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 0603833D8Z / *Engineering Science and Technology (S&T)*

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	40.102	24.447	19.371	19.376	-	19.376	19.511	19.722	19.912	15.230	Continuing	Continuing
401: *DoD Modeling and Simulation Management Office*	6.454	12.111	4.609	4.701	-	4.701	4.795	4.855	4.975	4.980	Continuing	Continuing
402: *Systems Engineering Research Center*	9.400	3.911	4.904	4.900	-	4.900	4.924	4.930	4.937	5.250	Continuing	Continuing
403: *Engineered Resilient Systems*	24.248	8.425	9.858	9.775	-	9.775	9.792	9.937	10.000	5.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

This Program Element (PE) addresses Defense Research and Engineering priorities to advance engineering state of the practice, and complex defense systems challenges through development of engineering capabilities to improve acquisition quality. Engineering science and technology, including modeling and simulation (M&S), systems engineering (SE) research, and engineering capabilities for resilience, supports the cost-effective acquisition of complex systems in support of the full range and scope of Department of Defense (DoD) missions and operations.

This Program Element (PE) addresses the National Defense Strategy priorities of increasing lethality, strengthening alliances and supporting Department business reform. Engineering Science and Technology underpins improving department-wide practices of evaluating and improving the lethality of complex systems through modeling and simulation and engineering capabilities for resilience. Improvements to the Department's systems engineering and simulation capabilities have a profound effect on ensuring that we are able to quickly and affordably field a lethal Joint Force by addressing the interwoven dependencies in system and mission capabilities, rapidly evolving technologies, lifecycle considerations, and resource limitations in the face of dynamic threats and changing missions. In addition, these engineering and modeling and simulation practices cross international boundaries and is an area of collaboration with our Allies; it improves the way we are able to train as an allied force and operate together on the battlefield.

M&S is a key enabler of DoD capabilities; underpins innovative solutions meeting real-world national security challenges and ensuring technical superiority; acts as a force multiplier; saves resources; and saves lives. The DoD Modeling and Simulation Management Office (MSMO), designated by the Office of the Under Secretary of Defense, Research and Engineering (OUSD(R&E)) to be the focal point and advocate for DoD M&S, enhances the DoD M&S Enterprise by (1) enabling joint and cross-cutting cooperation and collaboration in identifying, developing and sustaining modeling and simulation solutions; and (2) promoting technology solutions, including common M&S architectures, standards, and services that improve interoperability, reuse, and cost effectiveness of DoD M&S.

The Systems Engineering Research Center (SERC) is a University Affiliated Research Center (UARC) established in 2008 as a strategic resource to conduct systems research and improve the Department’s ability to develop and deploy complex weapon systems. Greatly improved SE methods, processes and tools are essential to the DoD strategy to field systems that are agile, affordably sustainable, and ready to incorporate emerging technologies to address a full range of contingencies, in the face

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 0603833D8Z / *Engineering Science and Technology (S&T)*

of constrained budgets and an aging workforce. The SERC consists of a network of 22 research universities from across the U.S. that work collaboratively to bring the best talent in the nation to bear on DoD's systems engineering research problems.

Engineered Resilient Systems (ERS) addresses the need for the faster design of cost- and mission-effective DoD warfighting systems by conducting research and development in computational engineering tools, system performance models, and data analysis techniques. From early design and testing through validation, fielding and sustainment, these tools and techniques give decision makers the information needed to make better-informed decisions and ensure Warfighter and mission success. A digital engineering initiative, ERS increases design agility by increasing design options across the lifecycle, leading to improvements in testing, manufacturing, fielding and sustainment of mission-effective and adaptable systems. ERS uses an advanced science and technology driven approach to provide the following core capabilities: Set-Based Design (SBD), Computational Engineering and Large-Scale Data Analytics. With ERS, DoD is reducing risk in future systems development by using high-fidelity modeling and advanced analyses of design options, as well as linking candidate platforms to traditional modeling and simulation toolkits and employing DoD's high-performance computing assets.

