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 0603781D8Z / *Software Engineering Institute (SEI)*

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	-	14.468	15.016	15.111	-	15.111	15.239	15.400	15.688	16.020	Continuing	Continuing
781: *Software Engineering Institute (SEI)*	-	14.468	14.016	14.114	-	14.114	14.242	14.403	14.691	15.002	Continuing	Continuing
816: *Cyber Security*	-	0.000	1.000	0.997	-	0.997	0.997	0.997	0.997	1.018	Continuing	Continuing

A. Mission Description and Budget Item Justification

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. 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 February 2018 Defense Science Board Report, "Design and Acquisition of Software for Defense Systems," software is a crucial and growing part of weapons systems and the national security mission, and the DoD must address its ability to build and sustain software continuously and indefinitely. With growing global parity in software engineering, the DoD must maintain leadership to ensure a competitive advantage.

The Software Engineering Institute (SEI) Federally Funded Research and Development Center (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.

The 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 research conducted by this PE directly benefits the technical domains such as Command, Control, Communications, Computers, and Intelligence (C4I), Autonomy and Artificial Intelligence (AI), Cyber, and Engineered Resilient Systems.

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B. Program Change Summary ($ in Millions)	**FY 2018**	**FY 2019**	**FY 2020 Base**	**FY 2020 OCO**	**FY 2020 Total**
Previous President's Budget	15.047	15.050	15.154	-	15.154
Current President's Budget	14.468	15.016	15.111	-	15.111
Total Adjustments	-0.579	-0.034	-0.043	-	-0.043
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.550	-			
• FFRDC Adjustment	-0.029	-0.034	-	-	-
• Other Program Adjustments	-	-	-0.043	-	-0.043

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 0603781D8Z / *Software Engineering Institute (SEI)*	Project (Number/Name) 781 / *Software Engineering Institute (SEI)*	

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
781: *Software Engineering Institute (SEI)*	-	14.468	14.016	14.114	-	14.114	14.242	14.403	14.691	15.002	Continuing	Continuing

A. Mission Description and Budget Item Justification

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.

SEI research focuses on the most significant and pervasive software 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 teaming and 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 2018	FY 2019	FY 2020
Title: Software Engineering Institute Advanced Technology Development in the Area of Software Engineering, Systems Verification and Validation, and Mission Assurance	9.252	9.716	9.881
Description: This research seeks to mature 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 2019 Plans: • Develop and prototype full-lifecycle software cost models to assess/predict the cost DoD software acquisitions. • Develop a decision aid prototype that automatically guides DoD developers in refactoring code so that it can be harvested for re-use in a new system; select components could be replaced; or it could be upgraded to new hardware.			
FY 2020 Plans: • Develop methods and prototypes for verifying timing properties of software executing on multiple cores of a processor. • Develop a machine learning-based classifier that identifies security defects in software source code with a low error rate by analyzing the output of multiple source code analyzers. • Automate the fielding and deployment of machine learning algorithms on novel computing architectures to allow faster and cheaper software capabilities as well as the realization of performance improvements within the hardware.			
FY 2019 to FY 2020 Increase/Decrease Statement:			

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Appropriation/Budget Activity 0400 / 3	**R-1 Program Element (Number/Name)** PE 0603781D8Z / *Software Engineering Institute (SEI)*	**Project (Number/Name)** 781 / *Software Engineering Institute (SEI)*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2018	FY 2019	FY 2020
The increase in budget from FY 2019 to FY 2020 reflects additional resources required for prototype development.			
Title: Software Engineering Institute Advanced Technology Development in the Area of Information Assurance	5.216	4.300	4.233
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. ***FY 2019 Plans:*** • Develop and test assurance frameworks and methodologies for Internet of Thing (IoT) devices, control nodes, and other intermediaries in DoD mission and edge systems. • Develop, test, and prototype ML enabled automated detection against research and military datasets and video; the prototypes will use unsupervised machine learning (ML) approaches that incorporate minimal, opportunistic analyst feedback and include means to continually verify underlying data. ***FY 2020 Plans:*** • Prototype verified enforcers that prioritize mission critical functions while assuring component behavior to enable use of unverified commodity software components in military autonomous systems ***FY 2019 to FY 2020 Increase/Decrease Statement:*** The decrease from FY 2019 to FY 2020 reflects minor budget fluctuations.			
Accomplishments/Planned Programs Subtotals	14.468	14.016	14.114

C. Other Program Funding Summary ($ in Millions)

Line Item	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
• BA 2, PE # 0602751D8Z: *Software Engineering Institute Applied Research*	8.614	9.279	9.580	-	9.580	9.662	9.760	9.811	10.019	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 DIB, and to a number of agencies and organizations sponsoring work.

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 0603781D8Z / *Software Engineering Institute (SEI)*	**Project (Number/Name)** 781 / *Software Engineering Institute (SEI)*

- 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

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 0603781D8Z / *Software Engineering Institute (SEI)*	Project (Number/Name) 816 / *Cyber Security*	

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
816: *Cyber Security*	-	0.000	1.000	0.997	-	0.997	0.997	0.997	0.997	1.018	Continuing	Continuing

A. Mission Description and Budget Item Justification

SEI research focuses on the most significant and pervasive 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 teaming and 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 2018	FY 2019	FY 2020
Title: Cyber Security	-	1.000	0.997
Description: DoD network-centric and data-dependent autonomous systems are currently developed with a focus on function rather than security. This approach makes them particularly vulnerable to cyber attacks, a risk we seek to mitigate by developing, prototyping, and demonstrating new tools, technologies, and techniques to increase their cyber security. ***FY 2019 Plans:*** • Develop technologies and techniques for automated code repair. • Develop techniques and prototypes that automate the examination and analysis of binary malware code ***FY 2020 Plans:*** • Prototype DoD specific secure DevOps process, to include integration of advanced techniques and mission requirements that exceed commercial industry norms and capabilities • Prototype methods to model and understand the cost and protection of cyber controls on complex computer systems allowing better choices for PMO/PEO in system development ***FY 2019 to FY 2020 Increase/Decrease Statement:*** There is no change in the Cyber investment between FY 2019 and FY 2020. Note: the Cyber effort was funded in Project 781 in FY 2018.			
Accomplishments/Planned Programs Subtotals	-	1.000	0.997

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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 0603781D8Z / *Software Engineering Institute (SEI)*	**Project (Number/Name)** 816 / *Cyber Security*

D. Acquisition Strategy

N/A

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