FY 2018, Wingman conducted an operational demonstration of the first unmanned system certified on the U.S. Army table VI scout gunnery course.				
FY 2019 Plans: Wingman will conduct a final military utility assessment of maneuver operations and Wingman technologies in cooperation with the U.S. Central Command and U.S. Army. Wingman will transition components to Product Manager, U.S. Army Applique and Large Unmanned Ground Systems (PM USA ALUGS); Program Executive Officer, U.S. Marine Corps Land Systems; and, U.S. Army Research, Development, Engineering Command. Complete the JCTD.				
FY 2019 to FY 2020 Increase/Decrease Statement:				

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
Project will complete in FY 2019.				
<p>Title: Autonomous Aerial Insertion and Resupply into Dense, Urban, Complex Terrain (AAIRDUCT)</p> <p>Description: Previously funded JCTD. AAIRDUCT supports the National Defense Strategy's focus to sustain Joint Force military advantages in austere locations and the Under Secretary of Defense, Research and Engineering's modernization priority for fully networked command, control and communications. AAIRDUCT will integrate and demonstrate multiple low-cost software enhancements into an autonomous precision aerial dispersion system capable of precisely delivering sensors, unmanned ground vehicles (UGV), munitions, humanitarian aid, and equipment into urban environments to reach isolated personnel. In FY 2018, AAIRDUCT completed the final design of the airdrop Multi-Use Aerial Dispersing System.</p> <p>FY 2019 Plans: AAIRDUCT will conduct a military utility assessment; finalize concepts of operation and tactics techniques and procedures; and update mission planning software to address urban operations. AAIRDUCT will transition the airdrop technology to Joint Precision Aerial Delivery System Ultra Lightweight programs of record (PoRs); the dispersion system to U. S. Army Special Operations Command Military Information Support Operations PoR; and UGV/Sensor PoR for autonomous emplacement. Complete the JCTD.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: Project will complete in FY 2019.</p>		2.200	1.400	-
<p>Title: Dialable Effects Munition (DEM)</p> <p>Description: Previously funded JCTD. DEM supports the National Defense Strategy's focus to enhance joint lethality in contested environments. DEM will provide U.S. Central Command and U.S. European Command the capability to modify munition effects while in flight to either increase a munition's effect on target or to lessen the effect for reduced collateral damage across a wide variety of targets. In FY 2018, DEM designed subsystem technologies and the systems integration plan for a full-scale prototype, designed the preliminary review of the DEM system, and pre-planned the options for a military utility assessment (MUA).</p> <p>FY 2019 Plans: DEM will perform the critical design review of the system, commence initial fabrication of the full-scale prototype, conduct ground tests, complete flight tests for inert and live prototypes, and conduct a readiness review. Upon successful completion of the DEM MUA, the government owned technical data package and test data will be transitioned to the U.S. Air Force Direct Attack Weapons Branch.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement:</p>		6.484	2.460	-

