OSD RDT&E BUDGET ITEM JUSTIFICATION (R2 Exhibit)

Date: February 2007

APPROPRIATION/ BUDGET ACTIVITY
RDT&E/ Defense Wide BA# 3

PE NUMBER AND TITLE
0603781D8Z - Software Engineering Institute

Cost ($ in Millions)		FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
	Total Program Element (PE) Cost	26.116	28.380	29.851	31.305	32.173	32.762	33.229	33.726
P781	Software Engineering Institute (SEI)	21.709	21.688	22.811	23.531	24.281	24.790	25.116	25.469
P782	Software Intensive Systems	2.437	2.680	0.000	0.000	0.000	0.000	0.000	0.000
P783	Software Producibility Initiative	1.967	2.073	3.140	3.074	3.092	3.072	3.113	3.157
P784	Advanced Lithography	0.003	1.939	0.000	0.000	0.000	0.000	0.000	0.000
P785	DeVenCl	0.000	0.000	3.900	4.700	4.800	4.900	5.000	5.100

A. Mission Description and Budget Item Justification: 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. 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 technology development and transition activities of the Software Engineering Institute (SEI) at Carnegie Mellon University.

B. Program Change Summary	FY 2006	FY 2007	FY 2008	FY 2009
Previous President's Budget (FY 2007)	30.762	26.594	29.648	30.340
Current BES/President's Budget (FY 2008/2009)	26.116	28.380	29.851	31.305
Total Adjustments	-4.646	1.786	0.203	0.965
Congressional Program Reductions		-0.169		
Congressional Rescissions				
Congressional Increases		1.950		
Reprogrammings	-3.797			
SBIR/STTR Transfer	-0.849			
Other		0.005	0.203	0.965

C. Other Program Funding Summary: Not Applicable.

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D. Acquisition Strategy: Not Applicable.

E. Performance Metrics: Not Applicable.

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RDT&E/ Defense Wide BA# 3	**0603781D8Z - Software Engineering Institute**	**P781**

Cost ($ in Millions)		FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
P781	Software Engineering Institute (SEI)	21.709	21.688	22.811	23.531	24.281	24.790	25.116	25.469

A. Mission Description and Project Justification: Software Engineering Institute 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. The SEI focuses on software technology areas judged to be of the highest payoff in meeting defense needs.

B. Accomplishments/Planned Program:

Accomplishment/Planned Program Title	FY 2006	FY 2007	FY 2008	FY 2009
Acquisition Practices for DoD Software Intensive Systems:	21.709	21.688	22.811	23.531

FY 2006 Accomplishments: Developed Version 1.2 of the CMMI Product Suite, including updated CMMI models, the SCAMPI Method Definition Document (MDD), and CMMI training courses to reflect lessons learned from their use. Maintained the CMMI Product Suite by creating, maintaining, and appropriately updating or enhancing products. Completed and published initial draft of the CMMI for Acquisition (CMMI-ACQ). Managed and administered transition programs and services to support the widespread, high-quality use of the CMMI Product Suite in government and industry. Investigated technology and practices for developing secure software and produced an operational definition and workshop for secure software development. Defined measurement tools and practices for software acquisition by evolving the Team Software Process (TSP) metrics framework to support program management in software acquisitions, and provided the transition mechanisms and infrastructure needed for adoption. Defined an engineering process improvement strategy that uses TSP to accelerate CMMI-based organizational improvement. Initiated work on version 5.0 of the Team Software Process Product Suite, including incorporation of a version of TSP for systems engineering being jointly developed with NAVAIR. Investigated the application of the TSP quality management practices to the development of safety-critical systems and published a technical note that describes the transitioning of the process into practice. Investigated the creation of measures and benchmarks that could be used to provide quantitative criteria for evaluating process performance. Managed, administered, and provided technical support for the training, authorization, certification licensing, and other activities needed to support transition of TSP into practice. Extended and operated the Software Engineering Information Repository (SEIR) to provide data and information that software organizations use to learn about (a) the experiences of other organizations attempting to improve their software engineering processes and technology, (b) new software engineering technology that may improve their performance, and (c) issues, challenges, and policies related to the DoD and its suppliers of software-intensive systems. Provided 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. Helped more than 50 key acquisition programs achieve their objectives by working directly with them to apply new technologies and conduct experiments with maturing SEI products and services in real-world acquirer contexts. Accomplished this through means such as conferences, workshops, courses, briefings, technical reports, articles, advocacy, and participaSupported survivability engineering by improving the technical basis for identifying and preventing both security flaws and malicious code; and limiting the damage caused by successful attacks. Coordinated activities in response to internet security incidents and supported the continued development of a national response team, US-CERT, and the President's National Strategy to Secure Cyberspace. Provided analysis and capabilities to the DoD, DHS, and the Internet community to enable situational awareness of Internet threats. Created a product line production planning workshop to guide a product production strategy, and to provide tools and directions for applying that strategy to a

