Exhibit R-2, RDT&E Budget Item Justification: PB 2022 Office of the Secretary Of Defense	Date: May 2021
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide I* BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602751D8Z *I Software Engineering Institute (SEI) Applied Research*

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
Total Program Element	-	9.232	9.567	9.601	-	9.601	-	-	-	-	-	-
278: *Software Engineering Institute (SEI) Applied Research*	-	7.669	8.573	8.627	-	8.627	-	-	-	-	-	-
817: *Cyber Security, Applied Research*	-	1.563	0.994	0.974	-	0.974	-	-	-	-	-	-

Note

The Software Engineering Institute (SEI) Applied Research Program Element (PE) develops and evaluates the feasibility and practicality of software and computer science concepts at the applied research level, with the potential to improve future DoD systems through research, development, and application in the SEI Advanced Technology Development Program Element (PE) 0603781D8Z. Promising projects proceed into advanced technology development through this PE.

A. Mission Description and Budget Item Justification

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 Department of Defense (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.

Software is critical to meeting the Department of Defense's (DoD) increasing demand for national defense systems that are high quality, affordable, and deployed in a timely way. With growing global parity in software engineering, the DoD must maintain leadership in all aspects of software-based system development, operation, defense, and evolution to avoid strategic surprise. To assist the DoD in retaining a long-term differential advantage over potential adversaries, the Software Engineering Institute (SEI) Applied Research program element (PE) develops and evaluates the feasibility and practicality of software and computer science concepts, with the potential to improve future DoD systems. The research conducted by this PE directly benefits the technical domains Autonomous Systems and Artificial Intelligence (AI), Cyber, and Engineered Resilient Systems.

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B. Program Change Summary ($ in Millions)	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total
Previous President's Budget	9.580	9.573	9.712	-	9.712
Current President's Budget	9.232	9.567	9.601	-	9.601
Total Adjustments	-0.348	-0.006	-0.111	-	-0.111
• Congressional General Reductions	-	-0.006			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.346	-			
• Cancelled Account	-0.002	-	-	-	-
• Program Adjustment	-	-	-0.111	-	-0.111

Exhibit R-2A, RDT&E Project Justification: PB 2022 Office of the Secretary Of Defense			Date: May 2021
Appropriation/Budget Activity 0400 / 2	R-1 Program Element (Number/Name) PE 0602751D8Z / *Software Engineering Institute (SEI) Applied Research*	Project (Number/Name) 278 / *Software Engineering Institute (SEI) Applied Research*	

COST ($ in Millions)	Prior Years	FY 2020	FY 2021	FY 2022 Base	FY 2022 OCO	FY 2022 Total	FY 2023	FY 2024	FY 2025	FY 2026	Cost To Complete	Total Cost
278: *Software Engineering Institute (SEI) Applied Research*	-	7.669	8.573	8.627	-	8.627	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

Work conducted under this Program Element (PE) will enable resilient mission assurance in heterogeneous and contested environments through the verification and validation of system performance and architecture. The program will also assist the Department of Defense (DoD) in retaining a long-term advantage in the areas of software-intensive systems and cyber security by enhancing assurance, exploiting automation and Artificial Intelligence (AI), and understanding human-computer interaction.

The Software Engineering Institute (SEI) Applied Research PE 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. This area is increasingly being applied to AI and autonomous systems.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: SEI Applied Research in the Area of Software Engineering, Systems Verification and Validation, and Mission Assurance (formerly Mission Assurance)	5.511	6.023	6.036
Description: Increasingly complex and AI-enabled systems will require a commensurate increase in sophistication of verification and validation mechanisms. This thrust seeks to develop verification techniques for requirements identification, systems of systems architectures, and virtual integration of components. Additionally, research in this area will enable requirements verification for software assurance, analysis and control of unverified code, and automated repair of damaged code. Software production and code analysis methods developed through this program will also improve the accuracy of behavior prediction of complex software, including AI-enabled systems, in untested environments.			
FY 2021 Plans: • Develop automated design conformance checkers, as part of a continuous integration toolchain. This will aid in correctly identifying significant design non-conformance, advancing DoD capabilities in rapidly composing software systems, including secure AI/ML systems.			
FY 2022 Plans: • Develop new techniques to give Machine Learning (ML) models the ability to express when they are likely to be wrong without drastically increasing the computational burden during training.			
FY 2021 to FY 2022 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2022 Office of the Secretary Of Defense		Date: May 2021
Appropriation/Budget Activity 0400 / 2	**R-1 Program Element (Number/Name)** PE 0602751D8Z / *Software Engineering Institute (SEI) Applied Research*	**Project (Number/Name)** 278 / *Software Engineering Institute (SEI) Applied Research*

