Carnegie Mellon
Software Engineering Institute

Annual Report 2001

Reporting on Fiscal Year 2001
October 1, 2000–September 30, 2001

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Message from the Director

Systems depend on software.

It is software that provides a system's "brains, heart, and soul" and the ability to interact with people and other systems. Whether on the battlefield or in the global marketplace, delivering the right software to end users is fundamental to success. The challenge is to do it faster than anyone else, but with predictable performance, quality, cost, and schedule. New technical challenges make the development of software more difficult and require the development and adoption of new software engineering practices. The SEI exists to help others improve their software engineering capabilities by advancing the state of the practice of software engineering.

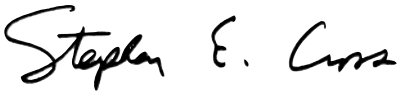
With this in mind, the SEI's work is centered on three technical themes:

1. **Move to the left.** Much of the SEI's work supports the engineering analysis of software issues early in the system's life cycle. This results in systems built right the first time, with less testing, increased quality, and reduced costs.

2. **Reuse everything.** A systematic and strategic approach to reuse is one key to reducing cost, increasing productivity, and improving reliability. Software architecture and the development/acquisition process can exploit common elements among systems and provide opportunities to reuse products, software assets, and knowledge-based artifacts (e.g., architecture, requirements plans) for families of similar products.

3. **Never make the same mistake twice.** Because of the rapid pace of technological change, software and systems engineers need to learn from the experiences of others. The SEI disseminates lessons learned and case studies based on real-world experience, providing practitioners a neutral and objective source through which they can share their knowledge and experience and interact with others. Furthermore, SEI training materials, guidelines, frameworks, improvement models, and publications help engineers and organizations use the best practices in developing, acquiring, and sustaining systems.

These three technical themes provide a conceptual framework for the SEI's comprehensive body of work, which is summarized in this annual report. The SEI annual report for fiscal year 2001 presents the SEI's major accomplishments in pursuit of its mission and summarizes progress toward achieving the SEI's vision for the practice of software engineering: "the right software, delivered defect free, on time and on cost, every time."



Stephen E. Cross
Director and Chief Executive Officer,
Software Engineering Institute

THIS IS THE **VISION** OF THE SEI

THE RIGHT SOFTWARE, DELIVERED DEFECT FREE, ON TIME AND ON COST, EVERY TIME.

TO BE **SUCCESSFUL,** INTEGRATED TEAMS OF **DEVELOPERS, ACQUIRERS, AND SOFTWARE USERS** MUST HAVE THE NECESSARY SOFTWARE ENGINEERING SKILLS AND KNOWLEDGE TO ENSURE THAT THE RIGHT SOFTWARE IS DELIVERED TO END USERS.

"RIGHT SOFTWARE" IMPLIES SOFTWARE THAT SATISFIES REQUIREMENTS FOR **FUNCTIONALITY, PERFORMANCE,** AND **COST** THROUGHOUT ITS LIFETIME.

"DEFECT-FREE" SOFTWARE IS ACHIEVED EITHER THROUGH EXHAUSTIVE TESTING AFTER CODING OR BY **DEVELOPING THE CODE RIGHT THE FIRST TIME.** THE SEI'S BODY OF WORK IN TECHNICAL AND MANAGEMENT PRACTICES IS FOCUSED ON **DEVELOPING IT RIGHT THE FIRST TIME**, WHICH RESULTS NOT ONLY IN HIGHER QUALITY, BUT ALSO IN **PREDICTABLE AND IMPROVED SCHEDULE AND COST.**

THIS IS THE **MISSION** OF THE SEI

TO PROVIDE THE TECHNICAL LEADERSHIP TO ADVANCE THE PRACTICE OF SOFTWARE ENGINEERING SO THE DOD CAN ACQUIRE AND SUSTAIN ITS SOFTWARE-INTENSIVE SYSTEMS WITH PREDICTABLE AND IMPROVED COST, SCHEDULE, AND QUALITY.

THE SEI MISSION INCLUDES FOUR OBJECTIVES:

1. **ACCELERATE** THE INTRODUCTION AND WIDESPREAD USE OF HIGH-PAYOFF SOFTWARE ENGINEERING PRACTICES AND TECHNOLOGY BY IDENTIFYING, EVALUATING, AND MATURING PROMISING OR UNDERUSED TECHNOLOGY AND PRACTICES.
2. **MAINTAIN** A LONG-TERM COMPETENCY IN SOFTWARE ENGINEERING AND TECHNOLOGY TRANSITION.
3. **ENABLE** INDUSTRY AND GOVERNMENT ORGANIZATIONS TO MAKE MEASURED IMPROVEMENTS IN THEIR SOFTWARE ENGINEERING PRACTICES BY WORKING WITH THEM DIRECTLY.
4. **FOSTER** THE ADOPTION AND SUSTAINED USE OF STANDARDS OF EXCELLENCE FOR SOFTWARE ENGINEERING PRACTICE.

THIS IS THE **STRATEGY** OF THE SEI

THE SEI'S STRATEGIC APPROACH TO ACHIEVING ITS MISSION CAN BE SUMMARIZED IN THREE WORDS: **CREATE, APPLY,** AND **AMPLIFY.**

CREATE

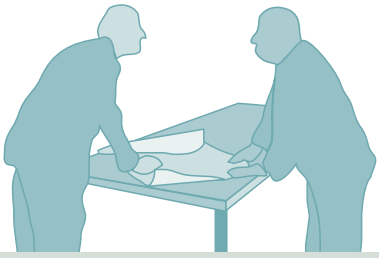
THE SEI WORKS WITH THE RESEARCH COMMUNITY TO HELP CREATE AND IDENTIFY NEW AND IMPROVED PRACTICES.

The SEI creates and identifies emerging or underused solutions to significant and pervasive software engineering problems and develops these solutions so that they can be applied by software developers and acquirers to improve their software engineering practices. The SEI enters into cooperative research and development agreements (CRADAs) with industry and academia to test new and emerging technologies.

2001 HIGHLIGHTS:
(see page 11)

- Sustained technical leadership and publication record
- Initiated new work in software component certification
- Supported development and initial use of the CMMI℠ framework

APPLY



THE SEI WORKS WITH LEADING-EDGE SOFTWARE DEVELOPERS AND ACQUIRERS TO APPLY AND VALIDATE THE NEW AND IMPROVED PRACTICES.

SEI staff members help the DoD solve specific software engineering and acquisition problems by applying these practices. SEI direct support is funded through task orders for government work.

2001 HIGHLIGHTS:
(see page 12)

- Created planned programs of work with senior acquisition executives in the U.S. Army, Navy, and Air Force to institute new and improved practices within the acquisition community and industry bases
- Demonstrated and documented a DoD case study of product line practice
- Positioned the CERT® Coordination Center (CERT/CC) and the SEI to anticipate new threats to networked systems and to have more impact
- Demonstrated and documented defect-free software-development methods

AMPLIFY

THE SEI WORKS THROUGH THE GLOBAL COMMUNITY OF SOFTWARE ENGINEERS TO AMPLIFY THE IMPACT OF THE NEW AND IMPROVED PRACTICES BY ENCOURAGING AND SUPPORTING THEIR WIDESPREAD ADOPTION.

The SEI works closely with DoD engineering organizations. In addition, the SEI offers continuing education courses based on matured, validated, and documented solutions. The SEI also licenses the packaging and delivery of new and improved technologies, working with developers and acquirers as well as with "transition partners"—DoD and industry organizations that help others adopt new technology.

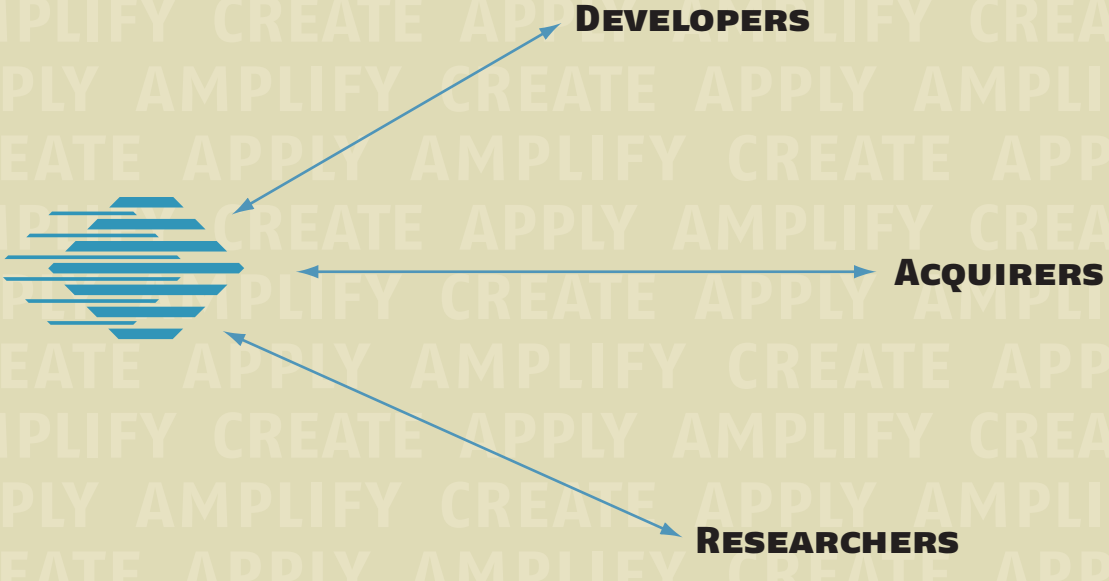
2001 HIGHLIGHTS:
(see page 13)

- Amplified the impact of the CERT/CC
- Documented evolutionary acquisition (EA) practices for software-intensive systems

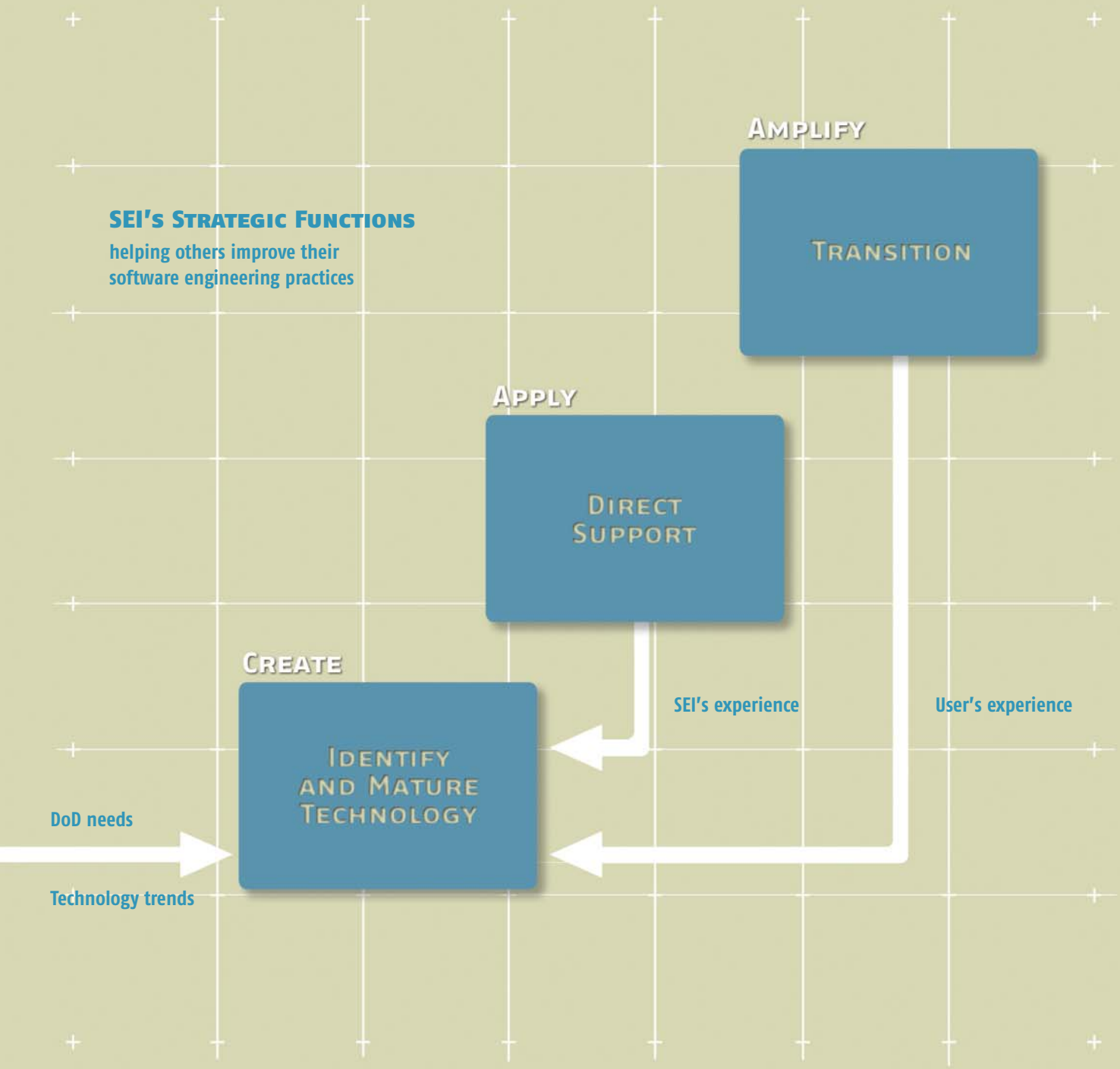
THESE ARE THE **COMMUNITIES OF PRACTICE** THAT THE SEI SERVES

THE SEI WORKS WITH THREE DISTINCT COMMUNITIES TO IDENTIFY, MATURE, TRANSITION, AND FACILITATE THE BROAD ADOPTION OF NEW AND IMPROVED PRACTICES.

1. **DEVELOPERS**, IN INDUSTRY AND DOD ORGANIZATIONS, ARE THOSE WHO ACTUALLY BUILD THE SOFTWARE THAT IS INTEGRATED INTO SYSTEMS.
2. **ACQUIRERS** ARE THOSE DOD ACQUISITION COMMANDS AND ORGANIZATIONS RESPONSIBLE FOR OBTAINING SYSTEMS NEEDED TO ACCOMPLISH THEIR MISSIONS THROUGH CONTRACTS WITH INDUSTRY.
3. **RESEARCHERS** ARE THOSE WHO TYPICALLY WORK IN UNIVERSITY, DOD, AND INDUSTRY RESEARCH CENTERS. THEY DEVELOP NEW AND IMPROVED SOFTWARE ENGINEERING TECHNOLOGIES AND PRACTICES.



Highlights for 2001

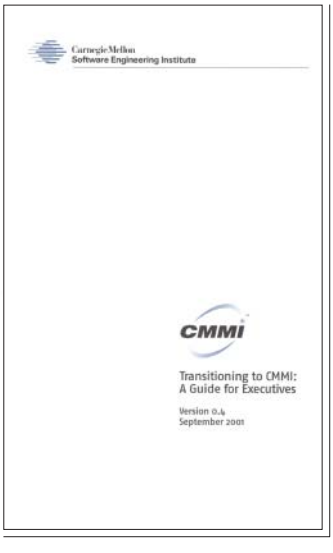


CREATE

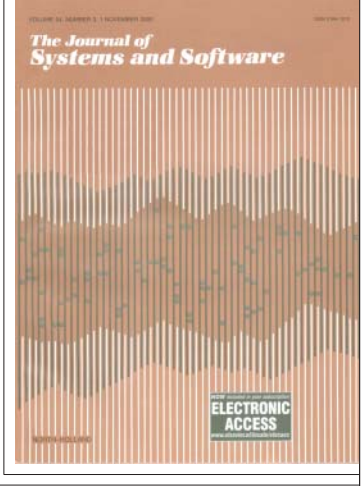
Sustained technical leadership and publication record—The SEI staff continued to advance research in the field of software engineering. An article by R. L. Glass and T. Y. Chen in the *Journal of Systems and Software* 59 (2001), pp. 107–113, rates Carnegie Mellon/SEI the number one institution for publishing scholarly articles in the field of systems and software engineering. For a list of FY2001 staff accomplishments, see page 50.

Initiated new work in software component certification—Through an SEI project called "Predictable Assembly from Certifiable Components," the SEI began exploring the feasibility of industrial certification for software components. This work is based on the premise that component properties that can be used in predictive models of system behavior (component assemblies) can be independently certified, and that the predictive models can also be empirically validated and independently certified. The intended result of this work will be an engineering discipline for predictable assembly from certifiable components.

Supported development and initial use of the CMMI Framework—Since the first release of the Capability Maturity Model® for Software (SW-CMM®) in 1991, software process improvement based on the SW-CMM has helped more than 5,000 organizations worldwide improve their software engineering practices. The Capability Maturity Model Integration (CMMI℠) project,[1] jointly sponsored by the Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics) (OUSD/AT&L) and the Systems Engineering Committee of the National Defense Industrial Association (NDIA), builds on the SEI's longstanding expertise in process improvement. CMMI facilitates the use of multiple CMMs for improvement in multiple disciplines. The first CMMI models were publicly released in 2001 and have gained support from a wide range of government and industry organizations. A transition-focused workshop brought together early adopters of CMMI to gather lessons learned about successful CMMI adoption. To date, more than 20 pilots of CMMI have been conducted—10 in 2001—in a wide range of organizational contexts. The impact of this work will be amplified by the more than 40 organizations (listed on pages 60–61) that have been authorized by the SEI to offer training and appraisal services related to the CMMI models.



Left:
Transitioning to CMMI: A Guide for Executives, *created by members of the CMMI Product Team, presents the business case for CMMI.*



Right:
SEI staff members were active and highly visible within the research community in component-based software engineering in 2001. Judith Stafford and Kurt Wallnau of the SEI are guest editors for a forthcoming special edition about component-based software engineering of The Journal of Systems and Software.

Created planned programs of work with senior acquisition executives in the U.S. Army, Navy, and Air Force to institute new and improved practices within the acquisition community and industry bases—For example, the SEI undertook a new portfolio of work for the Assistant Secretary of the Army (Acquisition, Technology, and Logistics); see *Army Workshop on Lessons Learned from Software Upgrade Programs*.[2] Also see page 39.

Demonstrated and documented a DoD case study of product line practice—The SEI helped the U.S. National Reconnaissance Office make dramatic improvements through a strategic and systematic reuse of software assets across a family of similar ground-based spacecraft command-and-control systems. A case study of this project was included in *Software Product Lines: Practices and Patterns* by Paul Clements and Linda Northrop, one of five books published by SEI staff members this year in the SEI Series in Software Engineering.[3] The case study[4] documents measurable benefits on one operational system, including a sevenfold increase in productivity, tenfold increase in quality, and 50% reductions in cost and schedule.

