Exhibit R-2, RDT&E Budget Item Justification: FY 2018 Office of the Secretary Of Defense	Date: May 2017
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 3: *Advanced Technology Development (ATD)*	**R-1 Program Element (Number/Name)** PE 0603781D8Z / *Software Engineering Institute (SEI)*

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
Total Program Element	-	13.687	14.264	15.047	-	15.047	15.156	15.241	15.272	15.611	Continuing	Continuing
P781: *Software Engineering Institute (SEI)*	-	13.687	14.264	15.047	-	15.047	15.156	15.241	15.272	15.611	Continuing	Continuing

A. Mission Description and Budget Item Justification

Software is a key to meeting the Department of Defense's (DoD's) increasing demand for high-quality, affordable, and timely national defense systems. Systemic software issues are significant contributors to poor program execution. Reliance on software-intensive mobile and net-based products and systems has increased (e.g., Joint Tactical Radio System, USS ZUMWALT (DDG-1000), Joint Strike Fighter, F-22, and Army Modernization). As stated in the January 2017 Defense Science Board Report, "Defense Research Enterprise Assessment," software, autonomy, and cyber are today's core challenges. With growing global parity in software engineering, the DoD must maintain leadership to avoid strategic surprise.

The Software Engineering Institute (SEI) Program Element (PE) addresses the critical need to research, develop, and rapidly transition state-of-the-art software technology, tools, development environments, and best practices to improve the engineering, management, fielding, evolution, acquisition, and sustainment of software-intensive DoD systems. The SEI's program of work coordinates across the DoD through Reliance 21, the overarching framework of the DoD's Science and Technology (S&T) joint planning and coordination process. This PE benefits every Community of Interest (COI) to some degree due to the ubiquitous nature of software, but particularly benefits: Command, Control, Communications, Computers, and Intelligence (C4I) which includes a computing and software sub-panel; Autonomy; Cyber; and Engineered Resilient Systems.

Software is more pervasive than ever, and computer programs are growing in size and complexity. Designing, managing, and securing integrated, complex, and large-scale mission-critical systems are abilities that the DoD and the Defense Industrial Base (DIB) have not yet mastered. To address this, the PE funds research and development within the SEI Federally Funded Research and Development Center (FFRDC).

The SEI FFRDC is the DoD's primary source for software research and development. It is an institute which enables the exploitation of emerging software technology by bringing engineering, management, and security discipline to software acquisition, development, and evolution. The SEI FFRDC focuses on software technology areas judged to be of the highest payoff in meeting defense needs.

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B. Program Change Summary ($ in Millions)	**FY 2016**	**FY 2017**	**FY 2018 Base**	**FY 2018 OCO**	**FY 2018 Total**
Previous President's Budget	15.173	14.264	15.441	-	15.441
Current President's Budget	13.687	14.264	15.047	-	15.047
Total Adjustments	-1.486	0.000	-0.394	-	-0.394
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-0.972	-			
• SBIR/STTR Transfer	-0.514	-			
• Other Adjustments	-	-	-0.394	-	-0.394

Exhibit R-2A, RDT&E Project Justification: FY 2018 Office of the Secretary Of Defense			Date: May 2017
Appropriation/Budget Activity 0400 / 3	R-1 Program Element (Number/Name) PE 0603781D8Z / *Software Engineering Institute (SEI)*	Project (Number/Name) P781 / *Software Engineering Institute (SEI)*	

COST ($ in Millions)	Prior Years	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
P781: *Software Engineering Institute (SEI)*	-	13.687	14.264	15.047	-	15.047	15.156	15.241	15.272	15.611	Continuing	Continuing

A. Mission Description and Budget Item Justification

The SEI FFRDC was established in 1984 as an integral part of the DoD's initiative to identify, evaluate, and transition software engineering technologies and practices. The mission of the SEI is to provide the DoD with technical leadership and innovation through research and development to advance the practice of software engineering and technology. The SEI works across government, industry, and academia to improve the state of software engineering from the technical, acquisition, and management perspectives. The SEI engages in research and development of critical software technologies and tools and collaborates with the larger software engineering research community. It facilitates rapid transition of software engineering technologies into practice and evaluates emerging software engineering technologies to determine their potential for improving software-intensive DoD systems. Since its inception, the SEI has helped to transform the fields of software engineering and acquisition, network security, real-time systems, software architectures, and software-engineering process management.

This program has two main research thrusts with known military applications: 1) Software Engineering, Systems Verification and Validation, and Mission Assurance (formerly Mission Assurance) and 2) Information Assurance and Cyber Security.