B. Program Change Summary ($ in Millions)	FY 2018	FY 2019	FY 2020 Base	FY 2020 OCO	FY 2020 Total
Previous President's Budget	25.395	19.415	19.431	-	19.431
Current President's Budget	24.447	19.371	19.376	-	19.376
Total Adjustments	-0.948	-0.044	-0.055	-	-0.055
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.899	-			
• FFRDC Adjustments	-0.049	-0.044	-	-	-
• Other Program Adjustments	-	-	-0.055	-	-0.055

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 0603833D8Z / *Engineering Science and Technology (S&T)*	Project (Number/Name) 401 / *DoD Modeling and Simulation Management Office*	

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
401: *DoD Modeling and Simulation Management Office*	6.454	12.111	4.609	4.701	-	4.701	4.795	4.855	4.975	4.980	Continuing	Continuing

A. Mission Description and Budget Item Justification

Modeling and Simulation (M&S) supports the full range and scope of Department of Defense (DoD) missions and operations, including joint and cross-cutting. M&S is a key enabler of DoD capabilities; underpins innovative solutions meeting defense and national security challenges to ensure technical superiority, and saves resources. The Office o the Under Secretary of Defense for Research and Engineering (OUSD(R&E)), under the authority of DoD Directive 5134.01, designated the DoD Modeling and Simulation Management Office (MSMO) to be the focal point and advocate for Defense M&S to enhance the Defense M&S Enterprise by (1) enabling cooperation and collaboration in identifying, developing and sustaining modeling and simulation solutions; and (2) promoting technology solutions, including common M&S architectures, standards, and services that improve interoperability, reuse, and cost effectiveness of DoD M&S. MSMO executes its efforts in accordance with the OUSD(R&E)-promulgated DoD Directive 5000.59, “Management of Modeling and Simulation” and DoD Instruction 5000.70, “Management of DoD Modeling and Simulation (M&S) Activities;” and other DoD Issuances, including DoD 4120.24-M, “DoD Standardization Program (DSP) Policies and Procedures” and DoD Manual 3200.14 Volumes 1 and 2, “Principles and Operational Parameters of the DoD Scientific and Technical Information Program (STIP).”

MSMO is responsible for:
• Planning, coordinating, and managing funds to support enterprise-level joint and cross-cutting M&S activities that guide the Defense M&S Community to achieve the DoD Strategic Vision for M&S.
• Bringing together M&S stakeholders to advise and assist on finding solutions for removing the barriers to interoperability, reuse, commonality, efficiency, and effectiveness.
• Developing, coordinating, and advocating for policy/guidance, technology, standards, best practices, and strategic planning processes that promote interoperability and reuse across the Department.

MSMO also serves as DoD’s:
• Focal point and advocate for coordinating M&S information exchanges and interactions within DoD, with other U.S. Government departments and agencies, international allies, industry, and academia to promote sharing of information and practices, synergy of efforts, and M&S as a key enabler of all organizations’ missions.
• Lead Standardization Activity (LSA) for managing M&S standards and methodologies.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: DoD Modeling and Simulation Management Office (MSMO)	12.111	4.609	4.701
Description: MSMO, as the OUSD(R&E)-designated focal point for Defense modeling and simulation (M&S), is responsible for maintaining and enhancing policies, standards, technology, and collaboration to ensure the efficiency and effectiveness of the M&S that supports the full range and scope of DoD missions and operations.			