Positioned the CERT® Coordination Center (CERT/CC) and the SEI to anticipate new threats to networked systems and to have more impact—During calendar year 2001, the CERT/CC—the nation's first and best-known computer emergency response team—handled 52,658 incidents, catalogued 2,437 vulnerabilities, published 41 security alerts, and provided testimony to two congressional hearings and one committee of the Pennsylvania House of Representatives.[5] The CERT/CC also collaborated with other government and industry organizations and played a major role in alerting the Internet community, providing reliable information, and helping to mitigate the damage caused by such threats as the Code Red and Nimda worms.

Demonstrated and documented defect-free software-development methods—Results from adopters of the Team Software Process℠ (TSP℠)[6] continued to validate the SEI's vision of defect-free software. On efforts ranging from a few thousand lines of code up to 100,000 lines of code, typical TSP projects produce

- near-zero defects in delivered software
- product quality that is from two to ten times better than comparable projects in the same organization
- cost and schedule performance that are within 10% of planned values
- reduced test costs and schedules (five to ten times, from months to days)

AMPLIFY

AMPLIFIED THE IMPACT OF THE CERT/CC THROUGH THE SURVIVABLE SYSTEMS INITIATIVE (see page 15)

- The SEI and the Electronic Industries Alliance (EIA), a federation of trade associations, formed the Internet Security Alliance (ISA),[7] an international coalition of industry, information security, and academic leaders. The ISA leverages the collective experience of its members to promote sound information security practices, policies, and technologies that enhance the security of the Internet and global information systems. The founding sponsors of the ISA are listed to the right.

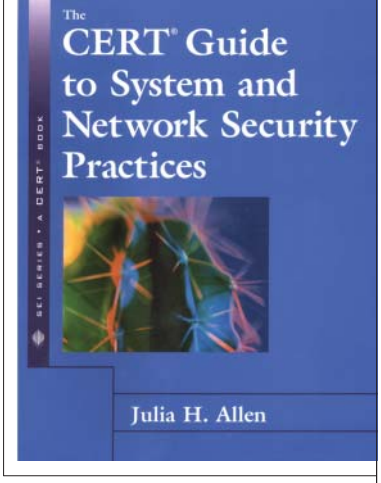
- The SEI published the *OCTAVE℠ (Operationally Critical Threat, Asset, and Vulnerability Evaluation℠) Method Implementation Guide*.[8] The OCTAVE method is a self-directed risk evaluation for information security. The guide contains everything needed to implement the OCTAVE method in an organization.

DOCUMENTED EVOLUTIONARY ACQUISITION (EA) PRACTICES FOR SOFTWARE-INTENSIVE SYSTEMS—Recent changes in government policy have emphasized EA, which extends the risk-management aspects of spiral development to earlier stages of software development. The SEI conducted a workshop/tutorial on EA at the 11th Annual PEO/SYSCOM (Program Executive Officers/Systems Command) Conference in October 2001, surfacing successes and barriers to success with EA. The SEI also published a report on the second Spiral Development and Evolutionary Acquisition Workshop, co-sponsored by the SEI and the University of Southern California in September 2000. This workshop explored the relationship between spiral development and EA.[9]

FOUNDING SPONSORS OF THE ISA

- American International Group, Inc.
- Exodus Communications, Inc.
- Guardent, Inc.
- IBM
- ITT Industries
- Mellon Financial Corporation
- Nasdaq, Inc.
- Norsk Tipping
- Raytheon
- Redleaf Group, Inc.
- Sony
- TATA Consulting Services
- TRW, Inc.
- University of Texas
- VeriSign, Inc.

Right:
Addison-Wesley published the CERT® Guide to System and Network Security Practices, *written by Julia Allen, one of the books published this year in the SEI Series in Software Engineering. The book provides a clear, comprehensive, and easy-to-follow set of state-of-the-art security practices and answers the question, What is the best way to protect computer networks and systems? The book has already been translated into Finnish and Japanese; these translations will be published within the coming year.*



Left:
(l to r) Dave McCurdy, president, EIA; Allan P. Woods, vice chairman and chief information officer, Mellon Financial Corporation; and Richard D. Pethia, SEI, at press conference announcing launch of the ISA.

SEI Technical Initiatives

- Survivable Systems
- Team Software Process
- Capability maturity Model Integration
- Product Line Practice
- COTS-Based Systems
- Performance-Critical Systems
- Architecture Tradeoff Analysis
- Software Engineering measurement and Analysis
- Accelerating Software Technology Adoption

Survivable Systems

The Internet has grown exponentially in the past decade. What was once a small community of professionals exchanging research information has become a diverse group of students and researchers, novices and experts. Many commercial and government organizations depend on the Internet for their day-to-day operations. As users have become more diverse, so have the hardware, software, and services available from Internet service providers, Web sites, programmers, and technology companies. This combination of users, services, and high expectations poses serious threats to government agencies, industries, and organizations that now live in and rely on an electronic world where, 10 years ago, trust was assumed.

The SEI began work in the area of computer and network security in 1988 when the institute established the CERT® Coordination Center (CERT/CC) in response to an attack on the Internet. The CERT/CC serves as a computer emergency response team and a central point for communication among computer experts. The CERT/CC has evolved into a national resource recognized as the preeminent network security organization in the world. CERT/CC technical experts are routinely called upon by their sponsors and by national and homeland-security leaders to identify and recommend remedies to security problems in the Internet infrastructure.

Incidents and vulnerabilities reported to the CERT/CC have doubled year by year. During 2001, the CERT/CC staff processed 52,658 separate incident reports as opposed to 21,756 the previous year. Vulnerabilities reported to the CERT/CC have increased at nearly the same alarming rate: 2,420 in 2001, more than double the 1,090 reported in 2000. Analysis done on these reports enables the CERT/CC to provide the DoD and other critical national infrastructure operators with the analysis reports they need to protect themselves from threats and vulnerabilities and to recover quickly from security breaches.

Left:
On Monday, January 29, 2001, the CERT/CC and the COVERT Labs at PGP Security simultaneously released advisories describing serious vulnerabilities in BIND, the most commonly used software for domain name system (DNS) servers. The CERT/CC released an advisory, held a press conference, and conducted several media interviews about the BIND vulnerabilities.

Data published by Men & Mice, a DNS consultancy and software firm, indicated that the CERT/CC's efforts to alert the community about these vulnerabilities had a positive impact. As reported in Computerworld,[10] *"The day after the CERT and [PGP Security] sent out the warnings, 33.3% of Fortune 1,000 sites were using a bad version of BIND and 40.27% of .coms were vulnerable. A week later, the figures were down to 17.4% and 16.73%, respectively, Men & Mice said."*

The report on the Men & Mice Web site attributed this drop to "the extensive media coverage and attention that this issue received shortly after the CERT announcement; technical engineers evidently responded promptly and installed the necessary software fixes provided to fix this security hole."

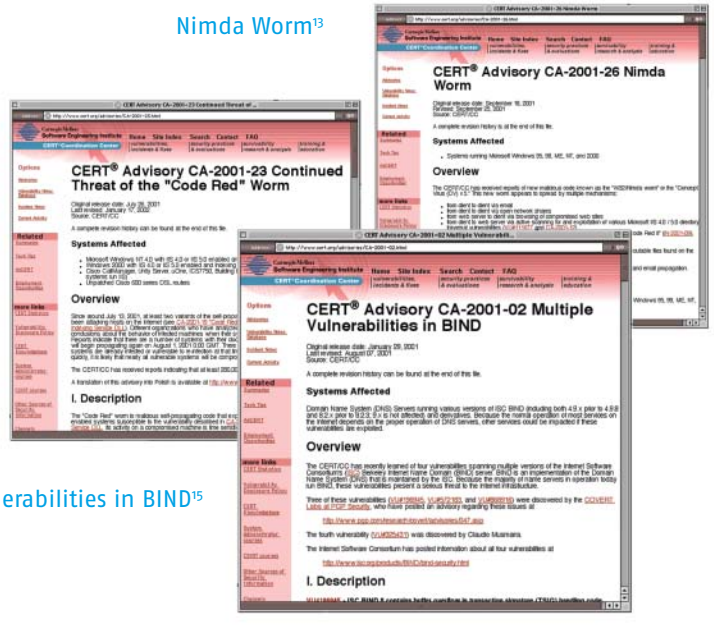
Support for Developers and Acquirers

CERT/CC staff members provide advice and convey information about Internet security to computer system administrators, network managers, and others in the Internet community. When the CERT/CC receives a report about a potential vulnerability, staff experts analyze the vulnerability, working with technology producers, vendors, and Internet-security experts. Staff members advise technology producers and vendors of security deficiencies in their products, help them to resolve the problems, and facilitate the distribution of corrections to other response teams and to the Internet community at large. The CERT/CC is a founding member of the Forum of Incident Response and Security Teams (FIRST). CERT/CC regularly participates in FIRST activities, including conferences and technical colloquia. Currently, more than 110 teams belong to FIRST.[11]

One way in which CERT/CC staff members respond to security problems is by publishing advisories, incident notes, and vulnerability notes on the CERT/CC Web site.[12] Advisories are prepared in response to the most severe threats.

Among the most serious intruder activities reported to the CERT/CC in FY2001 were the following:

Nimda Worm[13]



Continued Threat of the "Code Red" Worm[14]

Multiple Vulnerabilities in BIND[15]

Security Incidents Rise

During the 2001 calendar year, the CERT/CC received 118,907 email messages and more than 1,400 hotline calls about security information or computer-security incidents.

While continuing to maintain its leadership activities in responding to and analyzing threats and vulnerabilities, the CERT/CC is also active in helping others establish their own incident-response capability. The SEI has developed and offers a series of courses for security incident-response team managers and technical staff. These courses build awareness and understanding of the management and technical issues that must be dealt with to effectively respond to computer-security emergencies. Other courses, for executives and for system administrators, help organizations protect against today's threats, mitigate future threats, and improve the overall security of their networked systems.

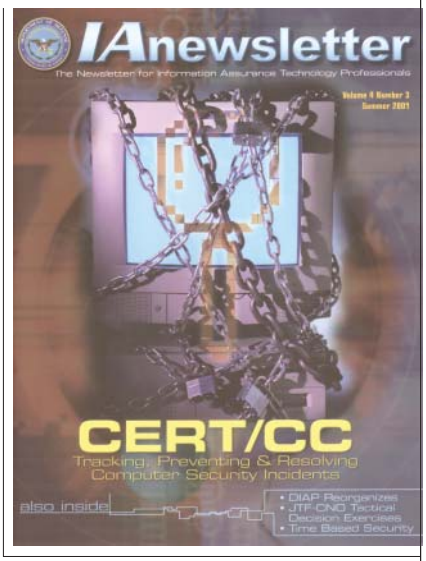
The SEI is improving practices for survivable enterprise management. CERT/CC security practices enable experienced network administrators to protect systems and information against both malicious and inadvertent compromises. The SEI seeks to establish the routine, institutionalized use of these practices.

Another major accomplishment of FY2001 was development of the **Operationally Critical Threat, Asset, and Vulnerability Evaluation℠ (OCTAVE℠) method,** an approach for self-directed risk evaluations that are tied to an organization's overall mission. The OCTAVE method balances critical information assets, business needs, threats, and vulnerabilities, and measures the organization against known or accepted good security practices.

The OCTAVE method helps organizations to

- identify and manage enterprise-wide information-security risks
- develop appropriate protection strategies by considering policy, management, administrative, technological, and other issues to form a comprehensive view of the security state of an organization
- establish an internal interdisciplinary team that can perform information-security assessments and act as a focal point for security-improvement efforts
- improve effectiveness at communicating business and security needs internally and externally
- manage the impact of security and data-privacy regulations, such as the Health Insurance Portability and Accountability Act (HIPAA) and Gramm–Leach–Bliley regulations. The DoD is planning to use the OCTAVE method as the center of its strategy for complying with the HIPAA data-security requirements. DoD teams chartered to use the OCTAVE method will be using it at all medical treatment facilities and will be collaborating with the SEI in planning future transition activities.

The OCTAVE method[16] for large organizations is currently available, and a method for small organizations is under development.



Above:
CERT/CC Featured in *IAnewsletter*
The CERT/CC is featured on the cover of the Summer 2001 (volume 4, number 3) issue of IAnewsletter, *the newsletter for information-assurance professionals.* IAnewsletter *is published quarterly by the Information Assurance Technology Analysis Center (IATAC). The IATAC is a DoD-sponsored Information Analysis Center, administratively managed by the Defense Technical Information Center (DTIC), Defense Information Systems Agency (DISA). In addition to a one-page introductory article about the CERT/CC, the issue includes articles by CERT/CC staff members on recommended network and security practices, system survivability analysis, and the OCTAVE method for evaluating information-security risks.*

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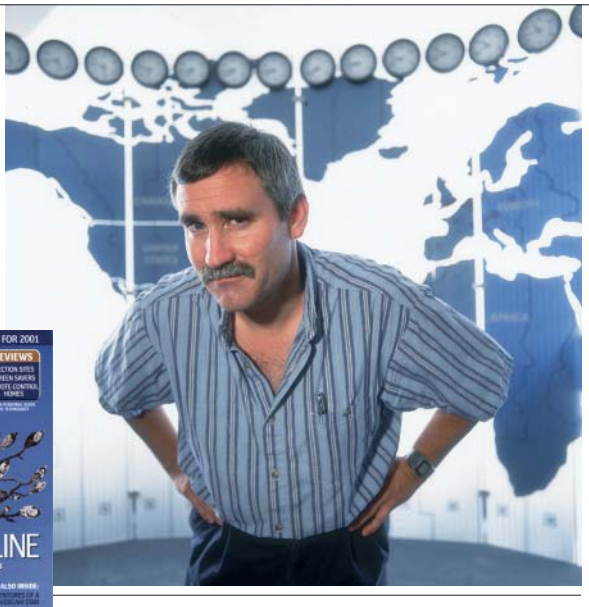
Left:
Senator Rick Santorum (PA), center front, visits with staff members of the CERT/CC.

Research

The SEI has also developed a research program that keeps pace with evolving information-system technology, threats, and vulnerabilities. Focused on system survivability (the ability of a system to provide essential services in the presence of attacks, accidents, and failures) and critical-infrastructure protection, the SEI work is aimed at developers and acquirers of systems as well as at system operators.

Developers and acquirers need to understand the importance of building security and survivability into systems, rather than trying to add it after the systems are installed. The SEI's **Survivable Systems Analysis method** helps system architects and designers systematically assess the survivability properties of proposed systems, existing systems, and planned modifications to existing systems.

The Emergent Algorithm project is developing a powerful system-modeling, simulation, and analysis tool, called Easel, that enables developers and researchers to uncover interactions in complex systems. Easel can be used to determine the effects of specific cyber attacks, accidents, and failures on large-scale systems of systems before development. It allows "what-if" scenarios and provides information that can be used for contingency planning.



Left:
***CERT/CC's Tom Longstaff Featured in* TIME Digital**
In its November 2000 issue,[17] TIME Digital *magazine contains a feature titled "The Digital Dozen" about 12 "movers and shakers for 2001." One of the 12 people featured is Tom Longstaff, manager of research and development for the CERT/CC.*
Photo: Patrick Harbron/TimePix

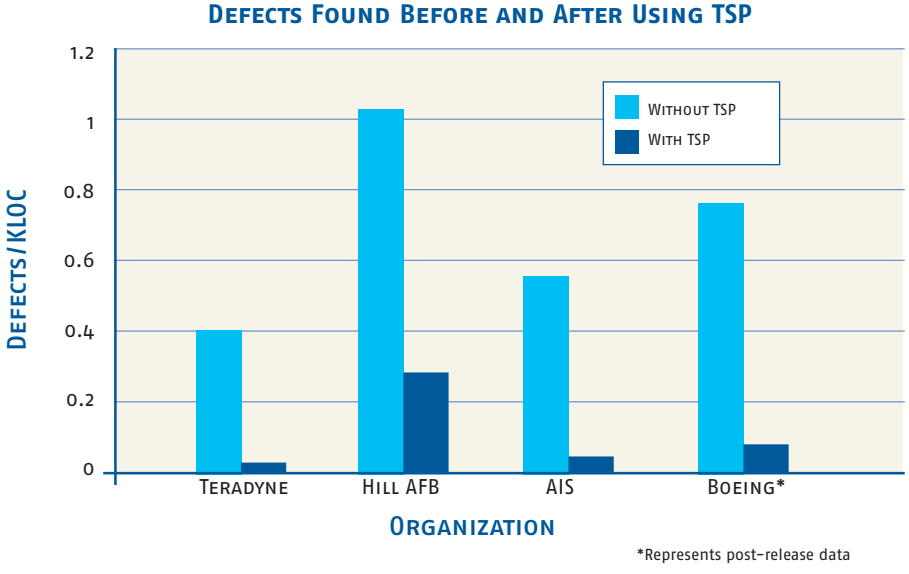
Team Software Process

The SEI is leading the way in helping software organizations to improve product quality, lower costs, enhance planning accuracy, reduce cycle times, and increase productivity. Often, the SEI's Team Software Process℠ (TSP℠) is the reason for these improvements.

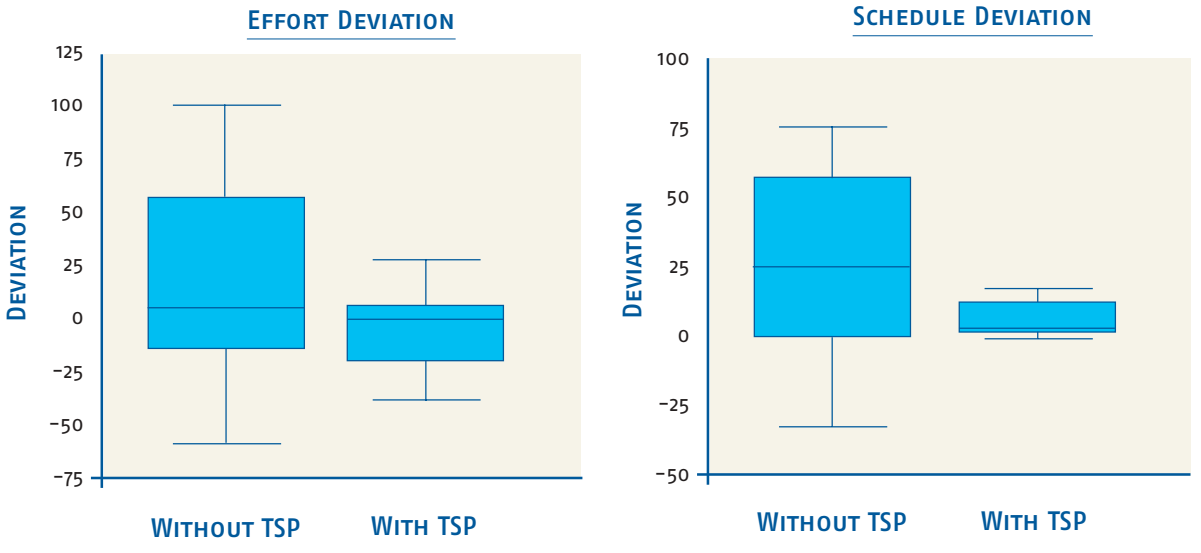
Effective teamwork is essential for most software projects. The TSP has brought outstanding results for both DoD and commercial organizations by providing a defined and measured framework for managing, tracking, and reporting on a software team's work. In these settings, the TSP has been very effective because it provides the specific steps that are rarely obvious to working engineers and managers.

