Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Office of the Secretary Of Defense	Date: February 2018
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 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
Total Program Element	17.904	22.198	25.395	19.415	-	19.415	19.431	14.556	14.770	14.963	Continuing	Continuing
401: *DoD Modeling and Simulation Management Office*	3.296	3.158	10.519	4.609	-	4.609	4.701	4.795	4.891	4.989	Continuing	Continuing
402: *Systems Engineering Research Center*	4.869	4.531	4.930	4.904	-	4.904	4.928	4.946	4.942	4.937	Continuing	Continuing
403: *Engineered Resilient Systems*	9.739	14.509	9.946	9.902	-	9.902	9.802	4.815	4.937	5.037	Continuing	Continuing

Note

Service Requirements Review Board (SRRB) efficiencies are included.

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.

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 further systems research and increase its impact on the Department's ability to meet its mission. Greatly improved SE methods, processes and tools are essential to the DoD strategy to field systems that are agile, affordably sustainable, flexible, and ready for a full range of contingencies in the face of declining budgets and a shrinking workforce. The SERC consists of a network of 23 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 achieving more affordable and mission-resilient warfighting systems designed within a shorter time frame by conducting research and development and new concepts for implementing an integrated suite of modern computational engineering tools, modeling capabilities, and tradespace assessment and visualization tools within an architecture aligned with acquisition and operational business processes. These integrated tools will operate

Exhibit R-2, RDT&E Budget Item Justification: PB 2019 Office of the Secretary Of Defense	Date: February 2018
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)*

within a framework that supports data-driven decision-making in an innovative environment that enables advanced knowledge management and multi-community collaboration, including data retention and lessons learned.

B. Program Change Summary ($ in Millions)	FY 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total
Previous President's Budget	17.659	25.395	19.884	-	19.884
Current President's Budget	22.198	25.395	19.415	-	19.415
Total Adjustments	4.539	0.000	-0.469	-	-0.469
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	5.000	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.432	-			
• Other Program Adjustments	-0.003	-	-0.339	-	-0.339
• FFRDC Transfer	-0.026	-	-	-	-
• Economic Assumption	-	-	-0.130	-	-0.130

Congressional Add Details ($ in Millions, and Includes General Reductions)	FY 2017	FY 2018
Project: 403: *Engineered Resilient Systems*		
Congressional Add: *Computational Research and Engineering Acquisition Tools and Environments (CREATE)*	5.000	-
Congressional Add Subtotals for Project: 403	5.000	-
Congressional Add Totals for all Projects	5.000	-

Change Summary Explanation

The FY 2017 baseline adjustment of $5M was added for Engineering Resilient Systems to focus on mission-relevant trade-space analysis and cost reduction pre-milestone B.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Office of the Secretary Of Defense			Date: February 2018
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 2017	FY 2018	FY 2019 Base	FY 2019 OCO	FY 2019 Total	FY 2020	FY 2021	FY 2022	FY 2023	Cost To Complete	Total Cost
401: *DoD Modeling and Simulation Management Office*	3.296	3.158	10.519	4.609	-	4.609	4.701	4.795	4.891	4.989	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 Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)), 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 USD(AT&L)-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 Instruction 3200.14, “Principles and Operational Parameters of the DoD Scientific and Technical Information Program.”

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 2017	FY 2018	FY 2019
Title: DoD Modeling and Simulation Management Office (MSMO)	3.158	10.519	4.609
Description: MSMO, as the USD(AT&L)-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 2019 Office of the Secretary Of Defense		Date: February 2018
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 2017	FY 2018	FY 2019

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 2018 Plans:

Integrated Defense Analytic Capability:

• Leveraging the FY 2017 assessment, develop and prototype use cases illuminating integration of Intelligence into analysis supporting acquisition decisions using Blue and Red models in an appropriate simulation environment in a joint concept.

Policy and Guidance:

• Initiate a DoD M&S Strategy to guide the Department's planning for and investing in M&S capabilities and tools, to include conducting a gap analysis for Defense M&S to inform the strategy.