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 0603833D8Z / *Engineering Science and Technology (S&T)*	**Project (Number/Name)** 401 / *DoD Modeling and Simulation Management Office*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
MSMO: (1) conducts management and technical support for the Department's current and long-term M&S needs; (2) responds to opportunities to leverage relevant DoD Information Technology (IT) enterprise capabilities and DoD-, Industry-, and Academia-developed M&S technologies; and (3) advocates an enterprise approach for the future of DoD M&S, maintaining strong engagement and ties with Defense and external community stakeholders. ***FY 2019 Plans:*** FY 2019 Plans: Integrated Defense Analytic Capability: • Demonstrate limited prototype, develop and standardize a capability for incorporating Intelligence into analysis for acquisition decision issues using Blue and Red models in an appropriate simulation environment in a joint concept. • Expand Community of Practice focusing on high-fidelity, joint mission simulation capabilities to enable acquisition professionals and warfighters to leverage these capabilities and enable reuse of databases, tools, and documentation. Policy and Guidance: • Publish a DoD M&S Guidebook to guide the Department's planning for and investing in M&S capabilities and tools. • Reissue overarching DoD policy- Convert DoD Directive 5000.59 to DoD Instruction 5000.59. • Assist Services and Defense Agencies in development of their Verification, Validation, and Accreditation (VV&A) plans. Standards: • Serve as the Lead Standardization Activity for M&S Standards and Methodologies, and/or lead and participate in Defense Standardization Program Office and Joint Enterprise Standards Committee activities and International standards activities such as NATO Standardization Agreements for M&S. • Enhance the Defense M&S Reference Architecture with additional patterns identified through user feedback. Technology: • Develop, enhance, and advocate the M&S enterprise suite of tools to improve joint and cross-cutting M&S capabilities. • Chair M&S Community of Interest, Cyber M&S Technical Working Group, and M&S Architecture Working Group. • Perform technology watch/horizon scanning related to M&S emerging capabilities to provide investment shaping and strategic direction. • Guide and support the Defense Science Board Task Force on Gaming, Exercises, and Modeling & Simulation (GEMS)through outreach, information and knowledge. Collaboration:			

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 0603833D8Z / *Engineering Science and Technology (S&T)*	**Project (Number/Name)** 401 / *DoD Modeling and Simulation Management Office*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
• Work with Defense stakeholders, continue and refine Department-wide M&S gaps monitoring and reduction capability. • Continue to leverage investment in M&S Catalog tools to expand reuse and interoperability among Defense M&S communities. • Work with USSOCOM and Simulator Interoperability Senior Steering Group to assess USSOCOM, other Combatant Commands, and Service needs for Simulator Interoperability. • Represent U.S. interests in International M&S activities: - Collaborate with the NATO M&S Group (NMSG) and participate in NMSG task groups. - US/UK Stocktake Future Operational Environment - Coordinate The Technical Cooperation Program (TTCP) Virtual Interoperability Prototyping and Research Environment (VIPRE) development with 5-Eyes partners • Collaborate with interagency organizations, as required.			
FY 2020 Plans: Policy and Guidance: • Publish a DoD M&S Strategy to guide the Department's planning for and investing in M&S capabilities and tools. • Assist Services and Defense Agencies in development of their Verification, Validation, and Accreditation (VV&A) plans. Standards: • Serve as the Lead Standardization Activity for M&S Standards and Methodologies, and/or lead and participate in Defense Standardization Program Office and Joint Enterprise Standards Committee activities and International standards activities such as NATO Standardization Agreements for M&S. • Enhance the Defense M&S Reference Architecture with additional patterns identified through user feedback. Technology: • Develop, enhance, and advocate the M&S enterprise suite of tools to improve joint and cross-cutting M&S capabilities. • Chair M&S Community of Interest, Cyber M&S Technical Working Group, and M&S Architecture Working Group. • Perform technology watch/horizon scanning related to M&S emerging capabilities to provide investment shaping and strategic direction. Collaboration: • Work with Defense stakeholders, continue and refine Department-wide M&S gaps monitoring and reduction capability, • Work with USSOCOM and Simulator Interoperability Senior Steering Group to assess USSOCOM, other Combatant Commands, and Service needs for Simulator Interoperability. • Represent U.S. interests in International M&S activities:			