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
Project will complete in FY 2019.				
<p>Title: HYDRA</p> <p>Description: Previously funded JCTD. HYDRA supports the National Defense Strategy's focus to enhance forward force maneuver and posture resilience, as well as joint lethality in contested environments. HYDRA will provide U.S. Central Command and U.S. European Command the capability to deliver payloads from an undersea platform. HYDRA adapts the Defense Advanced Research Projects Agency's Hydra system and Office of Naval Research technologies to solve a Combatant Command capability shortfall, and will mature command and control capabilities to deliver the desired payload from an unmanned system. In FY 2018, HYDRA delivered a draft of the concept of operations, initial technical data packages and a prototyped payload capsule.</p> <p>FY 2019 Plans: HYDRA will deliver a final concept of operations, final technical data packages, a command and control package, begin building a prototype launch platform with an undersea launch capability, and a military utility assessment.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: Project will complete in 2019.</p>		3.000	4.000	-
<p>Title: Undersea Communications With Optical Laser Frequencies (Under C-WOLF)</p> <p>Description: Previously funded JCTD. Under C-WOLF directly supports the National Defense Strategy's focus to develop resilient and federated communication and information systems from the tactical to the strategic level. Under C-WOLF provides stealthy and low-latency optical laser communications (OCOMMS) between undersea systems and air platforms. Using low probability of intercept/low probability of detection technology, the Under C-WOLF JCTD accomplished this by exploiting the air-water-interface (AWI) OCOMMS system and the all-through-water (ATW) OCOMMS system to operate at tactically useful bandwidths, depths, and ranges. The bandwidth for the AWI OCOMMS system provides real-time command and control capability to the submarine. The bandwidth for the ATW OCOMMS system allows an unmanned underwater vehicle to provide results of extensive surveys to a submarine. Both systems together increase operational effectiveness of underwater communications in a radio frequency denied, degraded, or contested area, particularly in the U.S. Indo-Pacific Command and U.S. European Command areas of responsibility. In FY 2018, Under C-WOLF began maturing the AWI and ATW systems. Commenced testing and laboratory demonstrations.</p> <p>FY 2019 Plans: Under C-WOLF will continue maturation of the AWI and ATW systems; formulate AWI and ATW concept of operations; and acquire hardware for test demonstrations and AWI system demonstration.</p> <p>FY 2020 Plans:</p>		3.350	3.250	0.800

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
Under C-WOLF will deliver the AWI system for operational testing in relevant environment; complete the AWI platform integration; conduct laboratory testing of the ATW system; and perform operational demonstration. Under C-WOLF will transition capabilities to the U.S. Navy Program Executive Office Command, Control, Communications, Computers, and Intelligence.				
FY 2019 to FY 2020 Increase/Decrease Statement: FY 2019 to FY 2020 funds decrease as the capabilities begin to transition to the U.S. Navy Program Executive Office Command, Control, Communications, Computers, and Intelligence.				
Title: Combatant Commander (CCMD) Support, Capability Transition and Strategic Project Operational Management		19.522	21.083	22.000
Description: Previously funded effort. This effort is comprised of three programs that support the entire JCTD Program. The three programs are (1) CCMD direct liaison support, (2) JCTD pre-transition and (3) Program Integration Office for execution of select, classified projects. (1) CCMD direct liaison support: The CCMDs are essential in specifying capability needs, project identification, demonstration venues, military utility assessment, and transition of JCTDs. The JCTD program provides direct support to CCMDs enabling them to provide an on-site JCTD operational manager. (2) JCTD pre-transition: In some cases, Service or Agency partner transition funding is not available for one to two years following the JCTD demonstration phase. In such cases, where there is a clear transition and the need to sustain the capability for a short time prior to availability of Service or Agency transition funds, the JCTD pre-transition funds may be used to meet that need. (3) Program Integration Office: Executes a select number of highly classified projects in areas such as electronic miniaturization, electronic countermeasures, advanced mobile ad hoc network communications, space situational awareness intelligence surveillance and reconnaissance, sensor platforms and communications, and persistence surveillance.				
FY 2019 Plans: Provide CCMD direct participation to enable CCMD staff participation in identifying and executing developmental and operational prototypes. Identify and execute projects selected by the technology assessment panels. Sustain selected projects until program of record funds are received. Execute a limited number of classified projects' military utility assessments.				
FY 2020 Plans: Provide CCMD direct participation to enable CCMD staff participation in identifying and executing developmental and operational prototypes. Identify and execute projects selected by the technology assessment panels. Sustain selected projects until program of record funds are received. Execute a limited number of classified projects' military utility assessments.				
FY 2019 to FY 2020 Increase/Decrease Statement: Slight increase from FY 2019 to FY 2020 is due to inflation of multi-year contracts.				
Title: Enabling Technologies (ET)		3.000	5.000	5.000

