Exhibit R-2, RDT&E Budget Item Justification: PB 2023 Office of the Secretary Of Defense	Date: April 2022
Appropriation/Budget Activity 0400: *Research, Development, Test & Evaluation, Defense-Wide* / BA 2: *Applied Research*	**R-1 Program Element (Number/Name)** PE 0602751D8Z / *Software Engineering Institute (SEI) Applied Research*

COST ($ in Millions)	Prior Years	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
Total Program Element	-	9.216	9.571	11.030	0.000	11.030	11.365	11.607	11.867	12.105	Continuing	Continuing
278: *Software Engineering Institute (SEI) Applied Research*	-	9.216	8.627	10.097	0.000	10.097	10.417	10.665	10.904	11.122	Continuing	Continuing
817: *Cyber Security, Applied Research*	-	0.000	0.944	0.933	0.000	0.933	0.948	0.942	0.963	0.983	Continuing	Continuing

Note

New Start (Y/N): No

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

This program supports the Department's initiative to Build Sustainable and Long-Term 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 the 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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total
Previous President's Budget	9.567	9.601	0.000	-	0.000
Current President's Budget	9.216	9.571	11.030	-	11.030
Total Adjustments	-0.351	-0.030	11.030	-	11.030
• Congressional General Reductions	-	-			
• Congressional Directed Reductions	-	-			
• Congressional Rescissions	-	-			
• Congressional Adds	-	-			
• Congressional Directed Transfers	-	-			
• Reprogrammings	-	-			
• SBIR/STTR Transfer	-0.349	-			
• Other Reprogramming	-0.002	-	-	-	-
• FFRDC	-	-0.030	-	-	-
• Adjustments to Budget Year	-	-	10.650	-	10.650
• Economic Assumption	-	-	0.380	-	0.380

Change Summary Explanation

FY 2023 funding increase reflects the fact that the FY 2022 President’s Budget request did not include out-year funding.

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
278: *Software Engineering Institute (SEI) Applied Research*	-	9.216	8.627	10.097	0.000	10.097	10.417	10.665	10.904	11.122	Continuing	Continuing

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 2021	FY 2022	FY 2023
Title: SEI Applied Research in the Area of Software Engineering, Systems Verification and Validation, and Mission Assurance (formerly Mission Assurance)	6.666	6.036	7.492
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 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 2023 Plans: • Develop new techniques to allow feedback between deployed software, software modeled through model based systems engineering, and deployed systems. This approach can be automated using machine learning methods that enable comparison of online information systems performance with modeled systems performance in a variety of mission and application contexts.			
FY 2022 to FY 2023 Increase/Decrease Statement:			

Exhibit R-2A, RDT&E Project Justification: PB 2023 Office of the Secretary Of Defense		Date: April 2022
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 2021	FY 2022	FY 2023
The additional resources will be needed to further develop methods and tools for software assurance, augmenting machine learning.			
Title: SEI Applied Research in the areas of Information Assurance (IA)	2.550	2.591	2.605
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, these solutions will be used to model and simulate operational environments to support software and cyber tactics, techniques, and procedures testing. ***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 2023 Plans:*** • Enable verification and validation of systems at the embedded level through graph based models of embedded systems performance and integration of large collections of such embedded systems on complex command and control applications. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** There is no significant change between FY 2022 and FY 2023.			
Accomplishments/Planned Programs Subtotals	9.216	8.627	10.097

C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
• RDT&E, BA 3, PE 0603781D8Z: *Software Engineering Institute*	12.128	14.631	13.417	0.000	13.417	16.993	17.427	17.829	18.186	Continuing	Continuing

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

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C. Other Program Funding Summary ($ in Millions)

Line Item	FY 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost

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 2023 Office of the Secretary Of Defense			Date: April 2022
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 2021	FY 2022	FY 2023 Base	FY 2023 OCO	FY 2023 Total	FY 2024	FY 2025	FY 2026	FY 2027	Cost To Complete	Total Cost
817: *Cyber Security, Applied Research*	-	0.000	0.944	0.933	0.000	0.933	0.948	0.942	0.963	0.983	Continuing	Continuing

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 2021	FY 2022	FY 2023
Title: Cyber Security	-	0.944	0.933
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 2022 Plans:*** • Improve emulation and virtualization techniques to advance understanding of – and defense capabilities against – adversary attacks. ***FY 2023 Plans:*** • Improve emulation and virtualization techniques to advance understanding of – and defense capabilities against – adversary attacks. ***FY 2022 to FY 2023 Increase/Decrease Statement:*** There is no significant change between FY 2022 and FY 2023.			
Accomplishments/Planned Programs Subtotals	-	0.944	0.933

C. Other Program Funding Summary ($ in Millions)

N/A

Remarks

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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*

D. Acquisition Strategy

N/A