• 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 to promote open architectures and standards.

• Refine the Defense M&S Reference Architecture to maintain consistency with changes to the overall DoD IT policies and infrastructure.

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.

Collaboration:

• Represent U.S. interests in International M&S activities:

– Serve as the Chair of the NATO M&S Group (NMSG) and participate in NMSG task groups.

• Collaborate with interagency organizations, as required.

FY 2019 Plans:

Exhibit R-2A, RDT&E Project Justification: PB 2019 Office of the Secretary Of Defense		Date: February 2018
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 2017	FY 2018	FY 2019
Integrated Defense Analytic Capability: • Following FY 2018 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. 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, • Represent U.S. interests in International M&S activities: - Collaborate with the NATO M&S Group (NMSG) and participate in NMSG task groups. • Collaborate with interagency organizations, as required. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** FY 2018 increase for one year congressional mandated study. In FY 2019, funding resumes as previous.			
Accomplishments/Planned Programs Subtotals	3.158	10.519	4.609

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2019 Office of the Secretary Of Defense		Date: February 2018
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*

C. Other Program Funding Summary ($ in Millions)

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 2019 Office of the Secretary Of Defense											Date: February 2018	
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 2017**	**FY 2018**	**FY 2019 Base**	**FY 2019 OCO**	**FY 2019 Total**	**FY 2020**	**FY 2021**	**FY 2022**	**FY 2023**	**Cost To Complete**	**Total Cost**
402: *Systems Engineering Research Center*	4.869	4.531	4.930	4.904	-	4.904	4.928	4.946	4.942	4.937	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 further systems research and increases its impact on the Department's ability to meet its mission. Greatly improved SE is essential to DoD's strategy to field systems that are agile, affordably sustainable, flexible, and ready for a full range of contingencies in the face of declining budgets and a shrinking 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, Pennsylvania State University, Purdue University, Southern Methodist University, Texas A&M University, Texas Tech University, University of Alabama, University of California, University of Maryland, University of Massachusetts, University of Southern California, University of Virginia, 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 2017	FY 2018	FY 2019
Title: Systems Engineering Research Center	4.531	4.930	4.904
Description: The SERC is a DoD UARC which conducts University-based research that directly supports DoD's Strategic Plan through development of new systems engineering methods, processes and tools. ***FY 2018 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; – Apply and validate tools to understand tradeoffs in affordability and other system qualities. • 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; – Complete pilot application of System of Systems Analytic Workbench with Naval Systems Warfare Center. • Trusted Systems: secure defense systems from cyber and other threats through systemic security and assurance approaches that complement incomplete current perimeter/network defense methods;			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Office of the Secretary Of Defense		Date: February 2018
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 2017	FY 2018	FY 2019
– Evaluate results of pilot application of formal methods for resilient systems with a focus on autonomous vehicles. • Human Capital Development: speed the professional development of highly capable systems engineers and technical leaders in the Department and the Defense Industrial Base. – Establish library of courses for the Systems Engineering Experience Accelerator. ***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 behavior specification framework to improve assessment of autonomous systems. • 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. • 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 of model and technical report identifying methods for organizations to improve their engineering workforce along with the expected benefits. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** Level of effort is consistent between FY 2018 and FY 2019. Small changes reflect minor budget fluctuations.			
Accomplishments/Planned Programs Subtotals	4.531	4.930	4.904

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

Exhibit R-2A, RDT&E Project Justification: PB 2019 Office of the Secretary Of Defense		Date: February 2018
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*

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 monographs.
- Adoption of SERC methods, processes, and tools into DoD component activities.

FY 2018 Accomplishments:
Enhanced 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;
– Completed empirical studies in model-centric decision-making and multi-stakeholder tradespace exploration.

• 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;
– Completed development of the System of Systems Analytic Workbench. Pilot applications at DoD laboratories and Federal Funded Research and Development Centers.