SEI research focuses on the most significant and pervasive software and cybersecurity challenges within the DoD, such as the scalability and reliability of software assurance, supply chain risk management, validation of and trust in autonomous systems, human-computer and human-technology interaction, computing and communication at the tactical edge, and efficiency and performance of acquisition strategies and software development appropriate for a contested cyber environment.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
Title: Software Engineering Institute Advanced Technology Development in the Area of Software Engineering, Systems Verification and Validation, and Mission Assurance (formerly Mission Assurance)	9.033	9.414	9.802
Description: This research seeks to develop and rapidly prototype techniques to verify methods for identifying requirements, systems of systems architectures, and virtual integration of components. Furthermore, research in this area will pursue rapid prototyping and transitioning of capabilities that verify requirements for software assurance, analysis/control of unverified code and automated repair of damaged code. Software production and code analysis methods developed through this program will also improve the ability to predict how complex software systems will behave in untested environments. Increasingly, large numbers of lines of code will require a commensurate increase in sophisticated verification and validation mechanisms. ***FY 2016 Accomplishments:*** • Developed and demonstrated tools and techniques for seamless processing and data access in disconnected, intermittent, and low-bandwidth tactical edge environments.			

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
• Developed a tool to perform code analysis, architectural requirement tradeoff risk analysis, and validation of software assessments. • Applied the SEI Software Assurance Framework to define practices for acquiring and developing software products. ***FY 2017 Plans:*** • Develop automatic tools and techniques to generate intelligible explanations of software-driven autonomous/robotic behaviors that will help to establish trust with human operators in critical situations. • Develop and demonstrate principles, tools, and techniques to improve efficiency of and accuracy in software-based cloud infrastructures. • Develop techniques and algorithms to efficiently balance workloads between the human operator and the software's machine-learning-based capabilities. • Develop and pilot a game theory approach to optimize acquisition behaviors. ***FY 2018 Plans:*** • Contribute to military-grade, scalable, secure autonomous systems by integrating technologies from verification, human prediction, and human-robot understanding. • Reduce risk for DoD systems by integrating commercial off-the-shelf (COTS) technology, legacy, and custom software into software architecture common control systems. • Enhance decision superiority with new algorithms and technologies that relate multiple patterns from all source data to provide quantified courses of action in tactical timeframes. • Enable DoD to manage software-intensive systems by facilitating better sustainment decisions. • Research, develop, and pilot quantitative software acquisition decision support tools focused on cost-effectiveness for DoD acquisition teams.			
Title: Software Engineering Institute Advanced Technology Development in the Area of Information Assurance and Cyber Security ***Description:*** Powerful machine learning algorithms can be subverted by malicious manipulation or falsification of data collected through normal channels. Algorithms must be trusted and effective in the presence of adversaries. This thrust seeks to defend against and minimize the impacts of information falsification attacks. Additionally, this thrust seeks to increase the security of network-centric autonomous systems. These systems are currently developed with a focus on function rather than security, which makes them particularly vulnerable to cyber-attacks. ***FY 2016 Accomplishments:*** • Worked with ASD(R&E) Research Directorate and relevant service representatives to define a sustainable long-term research plan, ensuring timely anticipation of information technology challenges for the DoD in the mid and long-term future.	4.654	4.850	5.245

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B. Accomplishments/Planned Programs ($ in Millions)	FY 2016	FY 2017	FY 2018
• Extended tools and expanded techniques for model-based engineering of software-reliant systems and the generation of assurance evidence. These tools will support automatic generation of secure code, automated code vulnerability discovery, and synthesis of assurance cases. • Enhanced and deployed scalable and validated methods and software support for the training and development of the cyber mission workforce. • Tested alternative data selection and visualization techniques in simulated environments to determine causes of anomalies and outliers in data analysis. ***FY 2017 Plans:*** • Create tools and techniques for automated assurance in mission-critical systems. Collect and analyze defect data to identify potential security issues early and to achieve cost reductions. • Perform vulnerability analysis to identify vulnerabilities in industrial control systems (ICS) and locate network cross-connections allowing cyber-attackers to move laterally through network domains from less protected non-critical systems to operationally critical systems. ***FY 2018 Plans:*** • Extend tools and techniques for model-based engineering of software-reliant systems and generation of assurance evidence with support for automatic generation of secure code, automated code vulnerability discovery, and synthesis of assurance cases. • Enhance and deploy scalable and validated methods and software support for the training and development of the cyber mission workforce. Includes developing methods for repeatable, automated assessment of cyber workforce performance in training.			
Accomplishments/Planned Programs Subtotals	13.687	14.264	15.047

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2016	FY 2017	FY 2018 Base	FY 2018 OCO	FY 2018 Total	FY 2019	FY 2020	FY 2021	FY 2022	Cost To Complete	Total Cost
• BA 2, PE # 0602751D8Z, P278: *Software Engineering Institute Applied Research*	8.807	8.420	9.343	-	9.343	10.120	10.260	10.462	-	Continuing	Continuing

Remarks

D. Acquisition Strategy

N/A

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E. Performance Metrics

•Transition of tools and practices for use in DoD programs of record to the DIB, and to a number of agencies and organizations sponsoring work.
• Number of publications in refereed journals and peer reviewed reports.
• Number of external research collaborations and interactions with the broader software engineering research community.
• Adoption of coding standards and process techniques by standards bodies, working groups, and software/systems engineering organizations