The TSP is built on the Personal Software Process℠ (PSP℠), which helps individual engineers to improve their performances and has been applied to teams ranging from 2 to 150 engineers. The PSP provides the foundation for building high-performance teams of professionals who have been trained to plan and control their personal work, define processes that best suit them, and consistently produce quality products.

The TSP has been widely tested with both commercial and military projects and shown to be highly effective in helping software-intensive teams deliver quality products on schedule and for their projected costs. Because of its emphasis on building high-quality teams that systematically prevent defects from the beginning of the development process, the TSP has been shown to sharply reduce the total cost of software development and acquisition. For example, the TSP helped Teradyne save $5.3 million in the first two years after TSP was introduced.



Left:
Defects per one thousand lines of code (Defects/KLOC) were reduced by 70% to 95% at four organizations representing 28 projects using TSP.



Above:
Using the TSP, fewer defects mean lower costs and more accurate cost estimates. The first figure shows the range of error in planned versus actual project costs at four organizations representing 28 projects. The second figure shows the improvement in schedule prediction. Of these 28 projects, 13 used TSP and 15 did not.

The TSP also provides timely and precise project status and tracking information to management and acquisition groups. Organizations such as the Boeing Company, Advanced Information Services, Inc. (AIS), and Hill Air Force Base have reported dramatic improvements as a result of applying the TSP.

On efforts ranging from a few thousand lines of code up to 100,000 lines of code, the typical TSP project benefits are

- near-zero defects in delivered software (product quality that is from two to ten times better than comparable projects in the same organization)
- cost and schedule performance that are within 10% of planned values
- reduced test costs and schedules (five to ten times; from months to days)

Support for Acquirers

A TSP team was launched this year at the Naval Air Systems Command (NAVAIR), which develops, acquires, and supports the aircraft and related systems used by the U.S. Navy and Marine Corps. NAVAIR's AV-8B Software System Engineering Process Group (SSEPG) has committed to using TSP for organic software development and is encouraging its suppliers to use TSP. NAVAIR management has stated that the TSP has started to provide a strong foundation to better support the way the organization plans, schedules, and tracks work. Specifically, NAVAIR has found that the PSP and TSP provide detailed, working-level data that allows the organization to detect and solve problems much earlier than before. The TSP has also helped NAVAIR, a lower maturity organization, to become better acquainted with the Capability Maturity Model® (CMM®)-Based Assessment for Internal Process Improvement (CBA IPI) process (see page 22). NAVAIR, currently a level 2 organization, had its first CBA IPI in May 2001.

TSP team members stated that they were more informed and better prepared for the extensive interviews that are part of the assessment process due to their TSP training. NAVAIR management is hoping to use the TSP to achieve higher maturity levels of the CMM for Software (SW-CMM). Many TSP activities map to process areas of the SW-CMM, making it easier and faster to satisfy maturity-level requirements. For example, the TSP has been shown to help organizations achieve maturity level 4 in just 20 months, compared to the average 30 it takes without TSP.

The SEI is helping Electronic Brokering Services (EBS), a worldwide currency exchange consortium owned by 13 banks, to revolutionize its software quality. EBS has formed 10 TSP teams, and senior management is committed to using TSP/PSP to improve quality and decrease cycle time. The company's TSP-guided update to its BrokerNet system, which handles between $80 billion and $100 billion in trades a day, was delivered with one-third fewer defects and completed final testing on schedule in only eight weeks (nearly half the time it took to test version 1). For a system of 100,000 lines of code that took a year to develop, this is remarkable. The BrokerNet system has now been installed and used in more than a dozen international banks since August 2000 with no reported problems.

Three books[18] about PSP and TSP written by Watts S. Humphrey for the Addison-Wesley SEI Series in Software Engineering are supporting broad adoption by incorporating TSP and PSP principles into computing curricula.

A Discipline for Software Engineering: The Complete PSP Book is being used at more than 50 colleges and universities, including Boston University, Embry-Riddle Aeronautical University, the Naval Postgraduate School, and the University of Pennsylvania.

Introduction to the Personal Software Process is being used at more than 80 colleges and universities, including the College of William and Mary, Illinois State University, Purdue University, and the U.S. Air Force Academy.

Introduction to the Team Software Process is being used at more than 20 colleges and universities, including Carnegie Mellon University and the University of Maryland.

TSP Results at EBS

- Average defect fix time was decreased by 25%
- Test defects dropped by a factor of 2; quality of product entering integration at least doubled, resulting in an expected integration-phase improvement of 50%.
- Test phases became shorter and more predictable.
- Higher quality coming out of the development phase led to all subsequent test phases costing less.
- Analysis indicated at least 30% savings attributed to increased time on task, increased quality, and increased productivity.

Capability Maturity Model Integration

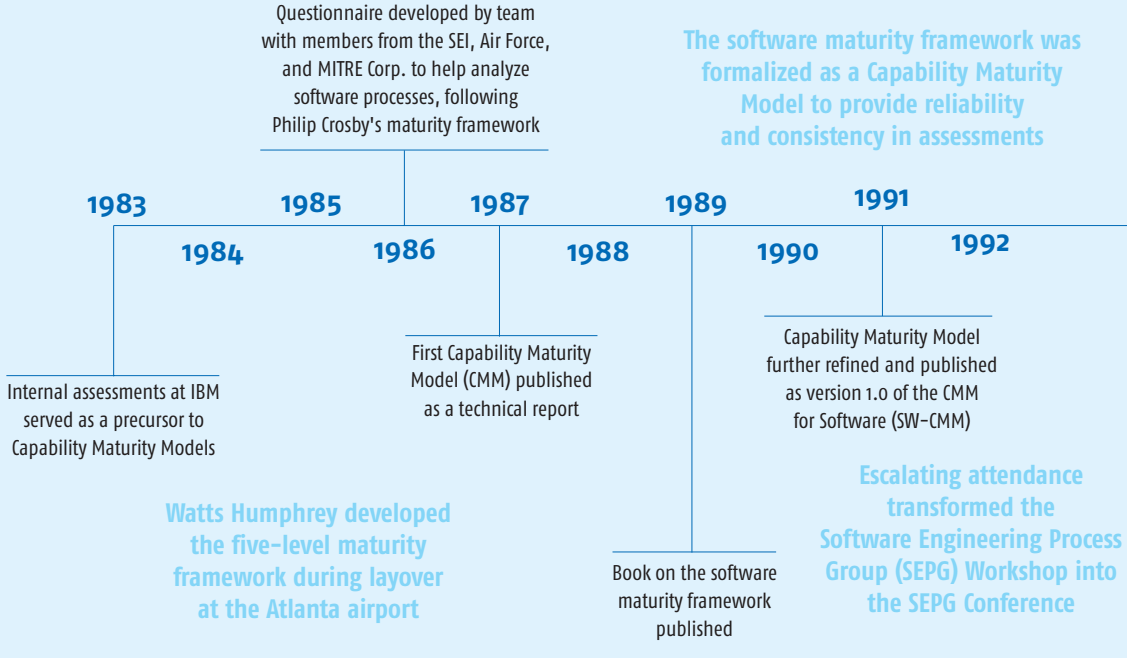
As Ahern, Clouse, and Turner wrote in their book *CMMI Distilled*, which was published as part of the Addison-Wesley SEI Series in Software Engineering in FY2001, "If imitation is a measure of success, then the Capability Maturity Model® for Software is exceptionally successful—and for good reason. People in many disciplines were attracted to the elegance of the CMM® concept and its close ties to quality-management theory and practice."

First released in 1991, the Capability Maturity Model for Software (SW-CMM®) provides a methodology for appraising the maturity of an organization's software processes and for identifying the practices that are required to improve those processes. Adopted and successfully used by more than 5,000 organizations worldwide, the SW-CMM has become the de facto standard for appraising and improving software processes.

Better products through process improvement

Because of its proven utility, the CMM methodology has been applied to other disciplines, resulting in additional models. As a result, organizations undergoing process improvement efforts often encountered the problem of deciding which model to choose, how to appraise against it, or how to interpret differences in terminology or guidance. The Capability Maturity Model Integration (CMMI℠) project integrates several of these models and appraisal methods into a more general framework to support enterprise-wide improvement.

The Evolution of CMM-Based Process Improvement



Support for Developers and Acquirers

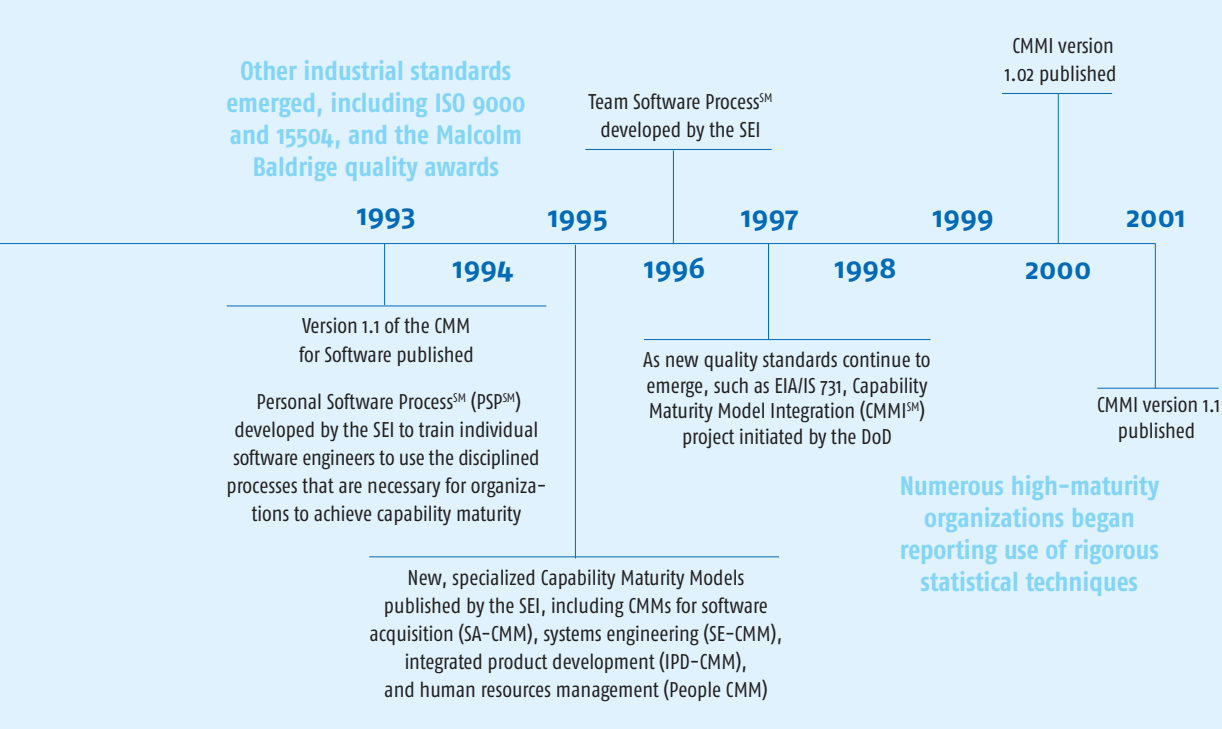
To respond to the challenges and opportunities created by the demand for a better integration of models, training, and appraisal methods, the Office of the Under Secretary of Defense for Acquisition and Technology initiated the CMMI project, which is co-sponsored by the National Defense Industrial Association Systems Engineering Committee. Experts from a variety of backgrounds and organizations were asked to establish a framework that could accommodate and integrate current and future models.

Since February 1998, industry, government, and the SEI have been working to build a set of integrated models covering three disciplines: software engineering, systems engineering, and integrated product and process development. In December 2000, version 1.02 of the *Capability Maturity Model—Integrated for Systems Engineering/Software Engineering (CMMI-SE/SW)* and the *Capability Maturity Model—Integrated for Systems Engineering/Software Engineering/Integrated Product and Process Development (CMMI-SE/SW/IPPD)* were released for use.

Version 1.02 of the CMMI Product Suite[19] includes CMMI models, assessment products and supporting information, and CMMI courses. As steward of the CMMI Product Suite, the SEI collaborates with industry and government, under the direction of a steering group, to support and maintain the CMMI Product Suite.

The SEI also supports the transition of the CMMI Product Suite into use by

- providing training and appraisals;
- licensing training and appraisal products to others for their delivery;
- training, authorizing, and monitoring lead appraisers;
- providing instructor training; and
- providing guidance in model interpretation and usage of appraisal methods.



During the next few years, the Capability Maturity Model Integration project will focus on helping organizations transition from use of the SW-CMM and other models to use of the CMMI Product Suite.

CMMI Appraisal and Assessment

Version 1.0 of the Standard CMMI[SM] Assessment Method for Process Improvement (SCAMPI[SM]) method description was published and made available on the Web in October 2000. The SCAMPI method is a benchmarking tool that helps an organization gain insight into its process area capability or organizational maturity by identifying the strengths and weaknesses of its current processes relative to one or more of the CMMI models, including the CMMI-SE/SW.

Thirty-one organizations[20] had been licensed by the SEI to provide SCAMPI assessment services as of September 2001. One hundred one people took the SCAMPI Lead Assessor training course this year as part of their qualification to become SCAMPI Lead Assessors.

Capability Maturity Modeling®

A Capability Maturity Model (CMM) is an organized collection of proven best practices for project, quality, and process management for use within a design-intensive discipline such as software engineering or systems engineering. A CMM provides an organization with a roadmap for continuous process improvement. The SEI's support of the CMM methodology provides for training and assessment, so that an organization can establish and track its progress against its process-improvement goals.

The original CMM for Software (SW-CMM)—the first CMM, published in 1991—was based on principles of managing product quality that were first developed by Walter Shewhart in the 1930s and expanded and successfully demonstrated in the work of W. Edwards Deming, Joseph Juran, and Phillip Crosby. These principles were adapted by the SEI's Watts Humphrey and others into a foundation for continuously improving software-development and maintenance processes.

The SEI has also helped to develop additional CMMs in other disciplines, including

- software acquisition (Software Acquisition Capability Maturity Model [SA-CMM])[21]
- human resources and organizational development (People Capability Maturity Model [P-CMM])[22]
- systems engineering and integrated product and process development (these disciplines have been combined with the SW-CMM in the new models, the CMMI-SE/SW/IPPD)[23]

To date, an estimated 5,000 organizations worldwide have invested in CMM-based software process improvement in some form, and some 2,000 have undergone formal assessments to determine where they fall among the models' five maturity levels. Initial SEI data showed that after organizations implement CMM-based improvement, median annual productivity improves by 35%, time to market is reduced by 19% annually, and post-release defects drop by 39% per year. The median annual cost per engineer of software process improvement using the CMM for Software was $1,375. The savings to organizations were about five times this amount.

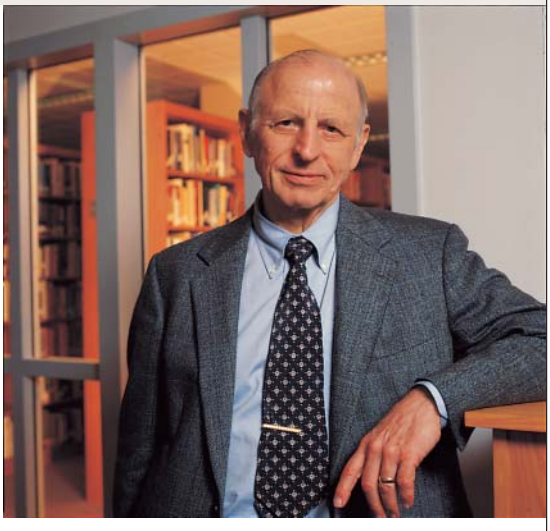
For detailed information and sources regarding return on investment from the use of Capability Maturity Models, see *Benefits of CMM-Based Software Process Improvement: Initial Results*, CMU/SEI-94-TR-013.[24]

CMM Pioneer: Watts S. Humphrey

The effort to create the original concepts of the SW-CMM was led by SEI Fellow Watts S. Humphrey, who has had a profound impact on the field of software engineering. In February 2000, a new software institute bearing his name, the Watts S. Humphrey Software Quality Institute,[25] was inaugurated in Chennai, India.

The March 1, 2000, issue of *Business Week* published a Newsmaker Q&A interview with Humphrey, titled "The Guru of Zero-Defect Software Speaks Out."[26] *Business Week* refers to Humphrey as the "Deming of Software," after W. Edwards Deming, the influential quality-manufacturing theorist and author.

Humphrey was also chosen as one of the top 10 people who have made the most significant contributions to the software industry by the managing editor of *CrossTalk* magazine, in an article published in the December 1999 issue.[27]



Software Process Improvement Networks

A Software Process Improvement Network (SPIN)[28] is a regionally defined group of software engineering professionals interested in software process improvement. The groups meet regularly to share improvement experiences, listen to presentations, and work toward solutions to common problems. There are more than 85 SPINs worldwide. Most SPINs are autonomous, volunteer organizations, though the SEI coordinates the network of SPINs. The SEI provides support to individuals and organizations that wish to form SPINs, and disseminates news and information about meetings and activities to existing SPINs.

Below:
One organization celebrates its CMM appraisal.

Product Line Practice

An important role of the SEI is to help the DoD adopt and apply cutting-edge commercial software development practices. One such practice is the use of a product line approach for software. Long a standard practice in traditional manufacturing, the concept of product lines is relatively new to the software industry.