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 0603833D8Z / *Engineering Science and Technology (S&T)*	**Project (Number/Name)** 401 / *DoD Modeling and Simulation Management Office*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
- Collaborate with the NATO M&S Group (NMSG) and participate in NMSG task groups. - US/UK Stocktake Future Operational Environment - Continued TTCP VIPRE coordination • Collaborate with interagency organizations, as required. ***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.			
Accomplishments/Planned Programs Subtotals	12.111	4.609	4.701

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

Performance in this program is monitored in the following ways:

- Number of instances where M&S standards, technical best practices, or tools have been adopted or employed.
- Number of M&S resources (tools, data, and services) made visible or updated in the DoD M&S Enterprise Catalog for reuse and the completeness of each record according to DoD discovery metadata standards.

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 0603833D8Z / *Engineering Science and Technology (S&T)*				Project (Number/Name) 402 / *Systems Engineering Research Center*			
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**
402: *Systems Engineering Research Center*	9.400	3.911	4.904	4.900	-	4.900	4.924	4.930	4.937	5.250	Continuing	Continuing

A. Mission Description and Budget Item Justification

The Systems Engineering Research Center (SERC) is a University Affiliated Research Center (UARC) established in 2008 as a strategic resource to conduct systems research and improve the Department's ability to develop and deploy complex weapon systems. Greatly improved SE methods, processes and tools are essential to the DoD strategy to field systems that are agile, affordably sustainable, and ready to incorporate emerging technologies to address a full range of contingencies, in the face of constrained budgets and an aging workforce.

The SERC's network of universities is led by the Stevens Institute of Technology, and includes the Air Force Institute of Technology, Auburn University, Carnegie Mellon University, Georgetown University, Georgia Institute of Technology, Massachusetts Institute of Technology, Missouri University of Science and Technology, Naval Postgraduate School, North Carolina Agricultural and Technical State University, Old Dominion University, Pennsylvania State University, Purdue University, Texas A&M University, University of Alabama, University of Maryland, University of Massachusetts, University of South Florida, University of Southern California, University of Virginia, Virginia Polytechnic Institute, and Wayne State University. These Universities work collaboratively to bring the best talent in the nation to bear on DoD's systems engineering research problems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Systems Engineering Research Center	3.911	4.904	4.900
Description: The SERC is a DoD UARC which conducts University-based research that directly supports DoD's National Defense Strategy through development of new systems engineering methods, processes and tools. ***FY 2019 Plans:*** Continue to enhance engineering methods, processes and tools (MPTs) to improve in the following areas: • Systems Engineering Transformation: transform current systems engineering methods to enable rapid, concurrent and scalable definition and affordable development of flexible systems that are responsive to changing threats and missions; – Develop and apply formal methods for resilient systems design to control unmanned aerial vehicle operations. • Enterprises and Systems of Systems: create foundational methods to develop and design enterprises and system of systems to provide an overwhelming competitive advantage over our adversaries; – Develop and apply models to gauge expected results from composition of diverse, modular components and systems.			

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 0603833D8Z / *Engineering Science and Technology (S&T)*	**Project (Number/Name)** 402 / *Systems Engineering Research Center*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
• Trusted Systems: secure defense systems from cyber and other threats through systemic security and assurance approaches that complement incomplete current perimeter/network defense methods; – Development and trial applications of model-based system assurance methods. • Human Capital Development: speed the professional development of highly capable systems engineers and technical leaders in the Department and the Defense Industrial Base. – Develop technical report identifying methods for organizations to improve their engineering workforce along with the expected benefits. Together, these new methods will accelerate the delivery of critical mission capabilities and technologies, such as autonomy and machine learning, in the face of a dynamic cyber adversary. ***FY 2020 Plans:*** Continue to enhance engineering methods, processes and tools (MPTs) to improve in the following areas: • Systems Engineering Transformation: transform current systems engineering methods to enable rapid, concurrent and scalable definition and affordable development of flexible systems that are responsive to changing threats and missions; - Develop and apply tradespace analysis methods to balance dynamic requirements and emerging technologies to improve mission success. • Enterprises and Systems of Systems: create foundational methods to develop and design enterprises and system of systems to provide an overwhelming competitive advantage over our adversaries; – Develop and apply enterprise model to measure factors impacting use digital engineering methods to acquire DoD's weapon systems, and the resulting mission benefits. • Trusted Systems: secure defense systems from cyber and other threats through systemic security and assurance approaches that complement incomplete current perimeter/network defense methods; – Develop risk-based algorithms and tools for static analysis of software, integrating attack databases and well-known vulnerabilities to prioritize mitigation activities. • Human Capital Development: speed the professional development of highly capable systems engineers and technical leaders in the Department and the Defense Industrial Base.			