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Changes reflect minor budget fluctuations.			
Title: SEI Applied Research in the areas of Information Assurance (IA)	2.158	2.550	2.591
Description: Description: To gain full advantage from data and information generated by software for use in missions, DoD needs to assure its software is free of vulnerabilities. In its complex systems, DoD may use software developed from an unknown supply chain that may include intentionally or unintentionally introduced vulnerabilities. This thrust seeks to develop scalable automated methods to locate, understand, and mitigate the effects of these vulnerabilities. Automated solutions developed through this thrust will be used to discover vulnerabilities in system software source code and to generate proofs of correctness or fault. Additionally, they will be used to model and simulate operational environments to support software and cyber tactics, techniques, and procedures testing. ***FY 2021 Plans:*** • Advance compositional verification techniques to allow the use of unverified commodity software components in DoD systems, including secure and robust AI/ML systems. ***FY 2022 Plans:*** • Use machine learning and semantic analysis of data generated during Continuous Integration/Continuous Delivery to reduce the number of alerts requiring human adjudication during the deployment of multiple situational awareness tools and increase the security of software without slowing the development process. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Changes reflect minor budget fluctuations.			
Accomplishments/Planned Programs Subtotals	7.669	8.573	8.627

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

The SEI Applied Research PE represents a pivot toward more fundamental research that enables the DoD to address longer-term challenges in software technology and engineering. The SEI Applied Research PE bolsters the organic research at the SEI Federally Funded Research and Development Center (FFRDC), enables stronger collaborations between the SEI FFRDC and academia, attracts top researchers to the SEI, and gives the DoD access to top experts in information science, which generally enhances the DoD's ability to benefit from the military applications of research in software and computer science.

D. Acquisition Strategy

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2022 Office of the Secretary Of Defense											Date: May 2021	
Appropriation/Budget Activity 0400 / 2					R-1 Program Element (Number/Name) PE 0602751D8Z / *Software Engineering Institute (SEI) Applied Research*				Project (Number/Name) 817 / *Cyber Security, Applied Research*			
COST ($ in Millions)	**Prior Years**	**FY 2020**	**FY 2021**	**FY 2022 Base**	**FY 2022 OCO**	**FY 2022 Total**	**FY 2023**	**FY 2024**	**FY 2025**	**FY 2026**	**Cost To Complete**	**Total Cost**
817: *Cyber Security, Applied Research*	-	1.563	0.994	0.974	-	0.974	-	-	-	-	-	-

A. Mission Description and Budget Item Justification

Work conducted under this project will enable resilient mission assurance in heterogeneous and contested environments through the verification and validation of system performance and architecture. The program will also assist the DoD in retaining a long-term advantage in the area of cybersecurity by enhancing assurance, exploiting automation, and understanding human-computer interaction.

B. Accomplishments/Planned Programs ($ in Millions)	FY 2020	FY 2021	FY 2022
Title: Cyber Security	1.563	0.994	0.974
Description: Warfighting in the cyber domain often operates at sub-second timescales and across multiple domains of authority. Methods used to accomplish many tasks (e.g., malware analysis, coordinating multiple agents) demand large amounts of time, attention, and special skills and are not scalable. This thrust seeks to develop and increase the use of automation to simplify the completion of these tasks. Example activities include automation of moving target defenses, code artifact reverse engineering, analysis of network flows at enterprise scale, assessing the operating boundaries for Artificial Intelligence (AI) and Machine Learning (ML) algorithms, and development and assessment of workforce skills. ***FY 2021 Plans:*** • Develop techniques to evaluate the effectiveness of proposed system defenses against code reuse attacks on multiple architectures and platforms of interest to the DoD including AI/ML systems. • Apply and advance new techniques to continuously assess the operating boundaries for AI/ML algorithms to assure and verify trustworthiness. ***FY 2022 Plans:*** • Improve emulation and virtualization techniques to advance understanding of – and defense capabilities against – adversary attacks. ***FY 2021 to FY 2022 Increase/Decrease Statement:*** Changes reflect minor budget fluctuations.			
Accomplishments/Planned Programs Subtotals	1.563	0.994	0.974

C. Other Program Funding Summary ($ in Millions)

N/A

Exhibit R-2A, RDT&E Project Justification: PB 2022 Office of the Secretary Of Defense		Date: May 2021
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C. Other Program Funding Summary ($ in Millions)

Remarks

D. Acquisition Strategy

N/A