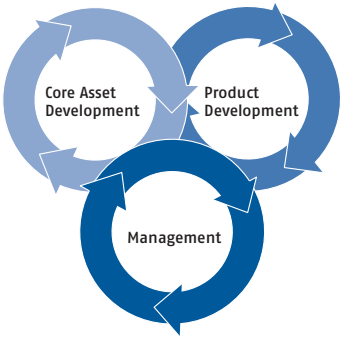
Organizations developing software-intensive systems face many challenges, such as long development cycles, low return on software investments, and difficulty in software system integration. A product line approach to software can overcome these challenges.

Traditionally, software-intensive systems have been acquired, developed, tested, and maintained as separate products, even if these systems have a significant amount of common functionality and code. Such an approach wastes technical resources, takes longer, and costs more than necessary. Using a product line approach, each product is formed by taking applicable components from a base of common assets, tailoring them as necessary through planned variation mechanisms, adding any new components that may be necessary, and assembling the collection according to the rules of a common, product-line-wide architecture. Building a new product (system) becomes more a matter of assembly or generation than creation, of integration rather than programming.

Software Product Line
\'sȯft-ˌwar\ \'prä-(ˌ)dəkt\ \'līn\

n : a set of products sharing a common, managed set of features that satisfy the specific needs of a particular market segment or mission and that are developed from a common set of core assets in a prescribed way

Organizations of all types and sizes are discovering that when skillfully implemented, a product line strategy can yield enormous gains in productivity, quality, and time to market. Making the move to product lines, however, is both a business and technical decision and requires considerable change in software engineering, technical-management, and organizational-management practices.



The SEI Product Line Practice Initiative is helping DoD organizations adopt commercial software product line practices to

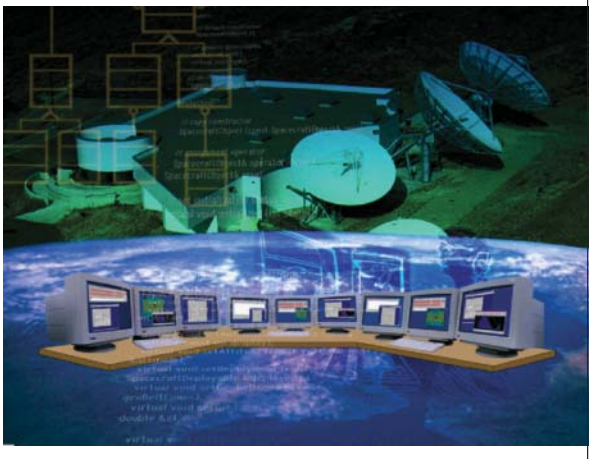
- reduce development and deployment time
- control costs
- improve system flexibility and functionality

Support for Acquirers

During 2001, the SEI increased its efforts to demonstrate the value of software product lines to the DoD, tailor product line practices to acquisition settings, and provide materials to acquirers. For example, the SEI documented its collaboration with the National Reconnaissance Organization (NRO) on its Control Channel Toolkit (CCT) program, which resulted in a product line asset base for ground-based command and control of satellite systems. The first government user of CCT product line assets has slashed development time and costs by 50 percent and reduced defect reports by an order of magnitude compared to similar efforts without an asset base.

CCT product line assets are also being used by other government programs and are the basis for a reference architecture for satellite systems and a commercial ground-based command-and-control product line. For more information, see *Control Channel Toolkit: A Software Product Line Case Study.*[29]

Below:
Ground-based satellite systems: fertile area for software product lines



In FY2001, the SEI developed a business case for applying software product line practices across the NRO. The business case was presented to the NRO's Acquisition Steering Group, which in turn charged the SEI NRO team to develop an adoption plan that identifies specific ways to realize strategic reuse across the organization.

Research

In 1999, the SEI first developed an online information resource, *A Framework for Software Product Line Practice* (PLP Framework).[30] It describes the management and technical practices whose mastery and application are necessary for success with product lines.

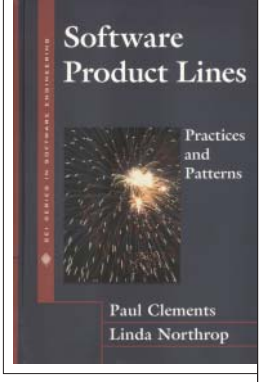
Support for Developers

In 2001, the SEI greatly enriched this conceptual framework and developed methods for product line analysis, architecture definition, and mining assets to assist software developers in carrying out the necessary product line practices. This work is documented in three technical publications: *The Architecture-Based Design Method;*[31] *Options Analysis for Reengineering (OAR): A Method for Mining Legacy Assets;*[32] *and Product Line Analysis: A Practical Introduction.*[33]

THE SEI HAS SPENT MORE THAN THREE YEARS DEVELOPING THE PLP FRAMEWORK FROM A COMBINATION OF IN-DEPTH STUDIES OF ORGANIZATIONS THAT BUILD PRODUCT LINES; DIRECT COLLABORATIONS WITH INDUSTRY AND DOD ORGANIZATIONS ON PRODUCT LINE EFFORTS; AND WORKSHOPS INVOLVING PARTICIPANTS FROM THE PRODUCT LINE COMMERCIAL LEADERS.

To assist organizations in making the move to software product lines, the SEI developed and applied the **Product Line Technical Probe,** which can be used to diagnose an organization's product line readiness.[34]

The SEI's 2001 product line efforts culminated in the publication of ***Software Product Lines: Practices and Patterns.*** This book incorporates the latest version of the framework, includes multiple product line case studies, including the CCT experience, and introduces 23 common product line problems paired with concrete solutions in the form of reusable product line practice patterns.



COTS-Based Systems

Few organizations today would consider building a system entirely from scratch. Use of commercial off-the-shelf (COTS) products offers the promise of faster time to market and an opportunity to take advantage of commercial investments in technology to increase the functionality and capability of the system.

But the promise of COTS products is too often not realized in practice. Many organizations find that COTS-based systems are difficult and costly to build, support, and maintain.

Organizations tend either to assume that COTS products can simply be thrown together or to fall back on the traditional development skills and processes with which they are familiar—skills and processes that are ineffective in the development of a COTS-based system.

Support for Acquirers

The useful life of a legacy system can often be extended, with enhanced capabilities, by replacing aged components with carefully selected COTS components. Successful transition from the legacy system requires careful strategy. During January through September 2001, the SEI performed highly successful work in this area for the Integrated Logistics System—Supply Program Office at Gunter Air Force Base. Four technical notes/reports were published, addressing analysis of alternatives, system modernization, componentization, model problems, and the unintended interaction of various commercial technologies. *(See below.)*

The technical analysis, risk identification, and risk reduction accomplished was cited by the program office as likely saving years in the development of this system. This work will help organizations to analyze legacy systems and identify opportunities for potential COTS upgrades.

CURE

The importance of managing risk is well understood in the software engineering community. DoD directives and mandates, such as DoD 5000.1 and 5000.2R, specify the use of risk-reduction activities. And the SEI's Software Risk Evaluation (SRE) has been a significant part of acquisition for several years.

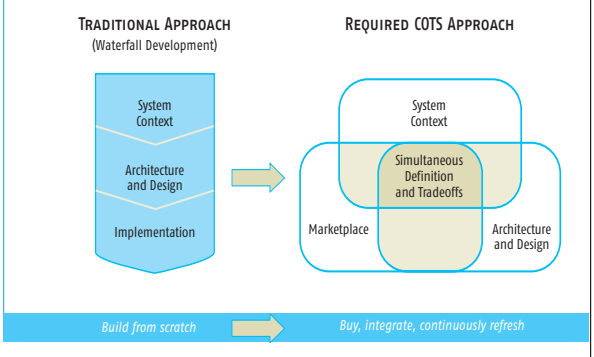
Technical Publications

- ***Maintaining Transactional Context: A Model Problem***, Dan Plakosh, Santiago Comella-Dorda, Grace Lewis, Patrick Place, Robert Seacord (CMU/SEI-2001-TR-012)[35]
- ***Incremental Modernization for Legacy Systems***, Santiago Comella-Dorda, Grace Lewis, Patrick Place, Dan Plakosh, Robert Seacord (CMU/SEI-2001-TN-006)[36]
- ***Legacy System Modernization Strategies***, Robert Seacord, Santiago Comella-Dorda, Grace Lewis, Patrick Place, Dan Plakosh (CMU/SEI-2001-TR-025)[37]
- ***An Enterprise Information System Data Architecture Guide***, Grace Lewis, Santiago Comella-Dorda, Patrick Place, Daniel Plakosh, Robert Seacord (CMU/SEI-2001-TR-018)[38]

In an acquisition that will include extensive use of COTS products, several problems emerge that are not present in non-COTS-intensive acquisitions. For example, the requirements process must become more flexible, yielding to the realities of commercial products, such as the inability to control when products are released, their features, and their ability to interface with other products. Such problems contribute to a program manager's loss of control, and hence, create added risk.

To help manage these risks, the SEI developed a **COTS Usage Risk Evaluation (CURE).**[39] This two-day "assessment" makes use of lessons learned from previously troubled programs. A CURE involves site visits by SEI personnel to the program office and contractor for COTS-based acquisitions. Structured question-and-answer sessions are used to uncover potential risks in the acquisition. Risks are identified, and strategies for mitigating these risks are provided in a final report. This year an updated version of the CURE method was completed and utilized for two programs.

Fundamental Change



COTS-Based Systems Courses

The SEI supports the acquisition community with two courses, COTS-Based Systems for Executives and COTS-Based Systems for Program Managers. More than 1,500 people have attended these courses over the past two years. The Defense Systems Management College (DSMC) has worked with the SEI to incorporate a version of these courses into its curriculum.

This year, the SEI completed a CD-ROM version of the COTS-Based Systems for Program Managers course.[40] The CD-ROM includes video, audio transcripts, notes for the student, links to other SEI documents, exercises to assess understanding, and an email query capability.

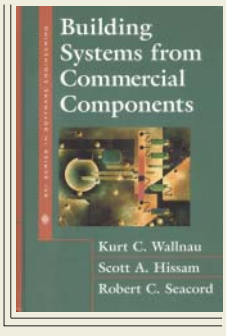
Also this year, the SEI completed and delivered a COTS Product Evaluation Course.

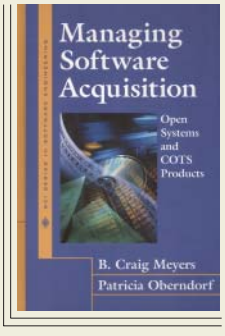
Two COTS-related books published in the SEI Series in Software Engineering

Building Systems from Commercial Components

I found most of my projects are more or less concerned about system integration since last year, and found some difficulties. Depending on the components from other vendors became a great challenge, for my experience was mostly based on designing/implementing components from scratch. This book provides a new point of view to look at the development process. The authors suggest how designs should be adapted to face the fact that the components we are able to assemble are in control of others' hands, and describe several techniques for component-based development... This book is a good guide for the managers and developers in this trend...I believe that readers will enjoy the in-depth knowledge the authors present in this book.

Chen-Wei Ho, a software engineer from Taiwan.





Managing Software Acquisition: Open Systems and COTS Products

A current, integrated approach to managing acquisition for open, COTS-based systems.

Performance-Critical Systems

Program managers need systems that can perform successfully under adverse circumstances—for example, under heavy loads or in the presence of subsystem failures. Yet the behavior of systems under such circumstances is often less than acceptable. The critical need to manage performance is obvious in real-time systems (such as flight-control software). Likewise, unexpected performance problems in command-and-control or even management-information systems can make such systems virtually unusable until costly repairs are undertaken.

The SEI is helping both the government and its contractors to apply effective techniques for predicting and controlling critical aspects of system performance. As new techniques evolve for controlling critical system performance properties, the SEI is bringing the best of these emerging practices into use on DoD systems.

This initiative was called the Dependable Systems Upgrade (DSU) Initiative until recently. Its name was changed in FY2002 because the work is no longer focused exclusively on real-time system upgrades; SEI work in performance-critical systems now covers many types of systems. In particular, the SEI aims to increase the ability of DoD acquisition organizations to specify and manage the performance attributes of software-intensive systems being developed by external organizations.

Support for Developers

Formal methods have long offered the promise of ensuring high-quality software using mathematical rigor. Formal methods represent a clear attempt to address such concerns. However, applying traditional formal methods to a complete system design requires a significant investment—from learning a difficult technology to applying it in all phases of the development effort. As a result, there have been relatively few success stories, and formal methods have failed to achieve widespread adoption.

The SEI has leveraged the work of the formal methods community to develop a software engineering practice known as model-based verification (MBV). MBV involves the selective use of formal methods on abstract models of important portions of a system, thereby providing many of the benefits promised by formal methods without the associated high cost.

The SEI is helping both the government and its contractors to apply effective techniques for predicting and controlling critical aspects of system performance.

In developing MBV, the SEI has collaborated with the Air Force's Computer Resources Support Improvement Program (CRSIP), the National Aeronautics and Space Administration Independent Verification and Validation Facility (NASA IV&V), and Embry-Riddle Aeronautical University.

In testing the MBV approach for the CRSIP, the SEI piloted MBV techniques against the Block 30 Upgrade of the F16 aircraft. This upgrade occurred in 1994, and extensive defect data was available. Using requirements and specification documents from 1994, the SEI applied MBV techniques, finding a number of previously known and some new defects. The newly found defects were judged to reflect marginal deficiencies in the documentation that would not have misled a knowledgeable engineer; the previously known defects were also not serious, but had necessitated changes in the documentation. Finding these defects earlier could have led to reduced rework costs.

The SEI piloted MBV techniques for the NASA IV&V center against a power distribution system designed for the (now-defunct) X-33 spacecraft. As with the F16, the SEI found several defects of note.

THE SEI AIMS TO INCREASE THE ABILITY OF DOD ACQUISITION ORGANIZATIONS TO SPECIFY AND MANAGE THE PERFORMANCE ATTRIBUTES OF SOFTWARE-INTENSIVE SYSTEMS BEING DEVELOPED BY EXTERNAL ORGANIZATIONS.

The SEI has provided support to several acquisition programs, including the Joint Mission Planning System, the 21st Century Land Attack Destroyer (DD21), the Ship Self-Defense System, the Program Executive Office (PEO) Sub, and the Coast Guard's Deepwater program. For example, the SEI assisted the DD21 program office in preparing request-for-proposal language and evaluation criteria for the system architecture, with emphasis on the real-time and fault-tolerant attributes of the system. In collaboration with DD21 and the University of Illinois at Urbana-Champaign Multi-University Research Initiative, the SEI is helping to develop a model real-time problem based on the DD21 radar's real-time scheduling concerns, thereby potentially bringing leading-edge research to bear on a DD21 technical issue. For the Coast Guard's Deepwater program office, the SEI produced a document giving an overview of dependability and reliability issues in software-based systems.

Technical Publications

The SEI has published four technical notes based on its work in MBV, each examining a different aspect of MBV for the practitioner or researcher. These notes are

- ***Model-Based Verification: Claim Creation Guidelines***, Santiago Comella-Dorda, David Gluch, John Hudak, Grace Lewis, Chuck Weinstock (CMU/SEI-2001-TN-018)[41]
- ***Model-Based Verification—Scope, Formalism, and Perspective Guidelines***, David Gluch, Santiago Comella-Dorda, John Hudak, Grace Lewis, John Walker, Chuck Weinstock (CMU/SEI-2001-TN-024)[42]
- ***Model-Based Verification: Analysis Guidelines***, Grace Lewis, Santiago Comella-Dorda, David Gluch, John Hudak, Chuck Weinstock (CMU/SEI-2001-TN-028)[43]
- ***Model-Based Verification: Guidelines for Generating Expected Properties***, David Gluch, Santiago Comella-Dorda, John Hudak, Grace Lewis, Chuck Weinstock (CMU/SEI-2002-TN-003)[44]

A fifth technical note, exploring MBV and abstraction guidelines, was published in early 2002.

Architecture Tradeoff Analysis

Developers and acquirers of complex software systems need their systems to be modifiable and to perform well. They may also need them to be secure, interoperable, portable, and reliable. Quality attributes such as these depend more on the software architecture than on code-level practices such as language choice. Moreover, these qualities do not exist in isolation. Performance affects modifiability; interoperability affects security; and everything affects cost.

An architecture either explicitly or implicitly makes tradeoffs among these qualities, often with undesirable consequences. The SEI has developed a high-payoff method for identifying the relationships and tradeoffs among such quality attributes. The Architecture Tradeoff Analysis Method℠ (ATAM℠)[45] enables software developers and acquirers to evaluate an architecture for required quality attributes and business goals before the system is actually developed. Architectural decisions are difficult and expensive to change later. An early evaluation with a proven method makes sense.

Software Architecture
\'sȯft-ˌwar\ \'är-kə-ˌtek-chər\

n : the structure or structures of the system, which comprise the software components, the externally visible properties of these components, and the relationships among them

Support for Developers

The SEI has been developing and piloting the ATAM and associated architecture tradeoff technology for several years. The method has now stabilized, and the SEI is in the initial stages of packaging the method for others to apply. NASA Goddard and Robert Bosch GmbH have already begun to adopt the ATAM as standard practice. To facilitate ATAM adoption, an ATAM Evaluators Training course has been developed to train an external evaluation team. *Evaluating Software Architectures: Methods and Case Studies* (see page 33), published this year in the SEI Series in Software Engineering, describes systematic methods for evaluating software architecture, with an emphasis on the ATAM, and applies them to real-life cases. It shows how such evaluation can substantially reduce risk while adding remarkably little expense and time to the development effort (in most cases, less than a week). Following the legacy of an earlier book in the SEI Series, *Software Architecture in Practice*, published in January 1998 and now in its 12th printing, the architecture evaluation book promises to make sound architecture practices accessible to the entire software community.

Support for Acquirers

The ATAM requires a documented architecture. However, there are also situations in which only conceptual architecture exists; for example, when competing contractors submit conceptual architectures for review. To provide support under such circumstances, the SEI created the Quality Attribute Workshop (QAW). In a QAW, stakeholders brainstorm general usage scenarios to determine required quality attributes. Using this information, they can set priorities among the attributes and make tradeoffs among the attributes and the architectural decisions that support them.