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
<p>Description: The ET funds are used to assess or mature emerging capabilities that support the initiation of a developmental or operational prototype. ET investments are small (average less than \$0.500M), short (less than one year) efforts that may lead to a JCTD prototype, depending on the final assessment and determination of technical maturity. Examples of ETs funding in FY 2018 include: 1) The Autonomous Mission Package Planning and Execution (AMPPE) ET, a risk reduction effort for a set of autonomy-focused JCTDs. AMPPE demonstrated a baseline system with the ability to mission plan and conduct distributed cognitive networked electronic warfare and intel-surveillance-reconnaissance (ISR) missions using multiple unmanned aerial systems. This set a foundation for the Brilliant Effects Employment Shadow (BEES), Low-Cost Cruise Missile (LCCM) and Resilient Autonomy JCTDs. 2) Scanning Infrared Sensor for Unmanned Air Vehicle Detection and Tracking (SISUDT), a prototype fixed-site, multi-sensor counter-unmanned aerial system (C-UAS) to detect, track, and identify group one and two UASs near forward operating bases. One SISUDT prototype was deployed in support of OPERATION INHERENT RESOLVE for an in-theater validation of infrared UAS detection. As a result, the U.S. Air Force funded the operation of two SISUDT prototypes in theater. 3) IMEA (acronym is classified): Matured and manufactured a new unmanned aerial system airframe to address significant Warfighting gaps (details are classified). Began a risk reduction effort to ensure manufacturing standards and requirements are in place for the initial airframe prototype.</p> <p>FY 2019 Plans: Projects will continue to be used to assess or mature emerging capabilities that support the initiation of developmental or operational prototypes. Selected efforts will be small, focused, and executable in less than one year and require a deliverable prototype hardware and/or software, integrated subsystem or technology assessment report. Selection of ETs will be informed by the technical assessment panels that evaluate each new JCTD proposal.</p> <p>FY 2020 Plans: Projects will continue to be used to assess or mature emerging capabilities that support the initiation of developmental or operational prototypes. Selected efforts will be small, focused, and executable in less than one year and require a deliverable prototype hardware and/or software, integrated subsystem or technology assessment report. Selection of ETs will be informed by the technical assessment panels that evaluate each new JCTD proposal.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: No change in funding profile.</p>				
Title: JCTD Concept Development/Developmental and Operational Prototypes		0.000	25.680	56.168
Description: Continually funded effort. This funding allocation is used to provide funding for the new start JCTDs. The JCTD program will select projects as developmental and operational prototypes in alignment with the DoD's modernization priorities. Senior representatives from each Combatant Command, Service and Joint Staff participate in the review and selection of JCTDs. Selected projects will leverage networks within the global research and engineering enterprise to include government labs and				

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
<p>integration facilities, depots, academia, as well as traditional and non-traditional technology providers. Prototypes will utilize best practices to satisfy joint and cross-cutting needs. The JCTD office will work with the Services to identify means to streamline prototype transition into the acquisition systems where appropriate.</p> <p>FY 2019 Plans: Select advanced prototyping activities as new starts in FY 2019 in the following three(3) focus areas: - Joint lethality in contested environments: Develop means to enable the Joint Force to strike diverse targets inside adversary air and missile defense networks to destroy mobile power-projection platforms. This includes capabilities that enhance long range and close combat lethality in complex terrain. - Resilient C4ISR and positioning, navigation, and timing: Mature and maintain resilient, survivable, networks and information systems. Investments will focus on gaining and exploiting information, denying competitors those same advantages through kinetic and non-kinetic means, and defending the Joint Force while holding accountable state or non-state actors during cyberattacks. - Survivable and agile logistics: Enabling prepositioned forward stocks and munitions, strategic mobility assets, partner and allied support, as well as non-commercially dependent distributed logistics and maintenance to ensure logistics sustainment while under persistent multi-domain attack. These focus areas may be updated based on evolving Combatant Commanders' needs.</p> <p>FY 2020 Plans: Fund the follow-on efforts for projects started in FY 2019. Select advanced prototyping activities as new starts in FY 2020 that support the National Defense Strategy and the Under Secretary of Defense for Research and Engineering (USD(R&E)) priorities.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: Program Element baseline show an increase from FY 2019 to FY 2020. This line is dedicated to new start projects. During the years of execution (FY 2018 / FY 2019), once projects are selected, funding is no longer accounted in this line and is accounted for in projects detailed separately throughout the R-2A. The reality is that total funding supporting new start projects remains constant at approximately 30 percent of the annual appropriation.</p>				
<p>Title: Expedient and Expeditionary Airfield Damage Repair (E-ADR)</p> <p>Description: FY 2018 new-start JCTD. E-ADR supports the National Defense Strategy's focus on resilient agile logistics and forward force maneuver. E-ADR will provide an expeditionary low-logistics repair capability that maximizes the use of indigenous materials and readily available equipment. E-ADR will provide an expedient repair capability for aircraft runways in austere and dynamic base locations. In FY 2018, E-ADR conducted technical testing, model development, and tactics, techniques, and procedures (TTP) development.</p> <p>FY 2019 Plans:</p>		2.000	2.000	2.000