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production method and production plan. Published guidance for DoD acquisition managers and executives on product line activities and acquisition strategies. Published version five of the SEI Framework for Software Product Line Practice. Presented the Software Product Line Conference (SPLC) 2006 in August 2006. Published the results of research into the suitability of approaches for specifying architecturally significant requirements. Initiated research into the use of real options for managing uncertainty in business goals, requirements, and architecture design decisions while evolving a software architecture. Created and piloted a set of architecture-related acquisition aids to help DoD acquisition organizations effectively prepare contractually required documentation for SEI's Quality Attribute Workshop (QAW) and architecture evaluations using the Architecture Tradeoff Analysis Method (ATAM). Conducted the Second SEI Software Architecture Technology User Network (SATURN) to bring together engineers, architects, technical managers, and product managers with SEI's technical staff. Created a Web-based community resources center for software architects. Developed and tested general purpose tools for measuring the timing characteristics of systems assembled from distributed components. Created an approach to apply software model checking to assembly code, enabling verification when source code is not available. Created the first tutorial on the principles, methods, and technologies of predictable assembly. Piloted SoS Navigator with MILSATCOM and NATO, and released the alpha version of this technology, which helps an organization navigate a system-of-systems procurement or development. Updated the Service-Oriented Migration and Reuse Technique (SMART). Defined model problems for the evaluation of Web services and for Ontology Web Language-Semantics (OWL-S).

FY 2007/2008/2009 Plans: Manage a joint industry, government, and SEI effort to develop an addition to the CMMI Framework to cover acquisition. Provide an addition to the CMMI Framework to cover service delivery. Explore whether and how to add Information Security to CMMI. Provide empirical analyses of CMMI costs and benefits. Provide stewardship functions for CMMI, such as support to transition products, programs and services, and to perform quality assurance, communications, and project operations. Develop a high-maturity team process and training for use in systems engineering and acquisition, guided by CMMI and based on the TSP elements and training courses. Develop performance benchmarks for software engineering management to quantitatively manage software engineering work. Create an integrated process improvement strategy with CMMI to define a new process improvement strategy and roadmap that leverages technologies to help organizations consistently achieve greater performance improvement and do it in less time than current methods. Create a specific "how to" methodology or implementation guidance for selected techniques and tools that have proven invaluable in industry and government applications, including Six Sigma tools, business case analyses, and various computations of expected benefits or returns. Identify, tailor, pilot, and package analytical techniques appropriate for interpreting and validating potential data that is represented in text and other formats that do not readily lend themselves to analysis. Adapt statistical and quantitative analysis techniques, commonly known as Six Sigma, for acquisition, systems engineering, and software engineering practitioners. Operate the Software Engineering Information Repository, a forum for members of the community to contribute and exchange information concerning implementation activities. Explore new methods of collaborative management on software-intensive systems.

C. Other Program Funding Summary: Not Applicable.

D. Acquisition Strategy: Not Applicable.

E. Major Performers Not Applicable.

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RDT&E/ Defense Wide BA# 3	**0603781D8Z - Software Engineering Institute**	**P782**

Cost ($ in Millions)		FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
P782	Software Intensive Systems	2.437	2.680	0.000	0.000	0.000	0.000	0.000	0.000

A. Mission Description and Project Justification: The Systems and Software Engineering (SSE) Directorate manages the Software Intensive Systems (SIS) mission to improve DoD SIS acquisition and sustainment. The SSE Directorate is the focal point for DoD initiatives that reduce software risk. The SSE 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 and Guidance, Education, Best Practices, Software Engineering Technology, and Collaboration. The SSE Directorate conducts its SIS efforts by understanding DoD needs, issues and solutions; and acting on/transitioning improvements to DoD enterprise, program and practitioner levels.