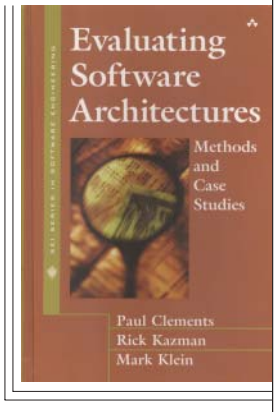
The SEI developed and piloted this concept with the sponsorship of the U.S. Coast Guard's Deepwater Acquisition Project. The goal of the Deepwater Project is to create a system of systems, using commercial and military technologies and innovation to develop a completely integrated, multi-mission, and highly flexible system of assets—including cutters, patrol boats, and short-, medium-, and long-range aircraft—at the lowest total ownership cost. The project is the largest and most comprehensive recapitalization effort in Coast Guard history. During the year, SEI team members applied the QAW on three contractor systems as part of the Deepwater Project.

The team also used a QAW to identify architectural risks and requirements on the NASA Johnson Space Center's Next Generation Communication Project. Similarly, Maxwell Air Force Base Gunter Annex asked the SEI to apply the QAW on its Integrated Maintenance Data System.

Research

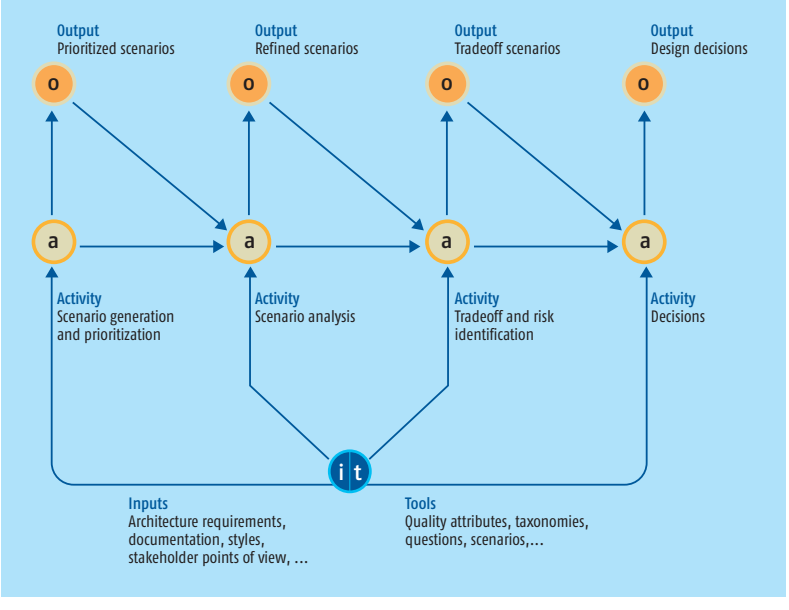
Architecture analysis methods hold great potential for the government acquisition community. In 2001, the SEI demonstrated that potential. For example, an ATAM evaluation was performed on the Joint National Test Facility's (JNTF's) Wargame 2000 architecture. The evaluation uncovered several unknown architectural risks and areas for improvement. The commander of the JNTF and the architect of Wargame 2000 both praised the method and the evaluation exercise as having significant results both in the understanding and the documentation of Wargame 2000.[46]

The SEI is also pushing the research community with its new Cost Benefit Analysis Method (CBAM) for analyzing the costs, benefits, and schedule implications of architectural decisions[47] and the attribute model theory that underlies the ATAM.[48]



Above:
In their first book, Software Architecture in Practice, [the SEI] helped me match my experience with theory. Their invaluable approaches and case studies changed my practice and the way I proceed to design systems and software architectures. This second book...covers what I will look at before I feel good about an architecture.

—Bertrand Salle, lead architect with a major telecommunications company



Right:
Roadmap for a Quality Attribute Workshop.

Software Engineering Measurement and Analysis

Software organizations generally recognize that measurable data are required for informed decision making. However, their attempts to collect and analyze useful information often fall short of expectations. The SEI provides guidance and techniques in software engineering measurement and analysis by showing an organization how to develop and analyze software measures that are tied to the organization's unique business goals. Organizations that have developed basic measurement capabilities can leverage that investment by learning to better analyze the data they collect and make more informed business decisions.

Software measurement-and-analysis programs help organizations to develop useful data on project control, organizational performance, and return on investment. Measurement activities enable organizations to answer questions such as

- How well are we meeting schedules and budgets?
- Has our performance really improved?
- What software practices and/or technologies should our organization invest in and what yields can we expect from this investment?
- How does my organization's performance compare to other organizations' performances?

Without measurement, none of these questions can be accurately answered. Measurement-and-analysis techniques allow organizations to better manage their projects, understand their own capabilities and performances, and document the results of innovations promising improvement in software development and maintenance.

The SEI provides basic measurement practices as well as leading-edge statistical techniques to improve an organization's software project management and software process improvement. These techniques can be used by developers to manage their own projects, as well as by acquisition organizations to track the performance of a contractor. The SEI coordinates with DoD measurement initiatives to keep SEI efforts current and in the forefront of measurement-and-analysis development efforts. These collaborations extend to the Practical Software Measurement (PSM) Project and measurement offices in the military services, as well as to the SEI's own Capability Maturity Model® Integration (CMMI℠) development. Through this coordination, the SEI can disseminate and integrate its work with that of other leading measurement programs.

The SEI Software Engineering Measurement and Analysis Initiative helps organizations to

Identify what to measure

Develop operational definitions for the measures

Define analytical approaches

Create an organizational infrastructure to support and conduct software-measurement activities

Support for Developers and Acquirers

The exchange of best practices and lessons learned is at the heart of the SEI's mission. The SEI produces two online resources to disseminate information about software engineering practices and technologies: the Software Engineering Information Repository (SEIR) and the Software Technology Review (STR). Software professionals can support their acquisition-and-development efforts by utilizing these resources for detailed information on a variety of software technologies.

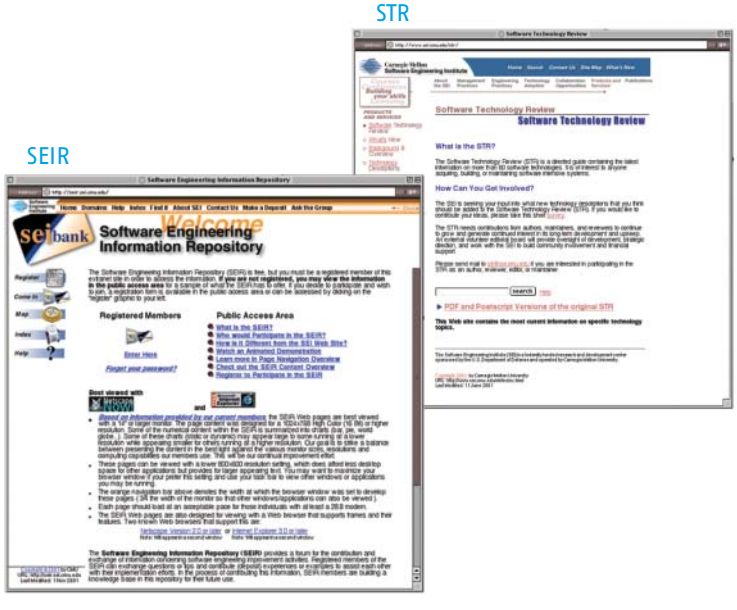
The SEIR[49] is a forum for software engineers in the field—from government, industry, and academia—to exchange lessons learned, pose questions, and submit materials that might help others to adopt improvement approaches.

The SEIR provides a repository of information showing the impact of demonstrated software engineering improvement methods on organizational performance. Since its launch in 1998 with 104 users and minimal site content, the SEIR has grown to become one of the most frequently visited areas of SEI-operated Web sites. This year the site has grown to include 13,000 members, representing nearly 5,000 organizations in 80 countries, and it includes more than 10,300 Web pages and 400 documents.

"Process Maturity Profiles" has become a benchmark for organizations pursuing software process improvement.

One component of the SEIR is the Process Appraisal Information System (PAIS). The PAIS provides the findings and data to support the publication of the "Process Maturity Profiles of the Software Community."[50] The maturity profiles provide a snapshot of the software community in terms of its software process maturity and common process strengths and weaknesses. They are based on results from nearly 2,000 process assessments and present information on organization type, size, maturity, and other factors. According to SEI Web statistics, more than 113,000 copies of the recently released maturity profiles were downloaded in the first half of 2001 alone.

The STR[51] is a Web-based resource that features concise and informative summaries of current and emerging software technologies. The STR supports the SEI's mission to share and disseminate new ideas, lessons learned, expertise, and best practices in the areas of software engineering for the DoD. As a reference source, the STR's primary purpose is to provide the DoD with a better understanding of software technologies that will enable it to systematically plan for the upgrade and evolution of current systems, as well as the development of new systems. In addition, the STR provides managers and engineers in the acquisition and other communities with technical descriptions that include a high-level summary of a software technology, an assessment of its maturity, usage considerations, costs and limitations, links to further information, and other valuable data. The STR is particularly useful for those building or maintaining systems in command, control, and communications applications, as well as automated information systems.



Right:
In FY2001, the STR site experienced nearly 2 million page hits, was viewed by more than 166,000 users in 139 countries, and had more than 18,000 documents downloaded.

Accelerating Software Technology Adoption

For many software-intensive organizations, *technology transition*— the process of facilitating the acceptance and use of a new technology—is a challenging and often unpredictable activity. Software developers, now more than ever recognizing a mission-critical need to improve their software engineering practices, are faced with a continuous spectrum of adoption challenges as they seek to improve their skills, processes, products, and capabilities. Researchers, developing software-improvement technologies for software developers or acquirers, are realizing that the value or quality of their technologies alone does not ensure their acceptance and use.

The SEI is developing methods to help those responsible for technology transition—a role the SEI calls "transition agent"—to be able to answer these questions:

- Is the technology to be transitioned ready for the target community or organization?
- Is the target community or organization ready to adopt the new technology?

Many organizations do not ask these questions, do not know how to determine an answer, or do not know what to do next when the answer is "no."

The SEI helps organizations plan to overcome gaps and, ultimately, manage the transition to a successful completion. The SEI's innovations are helping researchers, developers, and acquirers to better understand, evaluate, plan, and manage technology transition.

During FY2001, the Defense Modeling and Simulation Office (DMSO), a DoD science and technology (S&T) organization, piloted an SEI transition-planning approach called TransPlant. With the SEI's guidance, the program manager and deputy of DMSO's High Level Architecture (HLA) created the first of the necessary components of a good transition plan, including

- articulation of goals and strategy to meet transition needs
- a description of target adopters and plans for how and when to use them to accelerate the adoption
- specification of transition mechanisms, risks, and initial risk-mitigation plans

The HLA staff is working with these documents to guide transition for its vendor and user communities.

Support for Developers and Acquirers

To provide a means of evaluating the progress of an ongoing transition, the SEI introduced the Technology Transition Workshop (TTW) series in FY2001. The first workshop focused on Capability Maturity Model® Integration (CMMI℠, see page 22) and captured the mechanisms that organizations conducting pilot adoptions were using to transition to the CMMI Product Suite, as well as what is still needed and what they found that does not work. The workshop findings[52] were disseminated to the broader CMMI adopter population through the CMMI Technology Conference and User Group held in Denver, CO, November 13-15.

The SEI Accelerating Software Technology Adoption (ASTA) Initiative identifies, develops, and promotes practices that result in better, faster, and cheaper adoption of software engineering technologies.

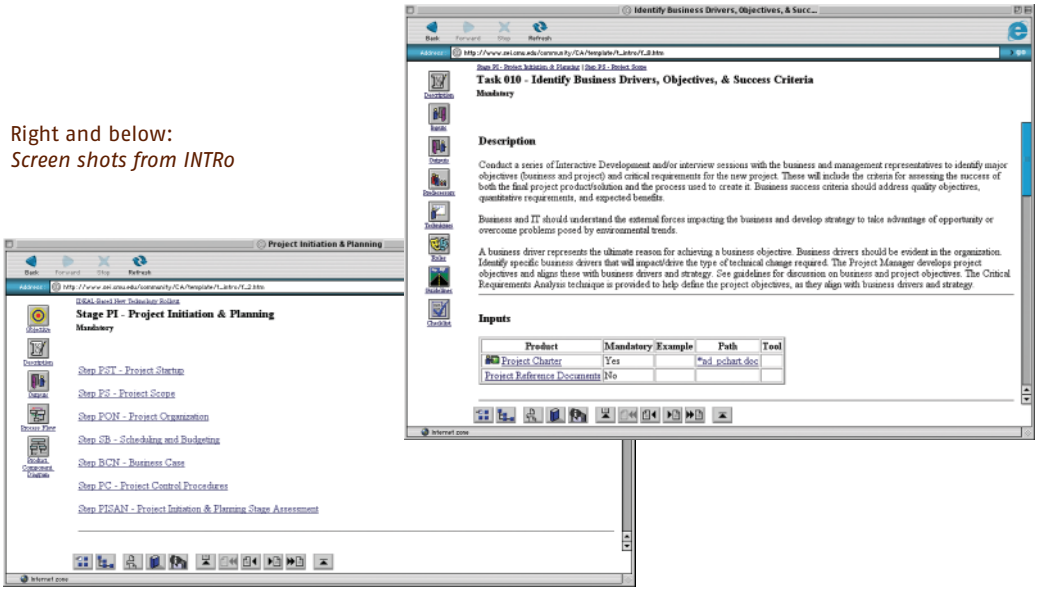
Sometimes the introduction and assimilation of a new technology requires the introduction of a supporting information technology (IT) package. Unfortunately, anecdotal evidence is replete with examples of failed tool adoption.

The SEI has developed INTRo, a Web-based adoption management guide for selecting and rolling out IT technologies across an enterprise. Using INTRo, an organization can introduce new software tools and technologies by following a series of structured and informative process steps, tutorials, tips, checklists, and sample process outputs. The model emphasizes the importance of sharing information and disseminating knowledge practices throughout an organization to develop more lasting and complete business solutions.

The SEI's focus on technology transition is expanding into other areas of need, such as how to measure the fit between a technology and its intended targets, and how to measure the progress of technology adoption within an organization or community. These are important aspects of preparing for, planning, and managing a successful technology transition.

SOMETIMES THE INTRODUCTION AND ASSIMILATION OF A NEW TECHNOLOGY REQUIRES THE INTRODUCTION OF A SUPPORTING INFORMATION TECHNOLOGY PACKAGE. UNFORTUNATELY, ANECDOTAL EVIDENCE IS REPLETE WITH EXAMPLES OF FAILED TOOL ADOPTION.

Right and below:
Screen shots from INTRo



2001 Special Programs

- Defense Strategic Impact Program
- Independent Technical Assessments
- Technology Insertion, Demonstration, and Evaluation Program

Defense Strategic Impact Program

Through the Defense Strategic Impact Program (DSIP), the SEI seeks to transition SEI technology and improve the quality of SEI engagements with defense organizations by supporting the goals and objectives of the defense acquisition community. The SEI is planning and working to create successful long-term engagements with the Air Force, Army, and Navy.

DSIP work is planned and executed to provide a broad cross section of defense organizations with access to SEI courses, workshops, and technology to improve the software-acquisition management skills of members of the defense acquisition workforce. The SEI provides technical assessments of critical defense programs to assess program status, and supports efforts by systems commanders, program executive officers, and program managers to rapidly transition best acquisition management and technical practices into use. The SEI also supports defense software-development organizations in transitioning best SEI management and technical practices that provide software engineering expertise to defense program offices.

DSIP work is planned and executed to provide a broad cross section of defense organizations with access to SEI courses, workshops, and technology to improve the software-acquisition management skills of members of the defense acquisition workforce.

DSIP activities include

- education and training, including courses, workshops, observations, and coaching
- acquisition pilots with selected defense acquisition programs. An acquisition pilot is an approach for maturing and transitioning improved practices to the acquisition community. It involves the trial use of one or more acquisition-focused products and/or services from the SEI in support of strategically important acquisition programs. The goal of an acquisition pilot is to foster widespread, institutionalized use of the piloted practices throughout an acquisition organization.
- direct technical assistance to service acquisition executives, program executive officers, and program managers
- placement of defense resident affiliates (see page 52), either full or part time, at the SEI
- collaboration with transition partners to leverage the transition of SEI technology to the defense acquisition community

In 2001, the SEI established project work statements with service acquisition executives (SAEs) in the Air Force, Army, and Navy. The SEI defined the proposed content of the Air Force Strategic Impact Program, the Army Strategic Impact Program, and the Navy Strategic Impact Program and presented these concepts to the respective SAEs or their designated representatives.

Through the DSIP, the SEI

- transitions SEI technology to improve the ability of defense acquisition organizations to acquire near-defect-free software-intensive systems on time, every time;
- increases awareness of SEI capabilities and technologies throughout the defense acquisition community;
- seeks strategic advocacy of senior defense leadership to actively endorse adoption of SEI technology by defense acquisition organizations; and
- demonstrates the applicability and relevance of SEI technology to systemic problems in acquiring software-intensive systems.

Independent Technical Assessments

Through independent technical assessments (ITAs), SEI teams uncover the root causes of problems affecting DoD software-intensive programs with the goal of providing recommendations that maximize a program's strengths and minimize and mitigate its risks. ITAs are objective, technical evaluations of software-intensive development or acquisition programs. They are typically initiated by the system program director, program executive officer, or a higher level acquisition official.

ITA teams are composed of SEI staff members and visiting scientists with an appropriate mix of expertise, who conduct a series of interviews with program stakeholders and ultimately deliver a briefing and recommendations to the party that initiated the ITA.

The SEI has performed many ITAs over the past four years on mission-critical systems for the DoD and other agencies. Most of the programs evaluated have been U.S. Air Force and Navy programs, and have been procurements of software-intensive systems with the following application-domain attributes:

- real-time vehicle electronics
- command, control, communications, and intelligence
- logistics support
- electronics testing and evaluation
- satellite ground control

ITAs conducted in 2001 included

- an assessment of technical risks to the Standard Procurement System (SPS), which included proposed mitigation strategies. The SPS is an automated information system that, when implemented, will support procurement functions—from the receipt of requirements until contract closeout—at all DoD procurement organizations. The SPS is intended to replace 76 automated procurement systems and additional manual processes.
- an assessment of key strengths, weaknesses, and risks of the Air Force's Military Personnel Data System, which supports all personnel management functions, from recruiting through job assignment, and ultimately separation or retirement.
- an assessment of the Space Based Infrared Systems (SBIRS). In conjunction with the Aerospace Corp., SEI staff participated on the independent review team that evaluated the SBIRS ground segment development, providing expertise in software engineering, real-time systems, and systems/architectural engineering and interoperability.
- an objective technical and programmatic evaluation of the Global Broadcast System program. In addition to SEI staff members, the ITA team included both government and support contractor personnel, selected by the Air Force acquisition executive. The ITA resulted in recommendations to leverage the program's strengths and minimize or mitigate its risks.
- an assessment of the Joint Mission Planning System and a later review of the program's response to SEI recommendations as a result of the ITA.
- a two-day "quick-look" assessment to examine software-related issues on the Air Force Mission Planning System program. The ITA included interviews with Air Force Mission Support System engineers and management staff, engineers from the B2 and B52 programs, and engineers from Sun Microsystems and Sybase.

