RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)	Date: February, 2005
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense Wide/BA 3	R-1 ITEM NOMENCLATURE Software Engineering Institute (SEI) PE 0603781D8Z

COST (In Millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Total Program Element (PE) Cost	21.601	21.096	25.209	26.180	29.156	29.808	30.409	31.196
Project 781/SEI	19.225	18.775	20.606	21.472	23.117	23.766	24.309	25.006
Project 782/ Software Intensive Systems	2.376	2.321	2.547	2.654	2.857	2.937	3.004	3.091
Project 783/Software Producibility Initiative	0.000	0.000	2.056	2.054	3.182	3.105	3.096	3.099

A. Mission Description and Budget Item Justification:

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.

Project 781 funds the technology development and 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.

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 2005 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, software component technology, performance-critical systems, and integration of software-intensive systems); and Software Engineering Management Practices [including personal and team software development processes, software engineering measurement and analysis, and Capability Maturity Model Integration (CMMI)].

This funding line includes the Software Intensive Systems (SIS) effort under project 782. The SIS mission stems from the recommendations of the FY 2000 DSB Task Force on Software. The Assessments and Support organization within AT&L/Defense Systems/Systems Engineering manages the SIS mission to improve DoD system acquisition and sustainment. The A&S organization, because of its assessment activities, is strategically positioned to ensure that software acquisition and development technology and best practices are adopted and implemented by DoD acquisition programs. The comprehensive A&S resources ensure coverage of the breadth of responsibilities necessary to achieve the mission of improving system acquisition performance, and to act as the DoD software community focal point. The work is divided into 5 focus areas: Policy & Guidance, Education, Best Practices, Software Engineering Technology, and Collaboration. This DoD function is not affiliated with the Software Engineering Institute.

This funding line also includes the Software Produceability Initiative starting in FY 2006 as project 783. The role of software in major Defense acquisition programs has been steadily increasing. Much of the mission functionality demanded from programs such as F/A-22, JSF, Future Combat System, and many others is embodied in large, complex software systems. Shortcomings in software development often lead to schedule slippage, cost growth, and mission compromises. These shortcomings can frequently be traced to underpowered software development technologies not up to the task of developing the scale and complexity of software needed. Despite the large role of the commercial sector in advancing software technology, there are many key aspects of complex, distributed, robust systems crucial to DoD that are not being addressed directly by commercial technology efforts, as our experience over the past decade shows. The Software Produceability Initiative will focus on developing and transitioning more powerful and effective software development science, techniques and tools.

B. Program Change Summary:

	FY 2004	FY 2005	FY 2006	FY 2007
Previous President's Budget:	22.324	21.599	23.296	23.286
Current FY2006 President's Budget Submission:	21.601	21.096	25.209	26.180
Adjustments to Appropriated Value:	-0.723	-0.503	+1.913	+2.894
Congressional Program Reductions:		-0.503		
Congressional Rescissions:	-0.168			
Congressional Increases:				
Reprogrammings:				
SBIR/STTR Transfers:	-0.555			
Program Adjustment:			+1.913	+2.894

C. Other Program Funding Summary: N/A

D. Acquisition Strategy: N/A

E. Performance Metrics:

A&S Performance Measures for Products				
Customer Supported	**Activity**	**Performance Requirement**	**Performance Measure**	**Method of Measurement**
SEI Admin Agent	Ensure value to PWS Customers	Average rating of 4 or higher	Level of overall performance	Paper or electronic survey of customers
SEI Admin Agent	Contract Billings	All costs are allowable and allocable	Contract costs	Approval by ACO
SEI Admin Agent	Performance and Cost Review	Less than 5% of solicited programs	Number of unsatisfactory ratings	DCAA conducts periodic review
For SIS: PM	Ensure valuable assistance to programs' success	Provide actionable and effective recommendations to PMs	Percentage of recommendations implemented	Customer Satisfaction Survey to PMs
			Cost avoidance realized as result of implementing recommendations	Interview w/PM as follow-up to Survey

Exhibit R-2a, RDT&E Project Justification							Date: February 2005	
Appropriation/Budget Activity RDT&E, DW/ BA 3			Project Name and Number: 781/Software Engineering Institute (SEI) PE 0603781D8Z					
Cost ($ in millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Total PE	21.601	21.096	25.209	26.180	29.156	29.808	30.409	31.196
Software Engineering Institute P781	19.225	18.775	20.606	21.472	23.117	23.766	24.309	25.006

A. Mission Description and Budget Item Justification: P781 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.

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 Intensive Systems	FY 2004	FY 2005	FY 2006	FY 2007
Accomplishment/ Effort/Subtotal Cost	2.023	2.002	2.145	2.145

