Fiscal Year (FY) 2005 Budget Estimates RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	DATE February 2004
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense Wide/BA 3	**R-1 ITEM NOMENCLATURE** Software Engineering Institute (SEI) **PE 0603781D8Z**

COST(In Millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	
Total Program Element (PE) Cost	21.535	22.324	21.599	23.296	23.286	23.524	24.052	
Project 781/SEI	19.166	19.868	19.223	20.733	20.724	20.936	21.406	
Project 782/ Software Intensive Systems	2.369	2.456	2.376	2.563	2.562	2.588	2.646	

(U) A. Mission Description and Budget Item Justification

U) Software is key to meeting DoD's increasing demand for high-quality, affordable, and timely national defense systems. There is a critical need to rapidly transition state-of-the-art technology and best practices to improve the acquisition, engineering, fielding, and evolution of software-intensive DoD systems. This project funds the technology transition activities of the Software Engineering Institute (SEI) at Carnegie Mellon University. The SEI is an R&D Laboratory Federally Funded Research and Development Center (FFRDC) sponsored by the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics. It was established in 1984 as an integral part of the DoD's software initiative to identify, evaluate, and transition high-leverage software engineering technologies and practices. The SEI fosters disciplined software engineering practices by DoD acquisition and life-cycle support programs and by the industrial base where the bulk of defense software is produced. The Institute works across government,

industry, and academia to: (1) improve current software engineering activities from acquisition, technical, and management perspectives; (2) facilitate rapid, value-added transition of software engineering technology into practice; and (3) evaluate and calibrate emerging software engineering technologies to determine their potential for improving the evolution of software-intensive DoD systems.

(U) The SEI enables the exploitation of emerging software technology by bringing engineering discipline to software acquisition, development, and evolution. The SEI focuses on software technology areas judged to be of the highest payoff in meeting defense needs. FY 2003 focus areas are: Acquisition Practices for DoD Software-Intensive Systems (including pilot demonstrations of new technologies, dissemination of lessons learned, and provision of selected important services to the DoD acquisition community); Software Engineering Technical Practices (including Survivable Systems practices, Software Architecture technology, and Integration of Software-Intensive Systems); and Software Engineering Management Practices [including personal and team software development processes and Capability Maturity Model Integration (CMMI)].

(U) This funding line also includes support of the Software Intensive Systems Office (SISO), a DoD office under the Office of the Secretary of Defense (Acquisition, Technology, and Logistics) Acquisition Resource and Analysis. This DoD function is not affiliated with the Software Engineering Institute.

(U) Current initiatives include: Stress Software Process and Past Performance; Establish Independent Expert Program Reviews (IEPRs); Improve Software Education and Training; Document and Promulgate Best Practices; and Strengthen the Technology Base.

B. Program Change Summary:	FY 2003	FY 2004	FY 2005
Previous President's Budget	22.189	22.652	22.627
Current FY 2005 President's Budget	21.535	22.324	21.599
Total Adjustments	.654	.328	1.028
Congressional Program reduction			
Congressional increases			
Reprogrammings			
SBIR/STTR Transfer			
Other	.654	.328	1.028

Fiscal Year (FY) 2005 Budget Estimates Exhibit R-2a, RDT&E Project Justification	Date: February 2004
Appropriation/Budget Activity RDT&E, DW/ BA 3	Project Name and Number **781**/Software Engineering Institute (SEI) PE 0603781D8Z

Cost ($ in millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	
Total PE	21.535	22.324	21.599	23.296	23.286	23.524	24.052	
Software Engineering Institute **P781**	19.166	19.868	19.223	20.733	20.724	20.936	21.406	

A. Mission Description and Budget Item Justification: P781

(U) Software is key to meeting DoD's increasing demand for high-quality, affordable, and timely national defense systems. There is a critical need to rapidly transition state-of-the-art technology and best practices to improve the acquisition, engineering, fielding, and evolution of software-intensive DoD systems.

(U) The SEI enables the exploitation of emerging software technology by bringing engineering discipline to software acquisition, development, and evolution.

B. Accomplishments/Planned Program

Acquisition Practices for DoD Software	FY 2003	FY 2004	FY 2005	
Accomplishment/ Effort/Subtotal Cost	.750	2.091	2.050	

(U) Acquisition Practices for DoD Software-Intensive Systems

FY 2003 Accomplishments:

- Conducted Acquisition Support Program, initiating pilot demonstrations of adopting new technology within the DoD program-office environment, coordinating and broadly disseminating lessons learned from these pilots, and providing selected and strategically important software engineering services to the DoD acquisition community.
- Conducted more than 30 training courses in information security for technical staff, managers, and executives from the DoD, federal agencies, and industry. Course attendance at the SEI's security-related courses more than doubled, from 400 in FY 2002 to 950 in FY 2003.