Based on its experiences with ITAs, the SEI published a technical note in 2001, *Real-Time Systems Engineering: Lessons Learned from Independent Technical Assessments* (CMU/SEI-2001-TN-004).[53]

ITAs are objective, technical evaluations of software-intensive development or acquisition programs.

Like other sectors within the U.S. economy, the defense manufacturing base is evolving. Increasingly, product development is being outsourced to small manufacturing enterprises, and large defense-contractor organizations are becoming integrators of supply chains, as opposed to manufacturers. A supply chain is only as strong as its weakest link. As the defense manufacturing base evolves, these links will be crucial for rapid defense response to future events, especially regional engagements.

Technology Insertion, Demonstration, and Evaluation Program

In recent years, advances in software technology have initiated dramatic improvements in the productivity of the U.S. manufacturing sector. Small manufacturers, however, have typically been reluctant to utilize this new technology in their design and manufacturing activities, even though easier-to-use, less costly software tools have been developed. The Technology Insertion, Demonstration, and Evaluation (TIDE) program,[54] initiated at the SEI in May 2000, seeks to improve the profitability and efficiency of small manufacturers by helping them understand the business and technical processes of selecting and integrating software tools for application to small manufacturing enterprises.

The TIDE program has been championed and supported by Congressman Mike Doyle (PA), who has also supported collaborations between the DoD's Manufacturing Technology Program and Department of Commerce manufacturing initiatives. In the TIDE program, small manufacturers apply advanced software engineering technologies to their business problems. In 2001, two small manufacturers in Southwestern Pennsylvania—Carco Electronics and the Kurt J. Lesker Company—invested time and engineering personnel to collaborate with the SEI on projects demonstrating the business benefits and process of adopting advanced technology in small-manufacturing enterprises. The outcome of these demonstration projects will be a toolkit that can be used by any smaller manufacturer attempting to establish an enhanced engineering-and-design capability, to move into new markets, and to provide more value to customers in the form of more technically sophisticated products. Case studies generated from these demonstration projects will provide solid justification to investors as well as to risk-averse owners of smaller businesses that insertion of commercially available software does have substantial benefit. These case studies and other lessons learned from the demonstration projects will then be shared in forums such as workshops, conferences, and curricula so that others in the DoD supply chain can take advantage of this work.

Left:
Congressman Mike Doyle (PA), with SEI Director and CEO Stephen E. Cross

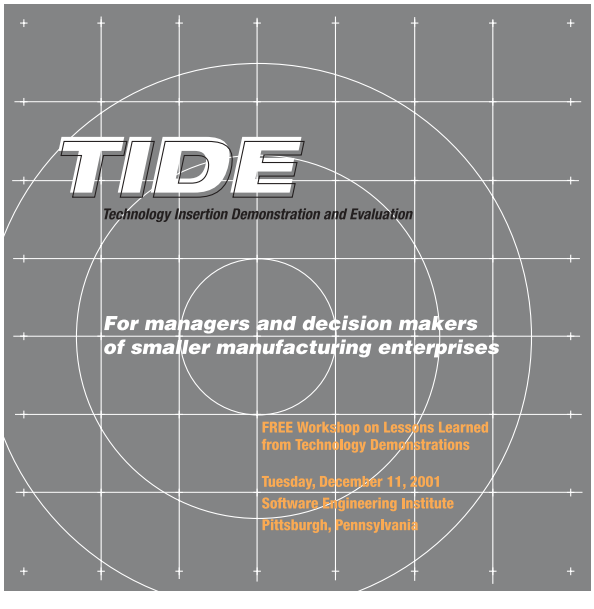
Concurrently with the TIDE demonstration projects, the SEI has initiated an education-and-training outreach program to expand technology adoption throughout the Southwestern Pennsylvania manufacturing community. The workforce-development part of the TIDE program leverages existing SEI assets for the benefit of the small-manufacturing community. This program offers scholarship support for small-business personnel to attend courses, seminars, and workshops in leading-edge information technology, leading to increased awareness of the value of and return on investment from technology adoption.

Workforce-development activities in 2001 included

- cost-free delivery to the small-business community of SEI training courses in information-technology topics
- development of a half-day workshop on technology adoption for small manufacturers. TIDE program funds covered the development and delivery costs of this workshop.
- development of a version of the SEI's OCTAVE[SM] (Operationally Critical Threat, Asset, and Vulnerability Evaluation[SM]) method for evaluating information-security risks, tailored to the needs of small manufacturing enterprises

The TIDE program also helped to sponsor two successful and well-attended regional workforce-development summits.

At this workshop, decision makers from small manufacturing enterprises learned about TIDE projects that demonstrated the benefits of applying commercially available software and information technology.



The SEI, Its People and Organization

- Board of Visitors
- Joint Advisory Council
- Director's Office
- Management Team

Board of Visitors

The SEI's Board of Visitors was established to advise the Carnegie Mellon University president and provost and the SEI director on the SEI's plans and operations.

The board monitors SEI activities and provides reports to the president and provost on the state of the SEI and recommendations for improvement.

Christine B. Davis
Chair

Independent Consultant

Former Executive Vice President, Raytheon Systems Company

Roger Bate
Chief Architect, CMM Integration℠

Software Engineering Institute Fellow

Former Chief Computer Scientist, Texas Instruments

Barry W. Boehm
TRW Professor of Software Engineering

Computer Science Department Director, University of Southern California Center for Software Engineering

William C. Bowes
Vice President, Program Management, Litton Industries

Gerald P. Dinneen
Chair, Policy Division, National Research Council

Philip L. Dowd
Senior Vice President, SunGard Data Systems

Trustee, Carnegie Mellon University

Paul G. Kaminski
Chairman and Chief Executive Officer, Technovation, Inc.

Former Under Secretary of Defense for Acquisition and Technology

John Major
President and Chief Executive Officer, Wireless Knowledge

Dave McCurdy
President, Electronic Industries Alliance

Former Member, U.S. House of Representatives

Alan B. Salisbury
President, Learning Tree International

Donald E. Stitzenberg
Vice President, Global Supply Chain, Merial (a division of Merck)

Trustee, Carnegie Mellon University

Dennis Yablonsky
President and Chief Executive Officer, Pittsburgh Digital Greenhouse

Joint Advisory Council

The Joint Advisory Council is the SEI's "Board of Directors." It provides strategic advice to the SEI's executive agent and primary sponsor.

Such advice includes review of the SEI strategic plan and program plan.

Dr. Charles Holland, Chair
Acting Deputy Under Secretary of Defense (Science & Technology)

Dr. Nancy Spruill, Vice Chair
Director, Acquisition Resources and Analysis

Office of the Under Secretary of Defense (Acquisition, Technology, & Logistics)

Dr. Jane Alexander
Deputy Director

Defense Advanced Research Projects Agency (DARPA)

Dr. Michael Andrews II
Deputy Assistant Secretary of the Army (Research & Technology)

RADM Jay Cohen
Chief of Naval Research

Office of Naval Research

represented by
Dr. Andre van Tilborg
Director Mathematical, Computer, & Information Sciences Division

Office of Naval Research

Dr. Donald Daniel
Deputy Assistant Secretary of the Air Force (Science, Technology, & Engineering)

Dr. Henry Dubin
Director for Assessment and Evaluation

Office of the Assistant Secretary of the Army (Acquisition, Logistics, & Technology)

Mr. Blaise Durante
Deputy Assistant Secretary of the Air Force (Management Policy & Program Integration)

Dr. Charles Infosino
Assistant Director of Technology
Ballistic Missile Defense Organization

Mr. John Landon
Deputy Assistant Secretary of Defense

Command, Control, Communications, Computers, Intelligence, Surveillance, & Reconnaissance and Space Command

Dr. Margaret Myers
Principal Director

Deputy Assistant Secretary of Defense (Deputy Chief Information Officer)

Mr. Michael O'Driscoll
Deputy Chief Engineer

Office of the Assistant Secretary of the Navy (Research, Development, & Acquisition)

Dr. Chuck Perkins
Deputy Under Secretary of Defense (Advanced Systems & Concepts)

Mr. George Schneiter
Director, Strategic & Tactical Systems

Office of the Under Secretary of Defense (Acquisition, Technology, & Logistics)

represented by
Dr. Spiros Pallas
Principal Deputy to the Director, Strategic & Tactical Systems

Office of the Under Secretary of Defense (Acquisition, Technology, & Logistics)

Dr. Starnes Walker
Deputy Director

Defense Threat Reduction Agency

Director's Office

Stephen E. Cross, Ph.D.
Director and CEO

Clyde Chittister
Chief Operating Officer

SEI Management Team

Steven K. Huth
Manager, Information Technology

Thomas C. Brandt
Director, Program Integration
Directorate

Richard D. Pethia
Director, Networked Systems
Survivability Program

Maureen McFalls
Director, Government Relations
Carnegie Mellon University

Peter J. Menniti
Manager, Financial
and Business Services

Linda M. Northrop
Director, Product Line
Systems Program

William C. Peterson
Director, Software Engineering
Process Management Program

John T. Foreman
Director, Dynamic Systems Program

John B. Goodenough
Chief Technical Officer

Purvis M. Jackson
Director, Community Sector

SEI Staff Accomplishments and Transition Activities

- Technical Leadership Positions
- Technical Staff Demographics
- Dissemination Activities
- Transition Partners
- Work with DoD Software Collaborators

Technical Leadership Positions

Journal Editorships

Bass, L. ■ Editor, *Universal Access in the Information Society*, Springer-Verlag.

Cross, S. ■ Associate editor, *IEEE Intelligent Systems*, Institute of Electrical and Electronics Engineers (IEEE).

Humphrey, W. ■ Member, editorial board, *Empirical Software Engineering*, Kluwer Academic Publishers ■ member, editorial board, *Software Process Improvement and Practice*, John Wiley & Sons, Ltd.

Kazman, F. ■ Guest editor, *International Journal of Software Engineering and Knowledge Engineering*, issue on software architecture, August 2001.

Kellner, M. ■ Member, editorial board, *Empirical Software Engineering*, Kluwer Academic Publishers; ■ member, editorial board, *Software Process Improvement and Practice,* John Wiley & Sons, Ltd.

McGregor, J. ■ Guest editor, special issue of *IEEE Software* on initiating software product lines, September 2002 ■ member, editorial board, *Journal for Software Testing Professionals* (JSTP) ■ member, editorial board, *International Journal on Computer Information Systems* (IJCIS).

Mead, N. ■ Guest editor, *IEEE Software*, special topic on malicious information technology, September /October 2000 ■ contributing editor, *IEEE Software* ■ member, Industry Advisory Board, *IEEE Software*.

Northrop, L. ■ Guest editor, special issue of *IEEE Software* on initiating software product lines, September 2002.

Paulk, M. ■ Member, editorial board, *Software Process Improvement and Practice*, John Wiley & Sons, Ltd. ■ member, editorial board, *Software Quality Professional*, American Society for Quality.

Smith, D. ■ Co-editor, "Special Issue on Program Comprehension," *Science of Computer Programming*, July 2001, Elsevier Science.

Weinstock, C. ■ Category editor, *Computing Reviews*, Association of Computing Machinery.

Zubrow, D. ■ Associate editor, *Software Quality*, newsletter of the Software Division of the American Society for Quality ■ member, editorial board, *Software Quality Professional*, American Society for Quality ■ guest editor, "Benchmarking Software Organizations," *IEEE Software*, September/October 2001.

Professional Memberships

SEI technical staff members are highly respected in their fields and serve in various leadership positions for many different organizations.

Barbacci, M. ■ Member, Industrial Advisory Board overseeing the development of the Software Engineering Body of Knowledge ■ co-chair, IEEE Computer Society Latin America Initiative ■ member, IEEE Technical Activities Board Strategic Planning and Research Committee ■ member, Steering Committee SEI/IEEE Computer Society Information Survivability Workshops ■ member, International Federation for Information Processing (IFIP) Working Group 10.5, Design and Engineering of Electronic Systems.

Barbour, R. ■ Vice president for administration for the Project Management Institute Risk Management Special Interest Group.

Bass, L. ■ Member NASA Goddard Space Flight Center Information Sciences and Technology Visiting Committee ■ Association for Computing Machinery (ACM) representative to the IFIP Technical Committee on Software: Theory and Practice.

Bate, R. ■ Member, Capability Maturity Model® Integration Steering Group.

Brownsword, L. ■ Conference chair, First International Conference on Commercial Off-the-Shelf (COTS)-Based Software Systems.

Carter, L. ■ Commissioner, Computing Accreditation Commission/Accreditation Board for Engineering and Technology (CAC/ABET).

Chittister, C. ■ Member, Capability Maturity Model® Integration Steering Group.

Clements, P. ■ Co-chair, Fourth International Workshop on Architectures for Product Lines, 2001 ■ member, Program Committee, International Workshop on Software and Performance, Rome, 2002 ■ member, Tutorials Committee, International Conference on Software Engineering (ICSE), 2001, 2002 ■ panels chair, member of Program Committee, International Software Product Line Conference (SPLC), 2002 ■ tutorials chair, Working IFIP/IEEE Conference on Software Architecture (WICSA), 2001, 2002 ■ co-organizer, Workshop on Advanced Separation of Concerns, ICSE 2001 ■ member, Program Committee, Workshop on Product Line Engineering—The Early Steps: Planning, Managing, and Modeling, German Conference on Software Engineering, 2002 ■ member, Program Committee, International Workshop on Product Family Engineering, 2001 ■ co-organizer, Dagstuhl Seminar on Software Product Lines, 2001 ■ member, Program Committee, International Conference on Software Reuse (ICSR7), 2002 ■ member, Program Committee, International Workshop on Reuse Economics, in conjunction with ICSR7, 2002 ■ member, Program Committee, First International Conference on Aspect-Oriented Software Development (AOSD), 2002 ■ co-organizer, Program Committee, Workshop on Aspect-Oriented Software Architecture Design, in conjunction with AOSD 2002 ■ member, Program Committee, Workshop on Requirements Engineering for Product Lines, in conjunction with Requirements Engineering '02, 2002 ■ member, Program Committee, Argentine Symposium on Software Engineering, 2002.

Cross, S. ■ Chair emeritus, Defense Advanced Research Projects Agency (DARPA) Information Science and Technology (ISAT) panel ■ member, Defense Science Board Task Force on Defense Software, November 2000 ■ member, editor-in-chief search committee, *IEEE Transactions on Software Engineering* ■ member, organizing committee for DoD Software Engineering Science & Technology Summit, August 2001 ■ panel member, Air Force Acquisition (AF/AQ) Work Culture Transformation Board.

Dailey, E. ■ Member, National Defense Industrial Association (NDIA) Science & Engineering Technology Advisory Board.

Feiler, P. ■ Member, Publicity Conference Subcommittee, International Conference on Software Engineering (ICSE) 2001 ■ secretary and co-author, draft standard, Avionics Architecture Description Language Subcommittee Working Group (AS-5C), Embedded Computing Systems Committee, Aerospace Avionic Systems Division, Society of Automotive Engineers (SAE).

Ferguson, J. ■ Member, Selection Committee, and chair, Office of the Secretary of Defense-sponsored track, Software Technology Conference ■ member, Selection Committee, Top Five U.S. Government Quality Software Projects ■ head, North Atlantic Treaty Organization (NATO) Ad Hoc Working Panel on Evaluation.

Foreman, J. ■ Co-organizer, COTS-Based Systems Workshop, sponsored by the University of Southern California (USC), the SEI, and the Center for Empirically Based Software Engineering (CeBASE).

Gallagher, B. ■ Technical program chair, First Annual Capability Maturity Model Integration Technology Conference and User Group.

Goldenson, D. ■ Coordinator, international trials for ISO 15504 ■ member, Program Committee, IEEE Seventh International Software Metrics Symposium (Metrics 2001).

Hayes, W. ■ Member, Program Committee, IEEE Eighth International Symposium on Software Metrics (Metrics 2002) ■ member, U.S. delegation, ISO 15504.

Hissam, S. ■ Member, Advisory Committee, Department of Computer Science and Electrical Engineering, West Virginia University ■ program co-chair, 2002 International Conference on COTS-Based Software Systems (ICCBSS 2002) ■ co-organizer, 2nd Workshop on Open Source Software Engineering, 2002 International Conference on Software Engineering (ICSE 2002).

Humphrey, W. ■ Member, Industrial Advisory Board, Department of Computing and Mathematics, Embry-Riddle Aeronautical University ■ member, Review Committee, Institute of Electrical and Electronics Engineers Process Achievement Award.

Jones, L. ■ Vice chair, Computing Accreditation Commission/Accreditation Board for Engineering and Technology (CAC/ABET).

Kasunic, M. ■ Member, Information Technology Integration Technical Committee, Systems, Standards, and Technology Council ■ member, Practical Software and Systems Measurement (PSM) Technical Steering Group.

Kazman, F. ■ Program co-chair, Second Working Institute of Electrical and Electronics Engineers/International Federation for Information Processing (IEEE/IFIP) Conference on Software Architecture (WICSA); chair, IFIP Working Group 2.7/13.4 ■ program chair and member, Steering Committee, Economics-Driven Software Engineering Research Workshop at International Conference on Software Engineering, 2002 ■ member, Program Committee, International Conference on Software Maintenance ■ general chair, Engineering for Human-Computer Interaction Conference ■ program chair, Dagstuhl Seminar on Software Architecture and Modeling ■ member, Program Committee, Workshop on Reuse Economics, International Conference on Software Reuse ■ member, Software Architecture Review and Assessment International Workshop Group.

Kitson, D. ■ Co-editor, ISO/IEC 15504-3 (Guidance on Performing an Assessment) ■ team lead, ISO/IEC 15504 U.S. Technical Advisory Group to SC7 (the committee responsible for software and systems engineering standards) ■ head of U.S. delegation for several international meetings on 15504.

Klein, M. ■ Member, Second Working Institute of Electrical and Electronics Engineers/International Federation for Information Processing Conference on Software Architecture (WICSA 2).