In FY 2008, the Software Intensive Systems funding line will be transferred from PE0603782D8Z to the Developmental Test and Evaluation line in Acquisition in Technology and will be renamed Software Engineering and System Assurance.

B. Accomplishments/Planned Program:

Accomplishment/Planned Program Title	FY 2006	FY 2007	FY 2008	FY 2009
Software Intensive Systems:	2.437	2.680	0.000	0.000

FY 2006 Accomplishments: Support Acquisition Success: Established Deputy Director for Software Engineering and System Assurance. Provided software and system assurance expertise on program support reviews. Improve State-of-the Practice of Software Engineering: Started effort to develop System of Systems Engineering. Guidebook, Capability Maturity Model Integration (CMMI) Guidebook for acquirers. Provide Software Leadership and Outreach: Established National Defense Industrial Association (NDIA) Software Committee. Hosted NDIA Top Software Issues workshop. Ensured Adequate Software Resources to Meet DoD Needs: Completed Phase 1 of Software Industrial Base Study, identifying critical needs.

FY 2007 Plan: Support Acquisition Success: Update review methodology to better address software and systems assurance issues. Provide software and system assurance expertise for ACAT ID/IAM and special interest programs. Improve state-of-the practice of software engineering: Identify and address systemic issues related to software. Conduct literature search of software best practices. Continue development of System Assurance Guidebook. Provide software leadership and outreach: Host NDIA Software Summit, complete report. Establish DoD software forum. Participate in Service-led software initiatives, e.g., Army Strategic Software Improvement Program and multi-national forums, e.g., Software. Intensive Systems Acquisition Improvement Group
develop Department/National strategic plan for meeting defense software requirements. Ensure adequate software resources to meet DoD needs: Complete Phase 2 of software industrial base study
Objectives: Tools, techniques identified; program support provided to ACAT ID/IAM and special interest programs; partners established, agenda set; Artifacts: System of Systems Engineering Guide, CMMI-Acquisition Guide, DoD Software Strategic Plan; Defense Acquisition Program Support methodology v1.2 (software focus); Industry summit report; Conference sponsorship and participation (e.g., Systems and Software Technology Conference, Systems Engineering).

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C. Other Program Funding Summary: Not Applicable.

D. Acquisition Strategy: Not Applicable.

E. Major Performers Not Applicable.

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APPROPRIATION/ BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
RDT&E/ Defense Wide BA# 3	**0603781D8Z - Software Engineering Institute**	**P783**

Cost ($ in Millions)		FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
P783	Software Producibility Initiative	1.967	2.073	3.140	3.074	3.092	3.072	3.113	3.157

A. Mission Description and Project Justification: The role of the Software Producibility 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:

Accomplishment/Planned Program Title	FY 2006	FY 2007	FY 2008	FY 2009
	1.967	2.074	3.140	3.074

FY 2006 Accomplishments: Awarded two contracts to define an architecture and concept of operations for the Software and Systems Test Track. Awarded three contracts to provide software development tools for promoting systems of systems interoperability. Initiated development of a business plan for options to foster government and industry co-investment in focused research centers for improving software producibility. Engaged with industry and government to mature options. Initiated development of a SIS Producibility Technology Roadmap to prioritize research investments and identify measures that allow the development community to judge progress.

FY 2007 Plan: Award the Software and Systems Test Track implementation contract. Continue research efforts in developing technologies for interoperable systems of systems. Mature business plan for gov/industry co-investment in research, select an implementation approach, initiate the necessary agreements. Mature the SIS Producibility Technology Roadmap, get community consensus on priorities and