• Trusted Systems: secure defense systems from cyber and other threats through systemic security and assurance approaches that complement incomplete current perimeter/network defense methods;
– Developed metrics to gauge the complexity of attack surface of weapon systems, and developed design selection tools to determine best methods to mitigate threats.
Human Capital Development: speed the professional development of highly capable systems engineers and technical leaders in the Department and the Defense Industrial Base.
–Systems Engineering Experience Accelerator courses used Defense Acquisition University, several U.S. universities and United Kingdom Ministry of Defense.

Exhibit R-2A, RDT&E Project Justification: PB 2019 Office of the Secretary Of Defense											Date: February 2018	
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 2017**	**FY 2018**	**FY 2019 Base**	**FY 2019 OCO**	**FY 2019 Total**	**FY 2020**	**FY 2021**	**FY 2022**	**FY 2023**	**Cost To Complete**	**Total Cost**
403: *Engineered Resilient Systems*	9.739	14.509	9.946	9.902	-	9.902	9.802	4.815	4.937	5.037	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, and fielding of mission-effective and adaptable systems. Its products are engineering design visualization and tool integration frameworks that will integrate physics-based models and engineering tools across acquisition disciplines to vastly improve the ability to perform tradespace and requirements analysis, iteratively optimize designs and improve architectures to reduce or eliminate sensitivity to adversary tactics and capability improvements, and adapt those designs over time. The goal is to provide new pathways to acquisition and achieve a vitally-needed transformation in the contribution of Defense systems engineering to design resilience and effectiveness across the systems lifecycle. These engineering improvements are essential to accelerate capability 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 research and development 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 within 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 utilization 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. ERS provides the capability to fully explore and identify key performance parameters and inform the requirements process. With ERS, DoD is buying down the risk of future systems 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. Accomplishments/Planned Programs ($ in Millions)	FY 2017	FY 2018	FY 2019
Title: Engineered Resilient Systems (ERS)	9.509	9.946	9.902
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 and new concepts for implementing an integrated suite of modern computational engineering tools, modeling capabilities, and tradespace assessment and visualization tools within 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 enables advanced knowledge management and multi-community collaboration, including data			

Exhibit R-2A, RDT&E Project Justification: PB 2019 Office of the Secretary Of Defense		Date: February 2018
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 2017	FY 2018	FY 2019

retention and lessons learned. The work being done through the ERS program currently spans all services and aids in analyses of fixed-wing planes, rotorcraft, ground vehicles and ships. The services use ERS to test and prove new technology solutions prior to major technology investments.

FY 2018 Plans:

Conceptual, Computational, and World-Wide Environmental Representation: Develop simulations of ground vehicle dynamics under varying physical and relative conditions; apply physics to analysis, integration and testing of NGA, Air Force, Navy, and Army environmental data sets. Continue to extend mission context analysis and evaluation to multiple environmental simulations. Test and integrate automatic computational scenario development with simulation parameter settings. Provide automated workflows with user-selected model-based simulations.

Mission-Relevant Engineering Tradespace Analysis: Improve and test primary framework for ERS next-generation tradespace analysis tools providing user-requirements in data package management, statistical analysis, automated data storage and advanced visualization; Implement and test sub-system analysis in trades; enhance and test user interfaces; enhance integration of tradespace analytics with ERS open system in mapping to acquisition users requirements and Defense Acquisition processes; apply tradespace capability to fixed-wing manned/unmanned, ground vehicle, modular ship design and service requested Joint Capability Technology Demonstration projects.

Capability Integration and Demonstration: Enrich and extend open architecture design by collecting and integrating DoD acquisition and industry user requirements, implemented in an open system model, allowing for feedback, evaluation, and enhancements. Implement and evaluate information assurance security architecture, perform vulnerability analyses, and integrate intellectual property management capability within can ERS computational framework. Align ERS tools and capabilities to Defense acquisition processes.