Levine, L. ■ Vice chair, International Federation for Information Processing (IFIP) Working Group 8.6 on Diffusion, Transfer, & Implementation of Information Technology ■ member, Program Committee, IFIP 8.6 Working Conference: The Adoption and Diffusion of IT in an Environment of Critical Change, Sydney, Australia 2002 ■ member, Program Committee, IFIP WG 8.6 Working Conference: Diffusing Software Process & Product Innovations, Banff, Canada, 2001.

Little, R. ■ Board member, Simulation Interoperability Standards Organization (SISO) ■ technical area director, Federation Execution Development Process IEEE standard development effort ■ chair, IEEE standard 1516.1 Working Group on Distributed Simulation High Level Architecture ■ core member, Defense Modeling and Simulation Office High Level Architecture Technical Support Team.

Marz, T. ■ Member, Common Operating Environment (COE) Real Time Advisory Group (RTAG) ■ chair, COE RTAG Fault Tolerance Subgroup.

Mead, N. ■ Tutorials chair, International Symposium on Requirements Engineering, August 2001 ■ chair, Steering Committee, International Conference on Requirements Engineering ■ chair, Working Group on Software Engineering Education ■ member, Advisory Committee, Forum for the Advancement of Software Engineering Education (FASE) ■ member, Executive Committee, Carnegie Mellon Master of Software Engineering Program.

Meyers, C. ■ Chair, IEEE Standard 1003.21 Working Group on Real-Time Distributed Systems Communication ■ member, Executive Committee, IEEE Portable Operating System Interface (POSIX) Sponsor Executive Committee.

Monarch, I. ■ Member, Association of Information Systems (AIS) and the AIS special interest group for History of Information Science.

Mueller, H. ■ Conference chair, 2001 International Conference on Software Engineering (ICSE 2001).

Nord, R. ■ Member, Program Committee, 2002 International Conference on Software Engineering (ICSE 2002) ■ member, Program Committee, Second Working Institute of Electrical and Electronics Engineers/International Federation for Information Processing Conference on Software Architecture (WICSA 2).

Northrop, L. ■ Chair-elect, Steering Committee, Object-Oriented Programming, Systems, Languages, and Applications (OOPSLA) Conference ■ co-chair, Fourth International Workshop on Product Family Engineering ■ conference chair, OOPSLA 2001 ■ Industry Track co-chair, 2001 International Conference on Software Engineering (ICSE 2001) ■ conference chair, Second Software Product Line Conference (SPLC2) ■ organizer, SEI Fifth Product Line Practice Workshop ■ organizer, SEI Fourth DoD Product Line Practice Workshop ■ 2001 Carnegie Science Center (Pittsburgh, PA) Award for Excellence in Information Technology ■ member, Program Committee, 2002 European Conference on Object-Oriented Programming (ECOOP) ■ co-organizer, Advanced Separation of Concerns workshop, ICSE 2001.

O'Brien, L. ■ Member, 2001 Program Committee, Working Conference on Reverse Engineering (WCRE) ■ organizer, Architecture Reconstruction and Product Lines, Working Institute of Electrical and Electronics Engineers/International Federation for Information Processing (IEEE/IFIP) Conference on Software Architecture (WICSA), 2001.

Oberndorf, P. ■ Co-organizer, COTS-Based Systems Workshop, sponsored by the University of Southern California (USC), the SEI, and the Center for Empirically-Based Software Engineering (CeBASE) ■ organizer, Software Technology Conference (STC) birds-of-a-feather session on future investigations needed for more successful pursuit of COTS-based systems.

Palmquist, S. ■ Principal secretary, American Institute for Aeronautics and Astronautics (AIAA) Information and Command and Control Systems Technical Committee ■ member, AIAA Corporate Council.

Paulk, M. ■ Member, advisory board, Carnegie Mellon University's extended Servicing Capability Model (eSCM) project ■ co-chair, 2001 High Maturity Workshop ■ judge, best paper/best practices, India Software Engineering Process Group (SEPG) Conference ■ reviewer, IEEE and ISO standards, including ISO 9001 (Quality Management Systems), ISO 9000-3 (Software Guideline for Quality Management Systems), ISO 12207 (Software Life Cycle Processes), ISO 15288 (System Life Cycle Processes), and ISO 15504 (Software Process Assessment).

Peterson, W. ■ Member, Capability Maturity Model Integration Steering Group ■ member, Office of the Secretary of Defense Integrated Process Team (OSD IPT) on Equivalent Methods and Tools for CMM Maturity Level 3 ■ member, OSD IPT on Government Assisted Appraisals ■ member, DoD Common Software Appraisal Integrated Process Team.

Phillips, D. ■ Member, Capability Maturity Model Integration Steering Group.

Ryan, C. ■ Member, Boston Software Process Improvement Network (SPIN) Steering Committee ■ member, Office of the Secretary of Defense Integrated Process Team (OSD IPT) on Equivalent Methods and Tools for CMM Maturity Level 3 ■ member, OSD IPT on Government Assisted Appraisals.

Siviy, J. ■ Member, International Council on Systems Engineering (INCOSE) Measurement Working Group.

Smith, D. ■ Chair, Steering Committee, International Workshop on Computer-Aided Software Engineering (IWCASE) ■ case study co-chair, 2001 International Conference on Software Engineering (ICSE 2001) ■ member, Program Committee, 2001 Association for Computing Machinery Special Interest Group on Systems Documentation Conference (SIGDOC 2001) ■ member, 2001 Program Committee, Working Conference on Reverse Engineering (WCRE).

Waclo, J. ■ Member, IEEE Nuclear Power Engineering Committee (NPEC) ■ member, IEEE NPEC Subcommittee 6 ■ member, NPEC Working Group 6.4.

Weinstock, C. ■ Member, International Federation for Information Processing (IFIP) Working Group 10.4 on Dependable Systems and Fault Tolerance ■ organizer, IFIP Working Group 10.4 Winter 2002 meeting ■ publicity chair, 2001 International Conference on Dependable Systems and Networks ■ member and local co-arrangements chair, Organizing Committee for the 2002 International Conference on Dependable Systems and Networks.

Zubrow, D. ■ Member, Data Analysis Center, Software Steering Group ■ member, DoD Measurement Initiatives Working Group ■ reviewer, National Science Award Grants for Ireland ■ reviewer, *Wiley Encyclopedia on Software Engineering* ■ member, Program Committee, 2001 Workshop on Software and Performance (WOSP 2001) ■ member, Program Committee, IEEE Seventh International Symposium on Software Metrics (Metrics 2001) ■ member, Practical Software and Systems Measurement (PSM) Technical Steering Group.

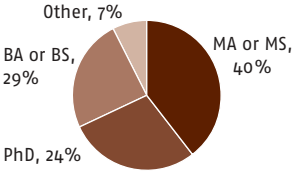
Technical Staff Demographics

The SEI's most valuable resource is its personnel. SEI staff members include members of the technical staff, support staff, resident affiliates, and visiting scientists.

Resident affiliates are personnel from industry or government who come to the SEI as members of the technical staff, at their organizations' own expenses, to work at the SEI for one to two years. Visiting scientists are temporary employees from industry, academia, or government.

Technical staff members have, on average, 22 years of software engineering experience. Most have master's degrees or greater.

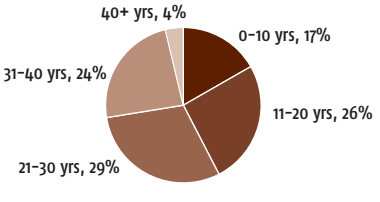
Education Profile



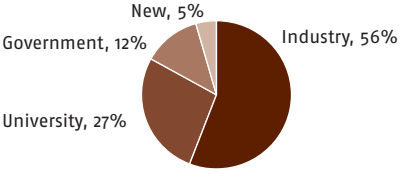
Total number of employees: 323

54	0–10 years
83	11–20 years
97	21–30 years
77	31–40 years
12	41–50 years

Years of Experience



Previous Affiliation



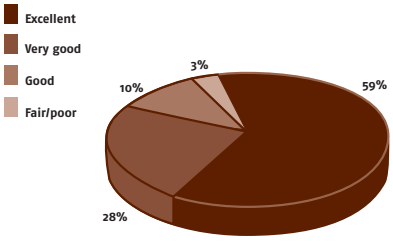
Dissemination Activities

A primary goal of the SEI is to expand the body of knowledge of the software engineering community. The SEI pursues this goal in many ways, such as publishing research reports, writing books and journal articles, speaking at conferences, and providing Congressional testimony. The institute frequently receives acclaim for its publishing efforts (see sidebar).

The SEI's dissemination activities are detailed in the following sections.

Above: *Congressman John P. Murtha (PA) spoke at the SEI Software Engineering Symposium in 2000.*

Conferences Presented by the SEI



More than half of all attendees at SEPG 2001 rated the conference "excellent."

An article by R.L. Glass and T.Y. Chen in the *Journal of Systems and Software 59 (2001)* rates Carnegie Mellon/SEI the number one institution for publishing scholarly articles in the field of systems and software engineering. This is the fourth consecutive year that Carnegie Mellon has achieved this rating, largely on the strength of the SEI's publishing activities.

"Carnegie Mellon University (CMU) once again tops the list this year," the authors write. "CMU passed the perennial leader, Bell Labs (Lucent) three years ago...CMU's score includes that for the Software Engineering Institute, which is located at CMU (that is not new in the study this year, but it does account for higher scores over the years than would have been achieved by CMU alone)." The article, "An Assessment of Systems and Software Engineering Scholars and Institutions (1996-2000)," is the eighth in an annual series in the journal. It includes five years of data and is based on frequency of publication in the following leading journals:

- *Information and Software Technology*
- *Journal of Systems and Software*
- *Software Practice and Experience*
- *Software (IEEE)*
- *Transactions on Software Engineering and Methodologies (ACM)*
- *Transactions on Software Engineering*

Software Engineering Process Group Conference

The Software Engineering Process Group Conference (SEPG) is the premier international conference and exhibit showcase for process professionals who champion the systematic improvement of people, process, and technology at their organizations. This four-day event, which was held in New Orleans in February 2001, brought together international representatives from government, industry, and academia to provide a global perspective on software process improvement results and activities, such as building quality products on cost and on schedule, and establishing and maintaining continuous improvement efforts.

SEPG 2002 was held Feb. 18–21, 2002, in Phoenix, AZ. SEPG 2003 will be held Feb 24–27, 2003, in Boston, MA.

European Software Engineering Process Group Conference

The European Software Engineering Process Group Conference (E-SEPG), a joint initiative between the SEI and the European Software Process Improvement (ESPI) Foundation, brings together European software process improvement practitioners and industry leaders to discuss current best practice and industry results. The conference provides a forum in which practitioners can share experiences with their peers in Europe regarding productivity gains in software development through the adoption of software process improvement. It provides guidance, inspiration, and real-world experience reports, demonstrating current thinking and proven techniques for improving quality, productivity, and predictability in software projects.

The sixth annual E-SEPG was held June 11–14 in Amsterdam, The Netherlands, and drew 419 attendees from 31 countries and 235 companies. In 2000, 381 people attended the event.

The next E-SEPG conference will be held April 9–12, 2002, in Amsterdam.[55]

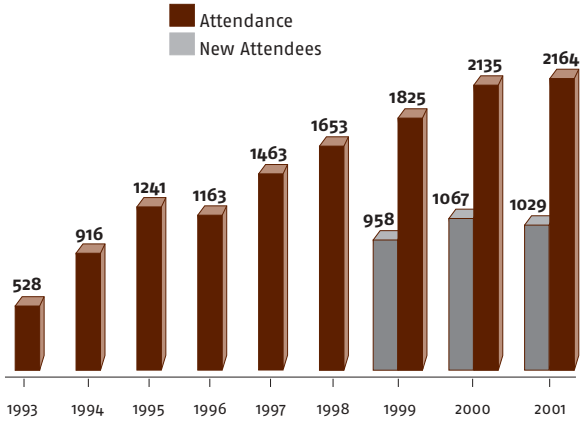
Software Product Line Conference

The SEI held the first Software Product Line Conference (SPLC1) in Denver, CO, the week of Aug. 28–31. There were 185 participants from North America (the United States and Canada), Europe (eight countries), Asia, Africa, and Australia. Most attendees came from commercial organizations, but academia and government (especially through government contractors) were also well represented. Corporations recognized as leaders in the field of software product lines were represented, including Hewlett-Packard, Nokia, Philips, Bosch, Lucent, Avaya, Cummins Engine, Motorola, Ericsson, Thomson, and General Motors.

The conference program included 10 tutorials, seven workshops, a keynote presentation, two panels, 27 technical paper presentations (59 papers were submitted), and an event called the "Software Product Line Hall of Fame," for which participants nominated the software product line elite. Inductees were A7 Avionics, CelsiusTech SS2000, Hewlett-Packard Owen Printer Product Line, and Nokia mobile cell phones.

The second Software Product Line Conference (SPLC2) is scheduled for Aug. 19–22, 2002, in San Diego, CA.

Right: *Attendance at SEPG has continued to climb as more and more industry leaders make a commitment to process improvement.*



SEI Courses

Through course offerings, the SEI helps to bring state-of-the-art technologies and practices from the research lab into widespread use by the software engineering community. The following are courses that were taught during FY2001 at the SEI's facilities in Pittsburgh, PA, and Arlington, VA, and at sites in Washington, DC; New York, NY; New Orleans, LA; San Francisco, CA; and Denver, CO. The number of offerings is indicated in parentheses.

Organizational Management Development

Consulting Skills Workshop (1)

Managing Technological Change (1)

Capability Maturity Model Integration

Intermediate Concepts of Capability Maturity Model Integration (CMMI) (4)

Introduction to Capability Maturity Model-Integrated (CMMI)-Systems Engineering and Software Engineering, V1.0, Continuous Representation (2)

Introduction to Capability Maturity Model-Integrated (CMMI)-Systems Engineering and Software Engineering, V1.0, Staged Representation (4)

Standard CMMI Assessment Method for Process Improvement (SCAMPI) Lead Assessor Training (2)

Capability Maturity Models

Introduction to the Capability Maturity Model for Software (SW-CMM) (5)

Introduction to the People Capability Maturity Model (P-CMM) (1)

Introduction to the Software Acquisition Capability Maturity Model (SA-CMM) (2)

COTS-Based Systems

COTS-Based Systems for Executives (1)

COTS-Based Systems for Program Managers (1)

Open Systems (1)

COTS Product Evaluation (4)

Software Process Improvement

Capability Maturity Model-Based Appraisal (CBA) Lead Assessor Training (1)

Continuous Risk Management (1)

Defining Software Processes (1)

High Maturity Practices of Software Organizations (1)

Implementing Goal-Driven Software Measurement (1)

Introduction to Personal Software Process (1)

Managing Personal Software Process (PSP)-Trained Engineers (1)

Managing Software Projects with Metrics (1)

Mastering Process Improvement (1)

Personal Software Process (PSP) for Engineers I: Planning (1)

Personal Software Process (PSP) for Engineers II: Quality (1)

Personal Software Process (PSP) Instructor Training (1)

Software Capability Evaluation (SCE) Lead Evaluator Training (1)

Statistical Process Control (SPC) for Software (1)

Team Software Process (TSP) Launch Coach Training (1)

Team Software Process Executive Seminar (1)

Computer and Network Security

Computer Security Incident Handling for Technical Staff (Advanced) (1)

Computer Security Incident Handling for Technical Staff (Introductory) (1)

Concepts and Trends in Information Security (2)

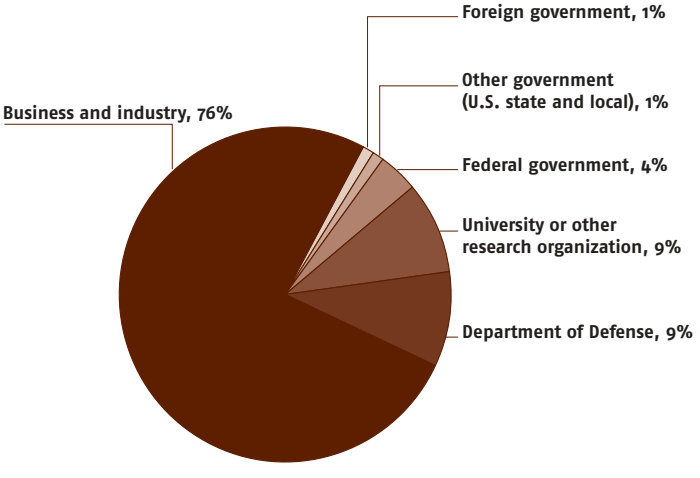
Executive Role in Information Security: Risk and Survivability (1)

Information Security for System and Network Administrators (1)

Managing Computer Security Incident Response Teams (1)

Creating a Computer Security Incident Response Team (1)

Overview of Managing Computer Security Incident Response Teams (1)



Course Attendees by Category of Organization (1,747 total attendees)

SEI-Published Reports and Other Documents in 2001

Documents published by the SEI include the following types:

- Technical reports (TRs) contribute to a specific body of knowledge by offering new technical information about a software topic, whether theoretical or applied.
- Technical notes (TNs) make publicly available peer-to-peer information about a software engineering topic, quickly, and in an abbreviated format.
- Special reports (SRs) provide information to a limited audience about software-related work, or provide non-technical information about software-related work to a general audience.
- Security improvement modules (SIMs) present a set of recommended practices that, if adopted, can help an organization improve its networked systems security in a specific problem domain.