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 0603833D8Z / *Engineering Science and Technology (S&T)*	**Project (Number/Name)** 402 / *Systems Engineering Research Center*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
– Develop systems engineering competencies in undergraduate engineers though capstone design projects that provide novel solutions to warfighter problems. Together, these new methods will accelerate the delivery of critical mission capabilities and technologies, such as autonomy and machine learning, in the face of a dynamic cyber adversary. ***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.			
Accomplishments/Planned Programs Subtotals	3.911	4.904	4.900

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

Develop and extend fundamental knowledge, advanced methods, processes and tools and cutting edge techniques for systems engineering of complex designs of relevance to the DoD mission.

- Promulgation of advanced system engineering approaches through research publications, presentations and workshops.
- Adoption of SERC methods, processes, and tools into DoD component activities.

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 0603833D8Z / *Engineering Science and Technology (S&T)*	Project (Number/Name) 403 / *Engineered Resilient Systems*	

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
403: *Engineered Resilient Systems*	24.248	8.425	9.858	9.775	-	9.775	9.792	9.937	10.000	5.000	Continuing	Continuing

A. Mission Description and Budget Item Justification

Engineered Resilient Systems (ERS) improves design agility and cost-effectiveness during analysis and development leading to improvements in testing, manufacturing, fielding and sustainment of mission-effective and adaptable systems. Its products are engineering design visualization and tool integration frameworks which integrate physics-based models and engineering tools to vastly improve the ability to perform tradespace and requirements analysis, optimize designs and improve architectures. These improved architectures will enable systems to more rapidly adapt to changing technologies and threats. ERS uses advanced science and technology methods to provide the following core capabilities: Set-Based Design (SBD), Computational Engineering and Large-Scale Data Analytics. These engineering improvements will accelerate delivery of advanced capabilities to the warfighter and address a geopolitical environment marked by rapidly changing threats, tactics, missions and technologies, and fiscal constraints. The pace of change renders current point-design approaches unsustainable in both cost and time. ERS methods and tools help engineers integrate advanced technologies into systems affordably, at the speed of relevance.

ERS research and development aims to transition practical applications to programs within the DoD, while continuing to evolve and develop future capabilities. ERS focuses on new concepts for implementing an integrated suite of modern computational engineering tools, models, simulations and related capabilities, and tradespace assessment and visualization tools with an architecture aligned with acquisition and operational business processes. These integrated tools will operate within a framework that supports transparency, inclusion and data-driven decision-making in an innovative environment that provides advanced knowledge management, including data retention and lessons-learned, and enables multi-community collaboration. ERS leverages multi-fidelity physics-based models developed by the S&T community to inform the acquisition decision process (e.g., increased/easier use of High-Performance Computing, web-based analysis with large data sets, and lifecycle cost sensitivity analysis). These new computational and model-based frameworks adapt advanced design and modeling approaches from Government, industry, and academia to enable our Nation to affordably deliver warfighting capability at the speed of relevance. ERS provides the capability to fully explore and identify key performance parameters and inform the requirements process. With ERS, DoD is reducing risk of future systems development by using high-fidelity modeling and advanced analyses of design options, as well as linking candidate platforms to traditional modeling and simulation toolkits and employing DoD's high-performance computing assets. ERS leverages existing investments in surface and subsurface ships, aircraft, and ground vehicles, radio frequency, meshing and geometry models. Future domains, driven by Service requirements, may include future developments in Space, Hypersonics, Electronic Warfare and Directed Energy.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
Title: Engineered Resilient Systems (ERS)	8.425	9.858	9.775
Description: Description: Engineered Resilient Systems (ERS) addresses the need for achieving more affordable, technically superior and mission-resilient warfighting systems designed within a shorter time frame by conducting research and development to deliver new concepts and capabilities to implement an integrated suite of modern computational engineering tools, modeling capabilities, and tradespace assessment and visualization tools within an architecture aligned with acquisition and operational			