Collaborative Engineering Analysis and Engineering Decision-making: Enhance established methods to protect industry intellectual property and provide lessons-learned repository for creating and collaborating between DoD research & development, DoD acquisition, and industry partners. Provide mature knowledge management environment for tradespace analysis using facilities at the Defense Technical Information Center.

FY 2019 Plans:

Conceptual, Computational, and World-Wide Environmental Representation: Develop, integrate, and evolve computational tools to support additional applications and novel approaches in warfare domains including surface ships and submarines, ground vehicles, fixed-wing and rotary-wing aircraft, sensors, electronic warfare, and hypersonics; continue to facilitate the rapid

Exhibit R-2A, RDT&E Project Justification: PB 2019 Office of the Secretary Of Defense		Date: February 2018
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 2017	FY 2018	FY 2019
development of environmental scenarios; and utilize physics-based tools to assess the impact of a variety of physical conditions on DoD materiel in operationally relevant environments. Mission-Relevant Engineering Tradespace Analysis: Improve and test primary framework for ERS next-generation tradespace analysis tools with data package management, data storage, statistical analysis, and advanced visualization; enhance and test user interfaces; explore tool deployment for multiple classification levels; develop linkage between system requirements and tradespace analysis; and apply tradespace capability to fixed-wing and rotary-wing air vehicle, ground vehicle, and ship design. Capability Integration and Demonstration: Leverage DoD acquisition and industry user requirements to enrich and extend open architecture design, allowing for feedback, evaluation, and enhancements; integrate multiple disciplines into ERS workflows such as high-fidelity fluid dynamics, structural mechanics, cost, and performance determination models; automate the execution of existing numerical simulations on DoD high-performance computing platforms; and integrate capabilities for a mixed classification user base requiring varied approaches. Collaborative Engineering Analysis and Engineering Decision-making: Extend established methods to protect industry intellectual property and provide a lessons-learned repository for creating and collaborating between DoD research & development, DoD acquisition, and industry partners; provide mature knowledge management environment using collaborative online communities; develop methodology for retaining tradespaces and other digital artifacts that are part of ERS early conceptual design activities; and leverage efforts to support digital engineering activities such as digital thread throughout the DoD. ***FY 2018 to FY 2019 Increase/Decrease Statement:*** Level of effort is consistent between FY 2018 and FY 2019. Small changes reflect minor budget fluctuations.			
Accomplishments/Planned Programs Subtotals	9.509	9.946	9.902

	FY 2017	FY 2018
Congressional Add: Computational Research and Engineering Acquisition Tools and Environments (CREATE)	5.000	-
FY 2017 Accomplishments: This work specifically addresses a need to automate workflows that include computational physics tools developed by the DoD High Performance Computing Modernization Program (HPCMP) Computational Research and Engineering Acquisition Tools and Environments (CREATE) program and tradespace and data analytics tools developed by the ERS program. Workflow automation will enable design engineers and data analysts to make acquisition and operation decisions faster, as well as increase the value added of Physics-based modeling and big data analytics practices to engineering. Combining hard science, high performance computing and process improvement practices, provides a lasting enhancement to		

Exhibit R-2A, RDT&E Project Justification: PB 2019 Office of the Secretary Of Defense		Date: February 2018
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*

	FY 2017	FY 2018
the broader DoD use of models, in some challenging areas, such as rotary and fixed wing performance, ship design, and 9 other platform specific challenges. This effort was fully coordinated and aligned with the work in Army PE 0603734A, Military Engineering Advanced Technology (Project T08).		
Congressional Adds Subtotals	5.000	-

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

N/A

D. Acquisition Strategy

N/A

E. Performance Metrics

- Development of a technological capability for DoD Science and Technology, academia, industry, and the requirements/acquisition communities to collaborate and provide an innovative and more effective means for engineering.
- Demonstration and evaluation of next-generation engineering methods and design tools, documented in analyses and technical reports.
- Use of Engineered Resilient Systems engineering methods and design tools.