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
<p>E-ADR will conduct technical and operational demonstrations for model validation; runway repair quality assessment; and, damaged surface cutout and removal.</p> <p>FY 2020 Plans: E-ADR will refine TTP, conduct an operational demonstration, and conduct a final military utility assessment of surface capping and crater fill material processing, placement, and compaction. E-ADR will transition low-equipment count kits optimized for expeditionary transport along with validated TTP to U.S. Air Force Silver Flag sites and Naval Construction Groups via U.S. Air Force Civil Engineer Center, U.S. Air Force Life Cycle Management Center, Naval Facilities Command and Naval Expeditionary Combat Command.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: There is no funding change from FY 2019 to FY 2020.</p>				
<p>Title: Electromagnetic Spectrum - Visual Instance of the Environment for Warfighters (EMS-VIEW)</p> <p>Description: FY 2018 new-start JCTD. EMS-VIEW supports the National Defense Strategy's focus on deepening interoperability and innovative operational concepts. EMS-VIEW provides a joint enterprise framework for Services to share situational awareness, collaboratively plan, and decentralize decision making. EMS-VIEW's first generation framework allows for reliable electromagnetic spectrum (EMS) access and EMS freedom of maneuver for offensive and defensive operations in a multi-domain environment. In FY 2018, EMS-VIEW drafted the project reference architecture, built DoD architecture framework views, identified software services, defined database interfaces, authored an implementation guide, and finalized the technical and operational demonstration plans.</p> <p>FY 2019 Plans: EMS-VIEW will design, integrate, and demonstrate software services and conduct its final demonstration. Upon completion of the military utility assessment, EMS-VIEW will transition the capabilities to the U.S. Marine Corps' Spectrum Services Framework program, the U.S. Army's Electronic Warfare Planning and Management Tool program, and the DoD's Defense Spectrum Office's Global Electromagnetic Spectrum Information System program.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: Project will complete in 2019.</p>		1.081	1.264	-
<p>Title: Joint Negotiation of Asymmetric Threats (JNAT)</p> <p>Description: FY 2018 new start JCTD. JNAT supports the National Defense Strategy's focus on innovative operational concepts to deny enemy freedom of action. JNAT uses an adaptable plug and fight architecture that leverages existing applications to create a second generation counter unmanned aerial system (C-UAS) architecture. This system-agnostic architecture integrates a variety of sensors to be adaptably employed against evolving UAS threats, particularly in the U.S. Indo-Pacific Command, U.S.</p>		3.808	1.850	2.767

