Exhibit R-2, RDT&E Budget Item Justification: PB 2017 Office of the Secretary Of Defense	Date: February 2016
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 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
Total Program Element	-	15.198	15.173	14.264	-	14.264	15.441	15.909	16.130	16.447	Continuing	Continuing
P781: *Software Engineering Institute (SEI)*	-	15.198	15.173	14.264	-	14.264	15.441	15.909	16.130	16.447	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 2010 National Research Council of the National Academy of Sciences report entitled Critical Code, "It is dangerous to conclude that we are reaching a plateau in capability and technology for software producibility." The report notes that software is "…unconstrained by traditional physical engineering limitations…," and what we can accomplish is derived "…from [the] human intellectual capacity to conceptualize and understand systems…." 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 directly benefits: Command, Control, Communications, Computers, and Intelligence (C4I); Autonomy; Cyber; and Engineered Resilient Systems. This PE also leverages expertise in government, industry, and academia to enable the development of joint-Service capabilities.

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) and, to access particular expertise, in the Services, industry, and academia.

The SEI FFRDC is the DoD's dedicated 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 2015**	**FY 2016**	**FY 2017 Base**	**FY 2017 OCO**	**FY 2017 Total**
Previous President's Budget	15.754	15.202	15.181	-	15.181
Current President's Budget	15.198	15.173	14.264	-	14.264
Total Adjustments	-0.556	-0.029	-0.917	-	-0.917
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.510	-			
• Realignment for Higher Priority Programs	-	-	-0.807	-	-0.807
• FY15 Reprog. for Cancelled Account	-0.006	-	-	-	-
• Other Reprogrammings	-0.040	-	-	-	-
• FFRDC Reduction	-	-0.029	-	-	-
• Economic Assumptions	-	-	-0.110	-	-0.110

Change Summary Explanation

FY 2017 internal realignment reflects funding for higher Departmental priorities and requirements.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Office of the Secretary Of Defense			Date: February 2016
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 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
P781: *Software Engineering Institute (SEI)*	-	15.198	15.173	14.264	-	14.264	15.441	15.909	16.130	16.447	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 SEI maintains unique software research and program support capabilities in a space where the DIB and academia cannot as readily address challenges. 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.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
Title: Software Engineering Institute (SEI) Research	15.198	15.173	14.264

Description: SEI research projects are awarded on a competitive basis across the SEI. The number of projects and funding levels will vary from year to year based on the size and scope of proposed projects. Research projects cross-cut the FFRDC's experience base in order to advance existing SEI initiatives. SEI research focuses on the most significant and pervasive software and cybersecurity challenges within the DoD, such as improving the scalability and reliability of software assurance, software/ hardware supply chain risk management, validation and trust in autonomous systems, human-computer and human-technology interaction including insider threats, computing and communication at the tactical edge, and quantitative methods to improve the efficiency and performance of acquisition strategies.

FY 2015 Accomplishments:

- Applied new formal verification algorithms and automated analysis techniques to verify the design and performance of complex, mission critical, cyber-physical, distributed-adaptive, real-time systems.
- Demonstrated and applied techniques for quantifying the efficacy of individual cyber operators in realistic cyber operations exercises, measuring the tactical and strategic capabilities of cyber mission forces.
- Integrated and configured existing DoD tools and systems to detect behaviors utilized by malicious insiders; validated the efficacy of fielded insider threat capabilities for DoD organizations.
- Produced, demonstrated, and delivered tools to trace information flow through and between mobile apps to discover unintended disclosure of sensitive information.

Exhibit R-2A, RDT&E Project Justification: PB 2017 Office of the Secretary Of Defense		Date: February 2016
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B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
• Developed and tested the feasibility of accelerated automated vulnerability discovery tools to assist in the discovery of exploitable software faults to reduce system exposure. • Accelerated adoption and demonstrated effective use of Agile methods by DoD software development and acquisition program offices through ongoing leadership of the Agile Collaboration Group, which is composed of DoD and DIB representatives. • Merged verification, testing, and assurance case information to implement a prototype notation allowing these concepts to be applied throughout the program lifecycle to demonstrate technical feasibility and build assurance evidence.			
FY 2016 Plans: • Review the technical thrust for high performance software components for processing, dissemination, and exploitation compared to ongoing efforts in the DoD to ensure that this technology area fills needed technology gaps. • Work with ASDR&E Research Directorate and relevant service representatives to define a sustainable long-term research plan so that investments anticipate information technology challenges for the DoD in the mid and long-term future. • Develop and demonstrate tools and techniques for cloud-computing-like processing and data access in disconnected, intermittent, and low-bandwidth tactical edge environments. • Apply human language synthesis techniques and demonstrate technical feasibility of the automatic generation of human comprehensible explanations of unexpected robot actions to help build trust in autonomous systems used in close proximity with humans. • Extend tools and expand 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. • Enhance and deploy scalable and validated methods and software support for the training and development of the cyber mission workforce. • Test alternative data selection and visualization techniques in simulated environments to determine causes of anomalies and outliers in data analysis. • Develop and apply techniques for rapidly prototyping tactical decision support systems that extract information from data, establish confidence in the information, and reliably deliver it in near real-time.			
FY 2017 Plans: • Create tools and techniques for automated assurance of security policy enforcement in mission and safety critical systems; collect and analyze defect data to identify potential security issues early, and achieve cost reductions. • Develop tools and techniques for early stage application of statistical model checking to validate the reliability and robustness of safety critical systems. • Create and implement an architecture and platform for adaptive Software Defined Electronic Warfare (EW) and Electronic Protection, where EW functionality is implemented in software rather than hardware.			

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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)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2015	FY 2016	FY 2017
• Develop tools and techniques to adapt, develop, and operationalize principles of robust decision making to support DoD strategic decision making processes in cases where uncertainty is deep, information is imperfect, dozens of variables interact in nonlinear ways, and human choice and behavior generate unpredictable patterns. • Develop and demonstrate principles, tools, and techniques for characterizing, measuring, and ensuring quality of data across multiple heterogeneous data sets; apply these techniques to imagery data from multiple international commercial and government sources.			
Accomplishments/Planned Programs Subtotals	15.198	15.173	14.264

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2015	FY 2016	FY 2017 Base	FY 2017 OCO	FY 2017 Total	FY 2018	FY 2019	FY 2020	FY 2021	Cost To Complete	Total Cost
• BA 2, PE # 0602751D8Z, P278: *Software Engineering Institute Applied Research*	8.844	8.807	8.420	-	8.420	9.343	10.120	10.260	10.462	Continuing	Continuing

Remarks

D. Acquisition Strategy

N/A

E. Performance Metrics

• Transition of tools and practices for use in DoD programs of record to the Defense Industrial Base, 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.
• Number of training courses and curricula developed to contribute to the growth of capability in the software engineering research and development community, and software/system acquisition workforce.
• Development of new scalable technical and software-enabled cyber security approaches that address software assurance and improve enterprise resiliency.
• Reduced number of mission-critical software-reliant acquisition program failures, cost and schedule overruns, as well as quantitative improvements in overall system cost, time to develop, and performance. This will be evidenced by: reductions in time to test software and the amount of rework required; improved ability to articulate software requirements; development of techniques that offer orders of magnitude improvement in software productivity; development of new software algorithms and abstractions; and decreased number of software defects found through application of effective process and software development methods.

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