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 0603833D8Z / *Engineering Science and Technology (S&T)*	**Project (Number/Name)** 403 / *Engineered Resilient Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
business processes. These integrated tools will operate within a framework that supports transparency, inclusion and data-driven decision-making in an innovative environment that enables advanced knowledge management and multi-community collaboration, including data retention and lessons learned. The work being done through the ERS program currently spans all services and aids in analyses of fixed-wing aircraft, rotorcraft, ground vehicles, ships and missiles. The services use ERS for computational analysis to validate new technology solutions prior to making major investment decisions. ***FY 2019 Plans:*** Set-Based Design: Improve and test primary framework for ERS next-generation tradespace analysis tools with data storage, statistical analysis, and advanced visualization techniques; develop model integration technologies to retain tradespaces and other early conceptual design artifacts; and develop linkage between system requirements and tradespace analysis, (e.g., multi-domain analysis of Air Force fixed-wing and missile design alternatives). Computational Engineering: Develop design process automation to rapidly incorporate new and existing high-fidelity models into the analysis of existing and proposed weapon systems; develop and demonstrate advanced parametric design and optimization tools to create credible acquisition models; develop computational environments that facilitate the use of high-performance computing infrastructure within the engineering design and analysis processes, (e.g., increasing the number of propeller designs evaluated for subsurface propulsion). Large-Scale Data Analytics: Leverage physical test datasets and national investments in artificial intelligence, machine learning, and deep learning technologies in order to produce concept prognostic and diagnostic tools for lifecycle analyses; begin exploration of the deployment of algorithms and tools trained with artificial intelligence and machine learning techniques to DoD platforms, (e.g., large scale data analysis of rotorcraft prognostics and health management data to inform sustainment decisions). ***FY 2020 Plans:*** FY 2020 Plans: Set-Based Design: Develop decision-support environments to enable set-based design, optimization, tradespace analysis, and visualization of data from DoD platforms; and incorporate techniques to reduce data duplication and increase reuse of data, models, software tools, and analysis, (e.g., develop methods and tools for multi-domain analysis of DoD technology priorities, such as hypersonics and directed energy). Computational Engineering: Develop and evolve computational tools to support parametric design environments; utilize high-performance computing to enable new capabilities in novel areas; continue to facilitate the rapid development of environmental scenarios to assess the impact of a variety of physical conditions on DoD materiel in operationally relevant environments;			

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 0603833D8Z / *Engineering Science and Technology (S&T)*	**Project (Number/Name)** 403 / *Engineered Resilient Systems*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
and integrate multiple disciplines into ERS workflows such as high-fidelity fluid dynamics, structural mechanics, and/or other performance determination models, (e.g., address needs of additional platforms and technologies). Large-Scale Data Analytics: Evolve data engineering techniques for storage, labeling, and analysis of vast data sets; explore automation of artificial intelligence and machine learning assisted design; and demonstrate automated machine learning methods for lifecycle data, (e.g., analysis of sensor data to improve automated target recognition). ***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.			
Accomplishments/Planned Programs Subtotals	8.425	9.858	9.775

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

- Development of next generation engineering methods and design tools
- Demonstration and evaluation of next-generation engineering methods and design tools, documented in analyses and technical reports.
- Use of ERS engineering methods and design tools by DoD programs or project offices, industry and academia.