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
<p>Africa Command (USAFRICOM), and U.S. Northern Command areas of responsibility. JNAT received partner funds from the U.S. Air Force, U.S Army, U.S. Navy, and USAFRICOM. In FY 2018, JNAT tested a system architecture with radar and negation tools to conduct the first technical demonstration for UAS target detection and tracking.</p> <p>FY 2019 Plans: JNAT will conduct its operational demonstration with multiple radar systems and high power microwave systems, while demonstrating kinetic and non-kinetic negation options. JNAT will develop a C-UAS concept of operations and demonstrate a common operating picture and reporting tool.</p> <p>FY 2020 Plans: JNAT will conduct a cyber-negation demonstration; demonstrate a leave behind integrated air defense and point defense capability; baseline adaptable C-UAS architecture; and conduct the final military utility assessment. JNAT will transition to the U.S. Navy, the U.S. Air Force Life Cycle Management Center, and the U.S Army Aviation and Missile Research, Development and Engineering Center.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: FY 2019 to FY 2020 funds increase to enhance prototype C-UAS architecture with additional capabilities prior to the military utility assessment.</p>				
<p>Title: More Situational Awareness for Industrial Control Systems (MOSAICS)</p> <p>Description: FY 2018 new start JCTD. MOSAICS supports the National Defense Strategy's focus on cyber space domain defense and improved posture resilience and cybersecurity modernization. MOSAICS will provide cyber defense for supervisory industrial controls of critical warfighting infrastructure. MOSAICS will provide the ability to semi-autonomously detect, analyze, visualize, mitigate and recover from asymmetric attacks on critical infrastructure industrial controls in mission relevant timeframes. In FY 2018, MOSAICS conducted technology development in a lab environment, validated system interfaces and protocols, drafted a concept of operations (CONOPS), and began demonstrations.</p> <p>FY 2019 Plans: MOSAICS will provide a fully integrated end-to-end prototype, conduct initial field demonstrations, and deliver advanced cyber industrial control systems tactics techniques, and procedures.</p> <p>FY 2020 Plans:</p>		1.650	1.300	2.040

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
<p>MOSAICS will conduct operational demonstrations and deliver leave-behind operational prototypes, validated CONOPS, training packages, and Unified Facilities Criteria. After the military utility assessment (MUA), MOSAICS will transition to U.S. Navy Naval Facilities Engineering Command for sustainment. Complete the JCTD.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: FY 2019 to FY 2020 increase is based on higher cost of executing multiple operational demonstrations and conducting the MUA.</p>				
<p>Title: Automating Indications and Warnings (I&W) for Operational Awareness (REDLINE)</p> <p>Description: FY 2018 new start JCTD. REDLINE supports the National Defense Strategy's focus on military applications of machine learning to gain a competitive military advantage. REDLINE will leverage machine learning to provide Combatant Commands the ability to conduct automated order of battle tracking of adversary conventional and grey zone forces in denied areas. In FY 2018, REDLINE provided the initial capability for vetted alerts to facilitate real-time tracking and mobilization I&W on the Joint Worldwide Intelligence Communications System. Details are classified.</p> <p>FY 2019 Plans: REDLINE will deliver improved algorithms and a fully automated dissemination of highest confidence alerts as assessed by calibrated performance models. The REDLINE system will deploy on the Secret Internet Protocol Router Network.</p> <p>FY 2020 Plans: REDLINE will scale performance to support global event detection and classification and provide open applications programming interfaces to facilitate interoperability with other systems. After the military utility assessment, REDLINE will transition to the Defense Intelligence Agency's Foundational Intelligence Modernization effort as a program of record. Complete the JCTD.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: FY 2019 to FY 2020 increase is based on higher cost of conducting multiple operational demonstrations and activities required for transition.</p>		3.000	3.000	4.000
<p>Title: Resilient Autonomy (RA)</p> <p>Description: FY 2018 new start JCTD. RA supports the National Defense Strategy's focus on advanced autonomous systems and machine learning modernization. RA will provide DoD with an innovative autonomous intelligence, surveillance, and reconnaissance system that implements sophisticated air and ground collision avoidance on unmanned air platforms in support of flight safety. RA will demonstrate and field a prototyped sense-and-avoid capability that will allow it to operate in joint airspace without constant human supervision. In FY 2018, RA conducted architecture development, integration and baseline system testing and evaluation. RA worked with the Federal Aviation Administration (FAA) to identify metrics required for RA flight certification and detailed FAA required milestones.</p>		3.803	3.689	2.505