- Enhanced support to those responsible for acquiring software in the Army, Navy, and Air Force, actively working with each service to establish a Strategic Impact Program (SIP) for software-intensive systems.
- Provided systems engineering and software engineering support to DoD programs identified as top priorities by the principal SEI sponsor, the Office of the Secretary of Defense (Acquisition, Technology, & Logistics), and increased interaction and support to DoD agencies and joint programs.
- Conducted a research-and-development project that examined system-of-systems interoperability, studying the full range of barriers to achieving interoperability among systems, including programmatic, constructive, and technical problems, and proposed solutions to those problems.
- Explored simulation and gaming techniques as a low-cost approach for DoD acquisition managers to experience the typical risks of program management.
- Developed and administered a survey to 150 Army acquisition program managers to help the U.S. Army Strategic Software Improvement Program (ASSIP)evaluate its acquisition environment.

FY 2004 Plans:
- Work with key acquisition programs to continually understand and meet the needs of the acquisition community.
- Build delivery teams to support the needs of Army, Air Force, Navy, and civil agency acquisition programs.
- Develop and pilot a Software Acquisition Survival Skills course and Mission Rehearsal workshop.
- Conduct a conference on the acquisition of software-intensive systems for government acquisition organization employees, their support agencies (i.e., support contractors, FFRDCs), and federal government contractors.

FY 2005-2006 Plans:
The SEI Acquisition Support Program (ASP) helps the DoD and other government acquirers make evolutionary and revolutionary improvements in the acquisition of software-intensive systems. The DoD has provided to the SEI an approved set of challenge problems that form the foundation of the SEI's program of work. In addition, SEI-managed independent research and development (IR&D) activities are focused on the DoD-approved challenge problems in the following areas: security and survivability; interoperability; software technology research and development; acquisition management; software metrics for acquisition management; sustainment; and commercial off-the-shelf (COTS) products.

Specific activities will also include:
- Conducting pilot projects that give acquisition organizations access to SEI technologies and expertise while giving the SEI an opportunity to observe these technologies in real-world

acquisition environments. These engagements will contribute to a growing body of knowledge about best practices in the acquisition of software-intensive systems.
- Developing and refining architecture guidelines for DoD acquisition organizations.
- Analyzing results of independent technical assessment to characterize the state of practice in acquisition programs and their industry partners.

Software Engineering Technical Practices	FY 2003	FY 2004	FY 2005	
Accomplishment/ Effort/Subtotal Cost	10.666	13.024	12.910	

U) Software Engineering Technical Practices

FY 2003 Accomplishments:
- Created documentation and support materials for COTS Usage Risk Evaluation (CURE) method, enabling the method to be administered by organizations without direct support from the SEI.
- Worked on a standard for the Avionics Architecture Description Language (AADL) under the auspices of the Society of Automotive Engineers (SAE) Avionics System Division (ASD) and with funding from the U.S. Army Aviation and Missile Command (AMCOM). The standard is based on more than 10 years of DoD-funded research and should be applicable in domains ranging from avionics to robotics and automotive systems.
-.Published the second edition of *Software Architecture in Practice*, written by SEI staff members to help practicing architects.
- Introduced a software architecture curriculum, made up of six courses and three certificate programs, that helps equip software professionals with state-of-the-art practices for designing, documenting, evaluating, and implementing software architectures.
- Through a Predictable Assembly of Certifiable Components initiative, provided technical leadership by helping to solve DoD-approved challenge problems such as the needs to
  - "develop improved, enhanced or new processes, principles, methods, and tools for determining expected properties of software systems before they are built and for confirming their as-built properties";
  - explicitly address the system properties of security, survivability, availability, interoperability
  - find a way to more effectively obtain benefits from commercial off-the-shelf (COTS) components.
- Hosted sixth DoD Software Product Line Workshop.
- Released OCTAVE-S, a variation of the Operationally Critical Threat, Asset, and Vulnerability Evaluation (OCTAVE) method that meets the needs of small organizations. Like the original OCTAVE

method, OCTAVE-S is a risk-based information security assessment that an organization can perform using a team of its own personnel.
- Developed a set of new software tools for analyzing large-scale, fluid datasets nearly in real time. The operational use of these tools has resulted in a major advance in the survivability of critical networks.