FY 2004 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.
- 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.
- Established work plans with 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; the SEI participated with OSD on 804 activities. Activities included acquisition pilots and performing diagnostics to aid in early program and engineering risk identification.
- Completed development of a Software Acquisition Survival Skills course
- Supported OSD on the SISAIG Trilateral (US-UK-AUS) Working Group
- Released the CMMI Acquisition Module (CMMI-AM), Version 1.0 for use by DoD and federal government acquisition offices to enable individual process improvement efforts within government program offices.
- Conducted 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.
- Published technical reports on risk-based diagnostics, the benefits of acquisition improvement, CMMI-AM, software process improvement for small manufacturers, measurements for software product lines, and system-of-systems interoperability

FY 2005 Accomplishments and 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.
- Determine gaps in current acquisition practices and strengthen those practices in support of acquisition programs
- Define mechanisms to support active and ongoing collection and dissemination of lessons learned in support of the acquisition community.

FY 2006-2007 Plans:
- Drawing on SEI expertise in software engineering, help DoD and other government acquirers improve their ability to acquire, deploy, and sustain systems and capabilities. Identify opportunities for the SEI to create, apply, and amplify technologies that respond to customer needs.

Software Engineering Technical Practices	FY 2004	FY 2005	FY 2006	FY 2007
Accomplishment/ Effort/Subtotal Cost	12.602	12.576	13.841	14.491

FY 2004 Accomplishments:
- Developed technologies in support of survivable systems engineering, enabling organizations to quantitatively assess security posture, characterize threats, and give security analysts and network operators a better overall understanding of their networks; established techniques for modeling and predicting survivability attributes of systems; and matured technology necessary for active network defense.
- Released into the open source community the System for Internet-Level Knowledge (SiLK), a suite of tools to help operators and security analysts better understand their networks
- Analyzed 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.
- Designed a sustainable and extensible information assurance training program for the U.S. Army Reserve Information Operations Command (ARIOC)
- Matured and piloted techniques for the largely under-explored, high risk areas of product derivation and sustainment in a product line context.
- Provided integrated, easily accessible knowledge repositories of software product line technology and experience as well as derivative methods and adoption and practice guides.
- Developed, delivered, and licensed software product line courses and certificate programs.
- Worked with U.S. Army to train Army personnel in SEI software architecture courses, principles, and methods.
- Developed and widely distributed books, support aids, case studies, and guidelines that assisted developers and acquirers in using effective software architectural practices.
- Developed, delivered, and licensed courses and certificate programs for software professionals in software architecture.
- Researched and developed quality attribute analysis techniques and their automation, and packaged them in a starter kit.

- Conducted pilots of predictable assembly from certifiable component (PACC) technologies and disseminated results.
- Defined key practices for constructive and programmatic interoperability, and developed and piloted tools and technologies to support the key practices.
- Conducted four workshops with stakeholders from the DoD and other government agencies to identify primary interoperability issues that they are facing and to provide input on emerging areas of focus
- Published key technical reports identifying the basic issues, programs, and research trends in interoperability, including an analysis of open challenges; and analyzing current technological issues and gaps in research, providing the foundation for a research program and a set of experiments in interoperability technologies
- Led development of SAE AADL standard for embedded real-time systems; finalized and balloted in March 2004, approved in September 2004.
- Developed training and tool support for AADL standard.

FY 2005 Accomplishments and Plans:
- Mature survivable systems engineering.
- Improve survivable enterprise management.
- Enhance the transition of information-assurance knowledge through practices and training.
- Build a national cyber response and readiness capability and build international computer security information exchange and collaborative analysis capabilities.
- Develop a comprehensive strategy for enhancing situational awareness.
- Mature and enable adoption of product line practices.
- Mature and transition software architecture technology.
- Mature PACC technology and build mechanisms to guide its maturation and transition.
- Develop a conceptual basis for understanding integration and interoperability of software-intensive systems; and identify and plan for the development of mechanisms to guide the maturation and transition of interoperability practices and technologies.
- Develop and apply SAE AADL as a model-based method for specifying, modeling, analyzing, and predicting performance and dependability properties of embedded and real-time systems.

FY 2006-2007 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: Provide the technical, business, and acquisition techniques and guidance required for organizations to achieve the significant cost, schedule, and quality benefits associated with using a product line approach for similar systems.•
- Software Architecture Technology: Harness innovations in quality attribute reasoning and software architecture technology for practical use. Provide an effective, integrated, widely available, and widely applicable set of architectural practices, enabling and providing automated support wherever possible.
- 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 development and 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 a model-based software systems engineering practice for embedded real-time systems. Develop and mature methods for creating and documenting structured rationales showing how evidence gathered during system design and test supports dependability and real-time performance claims for specific systems.