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
<p><i>FY 2019 Plans:</i> RA will complete integration of RA capabilities into the HQ-90 UAS; conduct technical demonstrations, and perform test and evaluation of the integrated capability package.</p> <p><i>FY 2020 Plans:</i> RA will conduct an operational demonstration of autonomous flight in civilian airspace using detect and avoid technologies to ensure safe separation from other aircraft or obstructions. A rigorous military utility assessment (MUA) will be conducted and FAA certification process completed. RA will transition the RA capabilities to a United States Marine Corps Unmanned Aerial System program of record.</p> <p><i>FY 2019 to FY 2020 Increase/Decrease Statement:</i> FY 2019 to FY 2020 funding decreases because the majority of hardware and technology development will be completed in the previous year. Funds in FY 2020 will primarily be used to support the operational demonstration and the MUA.</p>				
<p><i>Title:</i> Special Advanced Low-cost Surveillance Alternative (SALSA)</p> <p><i>Description:</i> FY 2018 new start JCTD. SALSA supports the National Defense Strategy's focus on resilient command, control, communications, computers, intelligence, surveillance and reconnaissance and missile defense modernization. SALSA will demonstrate an operational, affordable prototype sensor that provides on-demand, persistent wide-area surveillance for the Arctic environment. In FY 2018, SALSA designed and manufactured a baseline radar system and delivered an operational prototype for execution of technical and operational demonstrations.</p> <p><i>FY 2019 Plans:</i> Select site for the SALSA operational demonstration (OD), conduct planning and preparation for SALSA OD, finalize communications architecture for flight test; conduct OD.</p> <p><i>FY 2020 Plans:</i> Conduct final OD and military utility assessment. U. S. Army Program Executive Office Missiles & Space (PEO M&S) / Cruise Missile Defense System (CMDS) will provide integration partnering with Aviation and Missile Research Development and Engineering Center for transitioning of capability. Complete the JCTD.</p> <p><i>FY 2019 to FY 2020 Increase/Decrease Statement:</i> Technical demonstrations completing in FY 2019. Minimal funding required in FY 2020 for transition of the capability.</p>		1.570	0.820	0.004
<p><i>Title:</i> STRIKE-X Launched ATACMS from Ship (SLASh)</p> <p><i>Description:</i> FY 2018 new start JCTD. SLASh supports the National Defense Strategy's focus on joint lethality in contested environments. SLASh will provide a sea launch option for the Army Tactical Missile System (ATACMS). The JCTD will</p>		4.125	1.775	1.625