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measures. Started initial effort to define the Systems and Software Test Track to provide a place (possibly virtual and not a single physical location) for experimental verification of Software-Intensive Systems Producibility technologies due to their novelty and the potential complexity of the underlying theories. The experimental platforms will incorporate software technology to instrument, monitor and test large-scale applications. The experimental platform research included subtasks to conduct large-scale coordination experiments, and developed methods and tools for evaluating aggregate performance of applications. This environment provided a full range of collaborative technology challenges, run-time platforms and applications, experiments, evaluations, and demonstrations. A Common infrastructure will enable control and data flow between both kinds of application components for a distributed environment. The open experimentation environment provided the fundamental reference architecture and underpinnings helping researchers to develop and test their designs as well as facilitates transition of promising technologies into production use. Initiated a research topic in interoperability to address software techniques to improve system of system interoperability. Developed and transitioned new methodologies, tools, technologies and techniques that improve DoD's ability to acquire software for large, net-centric warfighting systems of systems. Key in this effort was to develop and establish principles of interoperability as a foundation for hardware-software. These principles enabled the precise description of components, their construction and their acceptable interactions, leading to new approaches for building and assembling systems. Conducted a third workshop on software producibility focused on industry needs, interests and motivations. In FY 2007, we will implement the Systems and Software Test track concepts developed in 2006 including establishing facilities, staff, and development artifacts. We will begin collaborative efforts between industry, DoD and academia to prototype and assess new tools and technologies against real-world problems. 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. We will conduct the second year and the optional third year of interoperability research to deliver useable software methodologies, prototypes, or tools which can be tested and incorporated into DoD R&D programs.

FY 2008 Plan: In 2008, begin partial funding for the on-going HPEC-SI program to provide standardized signal processing software for MDAPs, including Joint Strike Fighter. This core funding will allow continued evolution of the code base to new languages and processors, and initiate increasing available functionality to include image processing. We will also complete the study by the National Academy of Sciences on Advancing Software-Intensive System Producibility. Continue operation of the Software and Systems Test Track. Complete research efforts in interoperable systems of systems. Initiate one new research effort in SIS Producibility.

FY 2009 Plan: Depending upon the Service and Agency commitment of research funds for related initiatives and successful completion of the 2006 industry workshop, we will 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 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.

C. Other Program Funding Summary: Not Applicable.

D. Acquisition Strategy: Not Applicable.

E. Major Performers Not Applicable.

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APPROPRIATION/ BUDGET ACTIVITY	PE NUMBER AND TITLE	PROJECT
RDT&E/ Defense Wide BA# 3	**0603781D8Z - Software Engineering Institute**	**P784**

Cost ($ in Millions)		FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
P784	Advanced Lithography	0.003	1.939	0.000	0.000	0.000	0.000	0.000	0.000

A. Mission Description and Project Justification: Not Applicable.

B. Accomplishments/Planned Program:

Accomplishment/Planned Program Title	FY 2006	FY 2007	FY 2008	FY 2009
Advanced Lithography	0.003	1.939	0.000	0.000

Congressional add for thin film mask technology development. Funds will be reprogrammed to the proper execution Agent.

C. Other Program Funding Summary: Not Applicable.

D. Acquisition Strategy: Not Applicable.

E. Major Performers Not Applicable.

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Cost ($ in Millions)	FY 2006 Actual	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
P785 DeVenCl	0.000	0.000	3.900	4.700	4.800	4.900	5.000	5.100

A. Mission Description and Project Justification: The purpose of DeVenCI is to sustain an established process to increase Department of Defense (DoD) awareness of emerging commercial technologies developed by non-traditional DoD procurement sources, and to increase commercial awareness of DoD needs and requirements. Through this improved awareness, DeVenCI focuses on facilitating interactions and information exchanges that will speed adoption of innovative commercial technologies that address DoD challenges related to the Global War on Terrorism, and will encourage broader commercial support of the DoD supply chain. The DeVenCI process relies on workshops, technology expositions, industry outreach, and web access to accomplish its goal of improving communications between the DoD and companies with emerging commercial technologies. DeVenCI also provides the opportunity for DoD technology users to assess the potential for evaluating or adopting emerging technical innovations as relevant solutions to existing or anticipated DoD needs.

B. Accomplishments/Planned Program:

Accomplishment/Planned Program Title	FY 2006	FY 2007	FY 2008	FY 2009
DeVenCI	0.000	0.000	3.900	4.700

FY 2008/2009 Plans: Plan and conduct a minimum of six technology workshops in DoD relevant technology sectors. Prepare and issue a follow-on solicitation for venture capital consultants. Expand the program to examine the technical fundamental of patented inventions to assess the feasibility of developing combinatorial solutions focused on other DoD challenge areas. Conduct an assessment of the DeVenCI process.

C. Other Program Funding Summary: Not Applicable.

D. Acquisition Strategy: Not Applicable.

E. Major Performers Not Applicable.