FY 2004 Plans:
- Work with U.S. Army to train Army personnel in SEI software architecture courses, principles, and methods.
- Develop and widely distribut books, support aids, case studies, and guidelines that assisted developers and acquirers in using effective software architectural practices.
- Develop technologies in support of survivable systems engineering; established techniques for modeling and predicting survivability attributes of systems; and matured technology necessary for active network defense.
- Analyze malicious code to determine defenses against it and to identify trends that enable the DoD, federal agencies, and the private sector to anticipate the future evolution of threats from attack technology.
- Research and develop advanced technical analytical techniques for strategic situational awareness; researched technical threat areas, identifed indicators for those threats, and evaluated their contextual relevance.
- Provide integrated, easily accessible knowledge repositories of software product line technology and experience.
- Develop software product line courses and certificate programs.
- Define key practices for constructive and programmatic interoperability, and developed and piloted tools and technologies to support the key practices.
- Provide case study analyses of actual systems that have experienced performance, dependability, and interoperability problems to show the utility of proposed specification, modeling, and analysis techniques.
- Provide a handbook of techniques for developing credible predictions of operational properties of software-intensive systems.

FY 2005 Plans:
- Survivable Systems: Ensure that appropriate technology and systems management practices are being used to design and implement networked systems so they recognize, resist, and recover quickly from attacks.•
- Product Line Practice: Enable the Department of Defense (DoD) to reduce the cost and schedule for

producing similar systems by employing software product line techniques used effectively by commercial industry.•
- Software Architecture Technology: Improve DoD system cost, schedule, and quality by making engineering tradeoffs at the software architecture design level. Provide effective practices for the analysis, documentation, definition, and reconstruction of software architectures.•
- Predictable Assembly from Certifiable Components: Provide support for predicting properties of assemblies of components. Ensure that the builders of systems have the ability to select software components on the basis of their predicted runtime behavior within specific assemblies and therefore to predict the runtime behavior of these assemblies or systems.
- Integration of Software-Intensive Systems: Provide the acquisition community with principles, methods, and techniques to accomplish broad-based and sustainable integration and interoperation across components, systems, and systems-of-systems.
- Performance-Critical Systems: Establish methods for credibly analyzing and predicting performance, dependability, and interoperability properties of software systems prior to implementation and test.

Software Engineering Management Practices	FY 2003	FY 2004	FY 2005	
Accomplishment/ Effort/Subtotal Cost	7.75	4.753	4.263	

(U) Software Engineering Management Practices

FY 2003 Accomplishments:
- Developed Team Software Process (TSP) for Secure Software (TSP-Secure), based on proven TSP practices and the CERT Coordination Center's extensive security skills and knowledge. The goal of the SEI TSP-Secure project is to develop a TSP-based method that can predictably produce secure software.
- Accelerated pace of CMMI adoption. CMMI course attendance increased by 60% in FY 2003. To date, more than 7,000 people have received training in CMMI. There was also a 17% increase in the number of CMMI transition partners licensed by the SEI to teach Introduction to CMMI, and a 59% increase in transition partners licensed to conduct CMMI appraisals.
- Developed credentials program in software engineering process management.
- Developed a diagramming technique that is helping project managers gain greater insight into measurement data and make more informed business decisions.
- Piloted CMMI appraisal methods to determine if they could be used efficiently and effectively in acquisition environments. The SCAMPI method incorporates the best ideas of several process improvement appraisal methods to baseline process capabilities based on CMMI models. Pilot participants included the National Reconnaissance Office (NRO) and the Space and Missile Systems Center (SMC).
- Developed measurement and analysis approaches to help accelerate an organization's efforts to improve software processes. During FY 2003, two of these approaches—the goal-question-indicator-metric (GQIM) technique and Six Sigma for Software—were applied at Warner Robins Air Logistics Center and at the U.S. Air Force Human Resource Command & Control Systems Program Office.
- Through application of the Team Software Process, helped a team at NAVAIR to achieve SW-CMM Level 4 at an accelerated pace.

FY 2004 Plans:
- Set direction for Version 1.2 of the CMMI Product Suite based on input from the user community, analysis, and research.
- Produce interpretive guidance for use of CMMI Product Suite in software-only organizations and in acquisition environments.
- Work with DoD, government, and industry software developers and acquirers to apply TSP to software development and gather the data and experience to mature the technology to meet early-majority needs.
- Develop and disseminate guidance regarding how to rigorously and systematically assess the value and impact of selected innovations to the engineering of software, systems, and acquisition.
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FY 2005 Plans:

- Capability Maturity Model Integration: Provide stewardship for and transition into practice an integrated Capability Maturity Model (CMM) product suite that provides the DoD and industry with support for process and product improvement.
- Team Software Process: Define explicit team process techniques whose use predictably improves the cost, schedule, quality, and survivability of software-intensive systems developed by an integrated engineering team. Determine cost, schedule, and quality performance that the DoD can expect from teams using the TSP and establish metrics for use in software acquisition.
- Software Engineering Measurement and Analysis: Develop measurement and analysis guidance, information resources, and practices that assist DoD and industry software organizations in managing and improving their software engineering practices.