Software Engineering Management Practices	FY 2004	FY 2005	FY 2006	FY 2007
Accomplishment/ Effort/Subtotal Cost	4.600	4.197	4.620	4.836

FY 2004 Accomplishments:
- Held workshops, delivered courses, conducted Standard Capability Maturity Model Integration (CMMI) Appraisal Method for Process Improvement (SCAMPI) appraisals, provided direct assistance to organizations, and supported a vast transition partner program to ensure that the acquisition and development communities can implement process improvement programs, understand the applicability and coverage of CMMI best practices, and understand the relationships these models have to other sets of best engineering, management, workforce, and acquisition practices and standards.
- Established proactive certification and quality assurance programs for SCAMPI lead appraisers and instructors to ensure that appraisals are performed with integrity by qualified individuals.
- Set direction for Version 1.2 of the CMMI Product Suite based on input from the user community, analysis, and research.
- Produced interpretive guidance for use of CMMI Product Suite in software-only organizations and in acquisition environments.
- Worked with DoD, government, and industry software developers and acquirers to apply Team Software Process (TSP) to software development and gathered the data and experience to mature the technology to meet early-majority needs.
- Developed and disseminated guidance regarding how to rigorously and systematically assess the value and impact of selected innovations to the engineering of software, systems, and acquisition.
- Developed the indicator template, a tool for documenting an organization’s measurement and analysis processes

FY 2005 Accomplishments and Plans:
- Develop Version 1.2 of the CMMI Product Suite (models, appraisal methods, and training).
- Maintain CMMI Product Suite by creating, maintaining, and appropriately updating or enhancing products, including appraisal and improvement courseware and guidance for small organizations.
- Manage and administer transition programs and services for the CMMI Product Suite.
- Evolve TSP process and measurement framework and extend to increase breadth and scale of applicability.
- Extend and accelerate transition of TSP.
- Define an engineering process improvement strategy that utilizes TSP to accelerate CMMI-based organizational improvement.
- Provide expertise and specific techniques for software and acquisition organizations to use for measuring and analyzing their performance and managing their projects and processes, and research new areas with promise for improving organizational measurement and analysis capability.

FY 2006-2007 Plans:
- Capability Maturity Model Integration: Provide stewardship for and transition into practice an integrated Capability Maturity Model (CMMI) 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.

Exhibit R-2a, RDT&E Project Justification							Date: February 2005	
Appropriation/Budget Activity RDT&E, DW/ BA 3			Project Name and Number P782 Software Intensive Systems PE 0603781D8Z					
Cost ($ in millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Total PE	21.601	21.096	25.209	26.180	29.156	29.808	30.409	31.196
Software Intensive Systems P782	2.376	2.321	2.547	2.654	2.857	2.937	3.004	3.091

A. Mission Description and Budget Item Justification: P782 Software-Intensive Systems (SIS). The Systems Engineering Directorate (AT&L/Defense Systems) manages the Software Intensive Systems (SIS) mission to improve DoD SIS acquisition and sustainment. The SE Directorate is the focal point for DoD initiatives that reduce software risk. The SIS mission stems from the recommendations of the FY 2000 DSB Task Force on Software. The SE Directorate is 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. SE Directorate conducts its SIS efforts by understanding DoD needs, issues, and solutions; and acting on/transitioning improvements to DoD Enterprise-, Program- and practitioner-levels.

B. Accomplishments/Planned Program

FY 2004 accomplishments.

Policy and Guidance:
- Monitored Defense Authorization Section 804 Process Improvement activities implemented by the Services and Agencies.
- Developed guidance for software aspects of systems engineering revitalization effort and the DoD 5000 policy series.
- Issued requirements and monitored the development of CMMI Acquisition Module Version 1.0 (2/ 2004). Validated the module through pilot assessments on 8 diverse DOD programs.

Best Practices:
- Contributed software expertise to Defense Acquisition Program Support Reviews.
- Developed initial process and system concepts for the DoD Best Practices Clearinghouse.
- Measurement: Support 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:
- Participated in the DUSD(S&T) study into software engineering technology gaps and investment needs.
- Continued software expertise support to the Army's Future Combat Systems program, collected lessons learned on acquiring complex systems of

systems.

Collaboration:
- Continued the Tri-lateral Software Acquisition Working Group with the UK and Australia. Developed products addressing software product maturity, milestone decision criteria, training, and requirements elicitation.
- Continued membership on SSTC Program Committee and leadership in the Top 5 Software Projects awards.

FY 2005 Plans:
Policy and Guidance:
- Complete implementation of Section 804 and transition monitoring function to the Systems Engineering Forum.
- Revise and publish CMMI AM based on pilot feedback.
- Align systems engineering process guidance and software acquisition/development processes.