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B. Accomplishments/Planned Programs (\$ in Millions)		FY 2018	FY 2019	FY 2020
<p>demonstrate a long range supersonic ballistic surface to surface missile for employment by Expeditionary Strike Groups (ESGs), logistic forces and U.S. Army (USA) watercraft. In FY 2018, SLASH completed engineering design plans for shipboard blast pad; formulated baseline design work for ATACMS software modifications; scheduled the test range and ship and completed test launch planning.</p> <p>FY 2019 Plans: SLASH will complete the ATACMS software modification; conduct software validation and verification; conduct fabrication and qualification testing of shipboard blast pad; perform validation of launcher control system adaptability for shipboard use; request launch planning, safety and environmental approvals; request ship alteration and approval for T-ESB class ships; and conduct missile requisition and integration with High Mobility Artillery Rocket System (HIMARS) launcher.</p> <p>FY 2020 Plans: SLASH will seek launch approval from the Weapon System Safety Evaluation Review Board (WSSERB); and, test launch from a HIMARS launcher on a T-ESB class ship against a land target in a test range. Upon successful demonstration, SLASH will transition to the US Army, Program Executive Office, Missiles and Space (PEO M&S), ATACMS' program of record.</p> <p>FY 2019 to FY 2020 Increase/Decrease Statement: FY 2019 to FY 2020 decrease is based on higher cost of development activities occurring in the first year of effort.</p>				
<p>Title: Unmanned Logistics System-Air (ULS-A)</p> <p>Description: FY 2018 new-start JCTD. ULS-A supports the National Defense Strategy's focus on resilient agile logistics, advanced autonomous systems, and machine learning modernization. ULS-A will demonstrate the utility of unmanned aerial system (UAS) prototypes coupled with autonomous technologies to provide an organic, highly autonomous aerial distribution capability that increases ground maneuver force agility, decreases carrying load, and allows the Joint Commanders to have 'on-call' control of mission essential and time-critical resupply. In FY 2018, ULS-A conducted initial prototype acquisition, and small and medium ULS-A autonomy technical demonstrations.</p> <p>FY 2019 Plans: ULS-A will incorporate medium ULS-A prototype improvements, integrate autonomy algorithms and conduct a technical demonstration for medium ULS-A.</p> <p>FY 2020 Plans: ULS-A will conduct an operational demonstration of an upgraded autonomy package and UAS advanced capabilities; finalize capability development document (CDD) for Service review; complete medium ULS-A joint concept of operations; and conduct final military utility assessment. ULS-A will transition the small ULS-A operational prototype initial capability document (ICD) to U.S. Navy's Naval Air Systems Command (NAVAIRSYSCOM) program office. Medium ULS-A operational prototype will transition</p>		6.011	3.799	6.950

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B. Accomplishments/Planned Programs (\$ in Millions)	FY 2018	FY 2019	FY 2020
to a U.S. Army and/or NAVAIRSYSCOM program office to inform a Milestone B decision in FY 2022. Medium ULS-A capabilities description document and concept of operations will transition to Services fielding ULS-A.			
<i>FY 2019 to FY 2020 Increase/Decrease Statement:</i> Funding increases in FY 2020 due to final integration, testing, operational assessment, and transition costs of both small and medium ULS-A platforms.			
Accomplishments/Planned Programs Subtotals	102.769	105.808	107.359

C. Other Program Funding Summary (\$ in Millions)
N/A

Remarks

D. Acquisition Strategy
Successful JCTDs can transition to acquisition via one of several methods:

- The JCTD addresses a documented capability gap in an existing program of record (PoR). The existing PoR can acquire, further mature, sustain, and provide the capability under existing program documentation.
- The capabilities address capability gaps that naturally fit with an existing PoR, but program documentation addressing the new capabilities does not exist. In these cases, existing PoR documentation (such as the capabilities development document (CDD) or capabilities production document (CPD)) is revised to include the new capabilities from the JCTD, and the JCTD capabilities transition to the PoR.
- The capabilities address a current operational need without requiring PoR changes. In these cases, the JCTD capabilities may transition directly to operational use, with sustainment (operations and maintenance) funding arranged through the gaining command.
- The Results of JCTD can be used to inform research and engineering, or validate a joint requirement per the Joint Capabilities Integration and Development System. This includes identification of the need through development of an initial capability description (ICD) document or accelerating the development of a CDD or CPD to establish a new PoR.
- The capabilities may be widely applicable commodity products, useful to many commands. In these cases, the commodity products are listed on General Services Administration schedule, and made available for purchase by any commands needing the capability.

E. Performance Metrics
Strategic Goals Supported:

- Mature and demonstrate a prototype that fills a joint capability gap.
- Demonstrate a capability to address a DoD key strategic gap.
- Demonstrate a prototype that informs the acquisition and requirements process.
- Conduct an independent technology risk assessment.
- Successful military utility assessment.

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MEASURABLE OUTCOMES:

JCTDs demonstrate capability objectives within 24-48 months. The JCTD program continues to assess transition. In FY 2018, 100 percent of completed prototypes successfully transitioned and exceeded the DoD strategic performance goal of 40 percent. Two of three completed prototypes transitioned all or select capabilities or components to a new or existing PoR. One operational prototype was directly fielded and is being sustained by non-JCTD funds in theater operations.