Fisal Year (FY) 2005 Budget Estimates Exhibit R-2a, RDT&E Project Justification	Date: February 2004
Appropriation/Budget Activity RDT&E, DW/ BA 3	Project Name and Number **P782/Software Engineering Institute** **PE 0603781D8Z**

Cost ($ in millions)	FY 2003	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	
Total PE	21.535	22.324	21.599	23.296	23.286	23.524	24.052	
Software Intensive Systems **P782**	2.369	2.456	2.376	2.563	2.562	2.588	2.646	

A. Mission Description and Budget Item Justification: P782

U) P782 Software-Intensive Systems (SIS). The Software Intensive Systems (SIS) Directorate's mission is to improve DoD SIS acquisition and sustainment. The SIS Directorate is the focal point for DoD initiatives that reduce software risk. SIS is founded in the recommendations of the FY 2000 DSB Task Force on Software, and guided by the SIS Steering Group (SISSG) chaired by OUSD(AT&L) with senior software representatives from ODUSD(S&T), ASD(C3I), and the Services. SIS activities are organized into elements that ensure coverage of the breadth of responsibilities necessary to achieve the mission of improving SIS acquisition performance, and to act as the DoD software community focal point. These elements focus on Policy & Guidance, Education, Best Practices, Software Engineering Technology, and Collaboration. SIS conducts its efforts by understanding DoD needs, issues, and solutions; and acting on/transitioning improvements to DoD Enterprise-, Program- and practitioner-levels. SIS maintains and coordinates the Defense Software Collaborators, an organization of more than 30 defense and other government organizations that are involved with the development, maintenance, and/or acquisition of software-intensive systems.

B. Accomplishments/Planned Program

(U) FY 2003 Accomplishment:

Policy and Guidance:

- Implement Defense Authorization Section 804 language on Process Improvement, develop guidance for implementation by the Services and Agencies, monitor their implementation, and establish a clearinghouse for best practices.
- Develop software acquisition management guidance to account for the recent update to the DoD 5000 policy series.
- Transition the use of the Safety and Security Capability Maturity Model extension.

Best Practices:
- Independent Expert Program Reviews (IEPRs): Continue the Tri-service Assessment Initiative assessment and systemic analysis activities. Publish and disseminate report on systemic findings; begin to formulate corrective action strategies based upon the systemic root causes identified. Improve the systemic analysis tool and continue partnering with other DoD IEPR organizations to promote use of a single methodology.
- Measurement: Support Practical Systems/Software Measurement program research into evolutionary acquisition measures and measures to track process improvement programs (in response to Section 804 language). Continue efforts of the DoD Measurement Initiative.

Software Engineering Technology:
- Participate in the DUSD(S&T) study into software engineering technology gaps and investment needs.
- Continue the software expertise and experience factory support to the Army's Future Combat Systems program, collect lessons learned from this experience database and analyze data for application to other DoD programs and acquisition processes.
- Identify additional pilot opportunities in the Services to evaluate software engineering technologies.

Collaboration:
- Continue the Bi-lateral Software Acquisition Working Group with the UK, and the parallel relationship with Australia. Identify areas for joint study and develop/initiate cooperative study plans.

FY 2004 – FY2005 Plans:
Policy and Guidance:
- Continue Section 804 implementation activities, track establishment of Process improvement programs in the Services and DoD Agencies

Best Practices:
- IEPRs: Implement regular adoption of IEPRs by program managers, implement use of the systemic analysis as an enterprise level resource for tracking software acquisition performance issues and improvements. Begin to predict software acquisition performance shortfalls and use this information to impact acquisition decisions.
- Measurement: Publish Practical Systems/Software Measurement research into evolutionary acquisition and process improvement measures. Use the DoD Measurement Initiative to provide tools, training and guidance for implementing measurement into program and enterprise decisionmaking.

Technology:
- Further the use of the Center for Empirically Based Software Engineering experience factory pilots in DoD acquisition programs; use data from experiences to influence DoD software acquisition policy, guidance and education.
- Continue the technology watch activities, software engineering technology needs studies
Collaboration:
- Continue collaborative efforts across DoD and the international community