Best Practices:
- DoD Best Practices Clearinghouse: Develop two prototypes for operational evaluation. Populate Clearinghouse with initial practice set.
- Actively participate in assessments and systemic analysis activities to identify software-related best practices and practice gaps.

Technology:
- Support research into the integration of iterative software development into the traditional systems engineering process.
- Develop technology for program assessments and systemic analysis
- Continue technology watch activities and software engineering technology needs studies

Collaboration:
- Continue collaborative efforts across DoD and the international community

FY 2006-2007 Plans:
Policy and Guidance:
- Support systemic analysis of program assessments for software-related issues, inadequate or ineffective guidance, or unintended consequences.

Best Practices:
- DoD Best Practices Clearinghouse: Initiate operations and transfer responsibility to DAU. Continue to support clearinghouse population and update.
- Continue to participate in acquisition program assessments

Technology:
- Continue the technology watch activities and software engineering technology needs studies

Collaboration:

- Continue collaborative efforts across DoD and the international community

C. Other Program Funding Summary: N/A

Exhibit R-2a, RDT&E Project Justification							Date: February 2005	
Appropriation/Budget Activity RDT&E, DW/ BA 3			Project Name and Number P783/Software Produceability Initiative PE 0603781D8Z					
Cost ($ in millions)	FY 2004	FY 2005	FY 2006	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Total PE	21.601	21.096	25.209	26.180	29.156	29.808	30.409	31.196
Software Produceability Initiative P783	0.000	0.000	2.056	2.054	3.181	3.104	3.095	3.099

A. Mission Description and Budget Item Justification:

P783 Software Produceability Initiative. The role of software in major Defense acquisition programs has been steadily increasing. Much of the mission functionality demanded from programs such as F/A-22, JSF, Future Combat System, and many others is embodied in large, complex software systems. Shortcomings in software development often lead to schedule slippage, cost growth, and mission compromises. These shortcomings can frequently be traced to underpowered software development technologies not up to the task of developing the scale and complexity of software needed. Despite the large role of the commercial sector in advancing software technology, there are many key aspects of complex, distributed, robust systems crucial to DoD that are not being addressed directly by commercial technology efforts, as our experience over the past decade shows.

This initiative will conduct integrated program of research from basic through dem-val that advances the state-of-the art in produceability of software for DoD systems, particularly those systems characterized by high complexity, need for robustness, information assurance, real-time performance, and physical distribution. Research and transition efforts will pursue technical goals to (1) meet and ensure mission-critical requirements; (2) control complexities; (3) enable system evolution; (4) ensure seamless interoperability; and (5) model behavior and performance. Invest in promising software technologies involving (1) specification of complex requirements; (2) correct-by-construction software development; (3) composable and customizable frameworks; (4) high-confidence system software and middleware; (5) system architectures for network-centric environments; (6) technologies for testing, verification, and validation, and (7) modeling and metrics. Establish cost avoidance goals of 10% - requirements phase, 60% - design phase, 80% - code/unit test phase and 40% - integration and test phase in the software development lifecycle. Based on these goals, annuals cost avoidance is estimated at $10.6 billion. Additionally, these software experts would directly advise ongoing acquisition programs.

B. Accomplishments/Planned Program

FY 2004 Accomplishments:
N/A

FY 2005 Plans:
N/A

FY 2006– FY 2007 Plans:

In FY 2006, we will develop and finalize technical plans for future research, conduct government/industry/academia workshops and conferences, and begin sponsoring university-based research. We will also fund a study by the National Academy of Sciences on software research needs. Depending upon the Service and Agency commitment of research funds for related initiatives, we will, in FY2007, coordinate joint university/industry/Government research efforts to take promising prototype software techniques and tools and mature them for applicability to Defense acquisition programs. We will also coordinate the initiation of at least one joint university/industry/Government virtual (i.e., not physically collocated) center for integration of tools and techniques into prototype software produceability capabilities. We intend to obtain substantial participation, and possible cost sharing, by traditional Defense contractors and commercial software tool vendors, and also by standards bodies for open source development, industry associations, and consortia (such as ESCHER research instititute) for tech transition.

Also depending upon the Service and Agency commitment of research funds for related initiatives, we will coordinate, starting in FY 2007, a software produceability testbed that will host challenging DoD software problem sets, both synthetic and drawn from real DoD programs. The testbed will serve to focus the diverse research projects on common problem statements, thereby facilitating comparison of new techniques and measurement of effectiveness in controlled analyses. The supportability aspects of new technologies will be addressed, including tool documentation, maintenance, integration, and upgrade.

C. Other Program Funding Summary:
Not Applicable

D. Acquisition Strategy:
Not Applicable

E. Major Performers:
National Academy of Sciences, ESCHER Research Institute, Software Productivity Consortium, Other industry (selected competitively) and government performers