Allen, J.; Kossakowski, K.; Ford, G.; Konda, S.; Simmel, D. ■ *Securing Network Servers* (SIM) ■ www.cert.org/security-improvement/#modules

Bachmann, F.; Bass, L.; Klein, M. ■ *An Application of the Architecture-Based Design Method to the Electronic House* (SR) ■ www.sei.cmu.edu/publications/documents/00.reports /00sr009.html

Bachmann, F.; Clements, P.; Garlan, D.; Ivers, J.; Little, R.; Nord, R.; Stafford, J. ■ *SEI Workshop on Software Architecture Representation, 16-17 January 2001* (SR). ■ www.sei.cmu.edu/publications/documents/01.reports/01sr010.html

Bachmann, F.; Bass, L.; Carriere, J.; Clements, P.; Garlan, D.; Ivers, J.; Nord, R.; Little, R. ■ *Software Architecture Documentation in Practice: Documenting Architectural Layers* (SR). ■ www.sei.cmu.edu/publications/documents/00.reports/00sr004.html

Bachman, F.; Bass, L.; Buhman, C.; Comella-Dorda, S.; Long, F.; Robert, J.; Seacord, R.; Wallnau, K. ■ *Technical Concepts of Component-Based Software Engineering (Volume II)* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr008.html

Bachmann, F.; Bass, L.; Chastek, G.; Donohoe, P.; Peruzzi, F. ■ *The Architecture-Based Design Method* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr001.html

Barbacci, M.; Ellison, R.; Weinstock, C.; Wood, W. ■ *Quality Attribute Workshop Participant's Handbook* (SR). ■ www.sei.cmu.edu/publications/documents/00.reports/00sr001.html

Barbacci, M.; Ellison, R.; Stafford, J.; Weinstock, C.; Wood, W. ■ *Quality Attribute Workshops* (TR) ■ www.sei.cmu.edu/publications/documents/01.reports/01tr010.html

Bass, L.; John, B.; Kates, J. ■ *Achieving Usability Through Software Architecture* (TR) ■ www.sei.cmu.edu/publications/documents/01.reports/01tr005.html

Bass, L.; Clements, P.; Donohoe, P.; McGregor, J.; Northrop, L. ■ *Fourth Product Line Practice Workshop Report* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr002.html

Bass, L.; Buhman, C.; Comella-Dorda, S.; Long, F.; Robert, J.; Seacord, R.; Wallnau, K. ■ *Market Assessment of Component-Based Software Engineering Assessments (Volume I)* (TN) ■ www.sei.cmu.edu/publications/documents/01.reports/01tn007.html

Bass, L.; Klein, M.; Bachman, F. ■ *Quality Attribute Design Primitives* (TN) ■ www.sei.cmu.edu/publications/documents/00.reports/00tn017.html

Bergey, J.; Fisher, M.; Gallagher, B.; Jones, L.; Northrop, L. ■ *Basic Concepts of Product Line Practice for the DoD* (TN) ■ www.sei.cmu.edu/publications/documents/00.reports/00tn001.html

Bergey, J.; Goethert, W. ■ *Developing a Product Line Acquisition Strategy for a DoD Organization: A Case Study* (TN) ■ www.sei.cmu.edu/publications/documents/01.reports/01tn021.html

Bergey, J.; O'Brien, L.; Smith, D. ■ *DoD Software Migration Planning* (TN) ■ www.sei.cmu.edu/publications/documents/01.reports/01tn012.html

Bergey, J.; Smith, D. ■ *Guidelines for Using OAR Concepts in a DoD Product Line Acquisition Environment* (TN) ■ www.sei.cmu.edu/publications/documents/00.reports/00tn004.html

Bergey, J.; O'Brien, L.; Smith, D. ■ *Mining Existing Assets for Software Product Lines* (TN) ■ www.sei.cmu.edu/publications/documents/00.reports/00tn008.html

Bergey, J.; O'Brien, L.; Smith, D. ■ *Options Analysis for Reengineering (OAR): A Method for Mining Legacy Assets* (TN) ■ www.sei.cmu.edu/publications/documents/01.reports/01tn013.html

Bergey, J.; Barbacci, M.; Wood, W. ■ *Using Quality Attribute Workshops to Evaluate Architectural Design Approaches in a Major System Acquisition: A Case Study* (TN) ■ www.sei.cmu.edu/publications/documents/00.reports/00tn010.html

Boehm, B. ■ *Spiral Development: Experience, Principles, and Refinements; Spiral Development Workshop, February 2000* (SR) (edited by W.J. Hansen) ■ www.sei.cmu.edu/publications/documents/00.reports/00sr008.html

Butler, K.; Lipke, W. ■ *Software Process Achievement at Tinker Air Force Base* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr014.html

Chastek, G.; Donohoe, P.; Kang, K.; Thiel, S. ■ *Product Line Analysis: A Practical Introduction* (TR) ■ www.sei.cmu.edu/publications/documents/01.reports/01tr001.html

Clements, P. ■ *Active Reviews for Intermediate Designs* (TN) ■ www.sei.cmu.edu/publications/documents/00.reports/00tn009.html

CMMI Product Development Team ■ *ARC, V1.0: Assessment Requirements for CMMI℠, Version 1.0* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr011.html

CMMI Product Development Team ■ *CMMI℠ for Systems Engineering/Software Engineering, Version 1.02, Continuous Representation (CMMI-SE/SW, V1.02, Continuous)* (TR). ■ www.sei.cmu.edu/publications/documents/00.reports/00tr019.html

CMMI Product Development Team ■ *CMMI℠ for Systems Engineering/Software Engineering, Version 1.02, Staged Representation (CMMI-SE/SW, V1.02, Staged)* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr018.html

CMMI Product Development Team ■ *CMMI℠ for Systems Engineering/Software Engineering/Integrated Product and Process Development, Version 1.02, Continuous Representation (CMMI-SE/SW/IPPD, V1.02, Continuous)* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr031.html

CMMI Product Development Team ■ *CMMI℠ for Systems Engineering/Software Engineering/Integrated Product and Process Development, Version 1.02, Staged Representation (CMMI-SE/SW/IPPD, V1.02, Staged)* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr030.html

CMMI Product Development Team ■ *SCAMPI℠, V1.0: Standard CMMI℠ Assessment Method for Process Improvement, Method Description, Version 1.0* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr009.html

Cohen, S. ■ *Case Study: Building and Communicating a Business Case for a DoD Product Line* (TN) ■ www.sei.cmu.edu/publications/documents/01.reports/01tn020.html

Cohen, S.; Gallagher, B.; Fisher, M.; Jones, L.; Krut, R.; Northrop, L.; O'Brien, W.; Smith, D.; Soule, A. ■ *Third DoD Product Line Practice Workshop Report* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr024.html

Comella-Dorda, S.; Wallnau, K.; Seacord, R.; Robert, J. ■ *A Survey of Legacy System Modernization Approaches* (TN) ■ www.sei.cmu.edu/publications/documents/00.reports/00tn003.html

Comella-Dorda, S.; Lewis, G.; Place, P.; Plakosh, D.; Seacord, R. ■ *Incremental Modernization for Legacy Systems* (TN) ■ www.sei.cmu.edu/publications/documents/01.reports/01tn006.html

Dunaway, D.; Seow, M.; Baker, M. ■ *Analysis of Lead Assessor Feedback for CBA IPI Assessments, Conducted July 1998-October 1999* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr005.html

Feiler, P.; Lewis, B. (Army Aviation and Missile Command); Vestal, S. (Honeywell Technology Center) ■ *Improving Predictability in Embedded Real-Time Systems* (SR) ■ www.sei.cmu.edu/publications/documents/00.reports/00sr011.html

Gallagher, B. ■ *Using the Architecture Tradeoff Analysis Method℠ to Evaluate a Reference Architecture: A Case Study* (TN) ■ www.sei.cmu.edu/publications/documents/00.reports/00tn007.html

Goldenson, D.; Fisher, M. ■ *Improving the Acquisition of Software-Intensive Systems* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr003.html

Hansen, W.; Foreman, J.; Albert, C.; Axelband, E.; Brownsword, L; Forrester, E. ■ *Spiral Development and Evolutionary Acquisition* (SR) ■ www.sei.cmu.edu/publications/documents/01.reports/01sr005.html

Hansen, W.; Foreman, J.; Carney, D.; Forrester, E.; Graettinger, C.; Peterson, W.; Place, P. ■ *Spiral Development: Building the Culture; A Report on the CSE-SEI Workshop, February 2000* (SR) ■ www.sei.cmu.edu/publications/documents/00.reports/00sr006.html

Humphrey, W. ■ *The Personal Software Process℠ (PSP℠)* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr022.html

Humphrey, W. ■ *The Team Software Process℠ (TSP℠)* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr023.html

Huy, P.; Lewis, G.; Liu, M. ■ *Beyond the Black Box: A Case Study in C to Java Conversion and Product Extensibility* (TN) ■ www.sei.cmu.edu/publications/documents/01.reports/01tn017.html

Kazman, F.; O'Brien, L.; Verhoef, C. ■ *Architecture Reconstruction Guidelines* (TR) ■ www.sei.cmu.edu/publications/documents/01.reports/01tr026.html

Kazman, F.; Klein, M.; Clements, P. ■ *ATAM℠: Method for Architecture Evaluation* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr004.html

Kossakowski, K.; Allen, J. ■ *Securing Public Web Servers* (SIM) ■ www.cert.org/security-improvement/#modules

Lopez, M. ■ *An Evaluation Theory Perspective of the Architecture Tradeoff Analysis Method℠ (ATAM℠)* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr012.html

Marz, T.; Plakosh, D. ■ *Real-Time Systems Engineering: Lessons Learned from Independent Technical Assessments* (TN) ■ www.sei.cmu.edu/publications/documents/01.reports/01tn004.html

McAndrews, D. ■ *The Team Software Process℠: An Overview and Preliminary Results of Using Disciplined Practices* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr015.html

Mead, N.; Ellison, R.; Linger, R.; Longstaff, T.; McHugh, J. ■ *Survivable Network Analysis Method* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr013.html

Meyers, B.; Feiler, P.; Marz, T. ■ *Proceedings of the Real-Time Systems Engineering Workshop* (SR) ■ www. sei.cmu.edu/publications/documents/01.reports/01 sr022.html

Moitra, S.; Konda, S. ■ *A Simulation Model for Managing Survivability of Networked Information Systems* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr020.html

Moitra, S.; Konda, S. ■ *The Survivability of Network Systems: An Empirical Analysis* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr021.html

Moore, A.; Ellison, R.; Linger, R. ■ *Attack Modeling for Information Security and Survivability* (TN) ■ www.sei.cmu.edu/publications/documents/01.reports/01tn001.html

Oberndorf, T.; Brownsword, L.; Sledge, C. (PhD) ■ *An Activity Framework for COTS-Based Systems* (TR) ■ www.sei.cmu.edu/publications/documents/00.reports/00tr010.html

O'Brien, L. ■ *Architecture Reconstruction to Support a Product Line Effort: Case Study* (TN) ■ www.sei.cmu.edu/publications/documents/01.reports/01tn015.html

Paulk, M.; Goldenson, D.; White, D. ■ *The 1999 Survey of High Maturity Organizations* (SR) ■ www.sei.cmu.edu/publications/documents/00.reports/00sr002.html

Paulk, M.; Chrissis, M. ■ *The November 1999 High-Maturity Workshop* (SR) ■ www.sei.cmu.edu/publications/documents/00.reports/00sr003.html

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The SEI published five new volumes in the series in FY2001. Most books published in the SEI Series are based on SEI work, but the series also includes some books that are based on non-SEI work that complements the SEI technical program and helps to extend the practice of software engineering. SEI and non-SEI authors largely donate their own time and energy to writing the books in the SEI Series.

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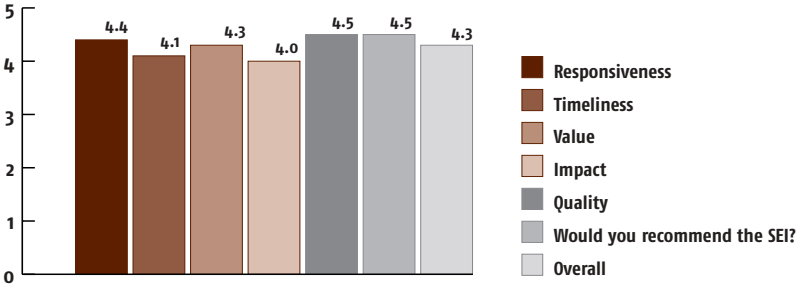
Customer Survey

Each year, the SEI and the DoD Joint Program Office ask DoD organizations that have worked with the SEI to rate the institute's work in seven categories. The chart below shows the average ratings, on a five-point scale with five being the highest, from 39 DoD organizations that worked with the SEI in FY2000 (the most recent results available).



News Conferences and Press Releases

The SEI conducted two news conferences this year. The first was to announce the launching of the Internet Security Alliance (see page 13), and the second was to discuss the problems caused by the Code Red worm.

Four press releases[61] were issued, and are summarized below.

July 24, 2001, Software Engineering Institute and Defense Acquisition University Form Strategic Partnership ■ The Software Engineering Institute (SEI) and the Defense Acquisition University (DAU) today signed a letter of intent to form a strategic partnership to improve software education and training opportunities for members of the defense acquisition workforce.

April 19, 2001, Internet Security Alliance Launched ■ A new alliance was formally launched today. The Internet Security Alliance is a response to the urgent economic security challenge posed by a growing dependence on e-commerce. The alliance aims to enhance the information security of member companies and, ultimately, the greater Internet community worldwide.

January 29, 2001, Software Engineering Institute's CERT Coordination Center Urges Organizations to Update Software ■ A newly discovered vulnerability in arguably the Internet's single most important software package threatens the Internet's integrity. On Monday, Jan. 29, 2001, the CERT Coordination Center (CERT/CC) and the COVERT Labs at PGP Security simultaneously released advisories describing serious new vulnerabilities in BIND, the most commonly used software for domain name system (DNS) servers.

August 21, 2001, Internet Security Experts in the United States and Australia Join Forces ■ The CERT Coordination Center and the Australian Computer Emergency Response Team (AusCERT) have signed a collaborative agreement to formalize their working partnership.

Media Coverage

During this fiscal year, SEI staff members participated in 449 individual interviews with members of the news media. Articles appeared in more than 100 different publications, including *U.S. News & World Report*, *The New York Times*, *The Wall Street Journal*, *Federal Computer Week*, and *The Washington Post*.

SEI staff members provided information about such topics as open-source software in government systems for *Federal Computer Week*, and the current state of software development for *Information Week* and *IEEE Software*. In July and August alone, staff members from the CERT Coordination Center participated in 86 interviews to discuss the Code Red worm with 73 different news agencies. They provided information about the worm, ranging from possible threats to local, state, and federal Web sites for *Government Technology*, to information about which home computers might be affected and how the worm could have been prevented for the *Seattle Post-Intelligencer*.

A selected bibliography of articles that resulted from interviews with SEI staff members follows.

Business Week ■ "A Chat with Worm Hunter Richard Pethia." October 23, 2001 ■ Richard Pethia discusses security breaches and viruses on the Internet in a question and answer session ■ www.businessweek.com/technology/content/oct2001/tc20011023_1269.htm

CIO.com ■ "CIO Research Reports." May 1, 2001 ■ A study by CIO.com found that the majority of those using a formal process for software development are using the Software Engineering Institute's Software Capability Maturity Model (SW-CMM). SW-CMM seems to be a relatively new but growing practice among CIO.com's site visitors ■ www2.cio.com/research/surveyreport.cfm?id=29.

Computerworld ■ "Real-Time Operating Systems." June 11, 2001 ■ New distributed-computing applications are pushing operating system developers into research and standards development. Government programs such as the DARPA's Quorum committee are at work on real-time resource management, networking, data management and middleware technologies. Quotes Mike Gagliardi of the SEI.

Computerworld ■ "Record Year for Security Breaks Expected." November 27, 2001 ■ The CERT Coordination Center at Carnegie Mellon University in Pittsburgh estimates that the number of security incidents reported this year will surpass 40,000, more than twice the number of incidents reported last year ■ www.cnn.com/2001/TECH/internet/11/26/security.reports.idg/index.html

Federal Computer Week ■ "Building a Brain Trust." April 30, 2001 ■ The Social Security Administration, alarmed by losing employees with vast amounts of expertise, chose to apply the Capability Maturity Model (CMM) to its whole software-development organization.

Federal Computer Week ■ "Worm Not Linked to Attacks." September 19, 2001 ■ Attorney General John Ashcroft says the Nimda worm is not connected to the September 11 terrorist attacks. The CERT Coordination Center began to see signs of the worm on the morning of September 18 ■ www.fcw.com/fcw/articles/2001/0917/web-worm-09-19-01.asp

Government Executive Magazine ■ "GAO Tells Pentagon to Share Software Best Practices." April 16, 2001 ■ The GAO compared the information technology practices of the two largest units within each of the department's services with Carnegie Mellon University's IDEAL℠ model ■ www.govexec.com/dailyfed/0401/041601t1.htm

Journal of Systems and Software 59 ■ "An Assessment of Systems and Software Engineering Scholars and Institutions (1996-2000)." October 15, 2001 ■ This report names the top institutions and researchers/scholars for systems and software engineering (SSE). ***CMU/SEI is ranked as the top institution for SSE.***

MenandMice.com ■ "Men & Mice Research on BIND Security Hole." March 6, 2001 ■ Results of surveys conducted by Men & Mice to measure the incidence of the vulnerability connected with BIND. Results show that only a week after the CERT announcement the number of vulnerable BIND servers has dropped down to 16.73%.

New York Times ■ "Critical Internet Software Found Vulnerable." January 29, 2001 ■ Article about CERT/CC announcement of vulnerabilities in BIND software.

New York Times ■ "Cyberspace Seen as Potential Battleground." November 23, 2001 ■ Government officials are warning that cyberattacks are likely as retribution for the United States campaign in Afghanistan. The CERT Coordination Center at Carnegie Mellon University published a memorandum outlining the nature of the new types of attacks. Quotes Kevin Houle of the CERT/CC ■ www.nytimes.com/2001/11/23/technology/23CYBE.html?ex=1007798283&ei=1&en=f1f5c63aa276f8e2

NewsFactor Network ■ "Hack Attacks Become Deadlier: Is There a Defense?" November 28, 2001 ■ Denial-of-service (DoS) attacks overwhelm computers, Web sites and servers, and hackers are increasingly aiming them at routers, according to a recent report by the CERT/CC. Quotes Kevin Houle of the CERT/CC, references his paper on the subject ■ www.newsfactor.com/perl/story/14989.html

Pittsburgh Post-Gazette ■ "Program helps small firms turn the TIDE." March 21, 2001 ■ TIDE has helped several local manufacturing companies gain better access to technology ■ Quotes Stephen Cross of the SEI.

Register ■ "Everything you ever wanted to know about PC security." July 24, 2001 ■ States that, "Security clearinghouse CERT has published advice on how home PC users can protect themselves from the security threats posed by the Internet. For the most part the document is clearly written and provides good arguments why it is in a user's best interest to keep security patches and antiviral pro-tection up to date." ■ www.theregister.co.uk/content/55/20609.html

Time Digital ■ "The Digital Dozen: Tech's Movers and Shakers for 2001." November 2000 ■ Tom Longstaff, head of research and development for the CERT/CC, is identified as one of the "digital dozen."

Wall Street Journal ■ "Electric Fences." April 23, 2001 ■ Even small businesses need to protect their computer networks. This article describes what needs to be protected, and gives instructions about how to protect it. Quotes Larry Rogers of the SEI.

Wall Street Journal ■ "Nimda Virus Outbreak Slows For Lack Of Fresh Targets." September 19, 2001 ■ The CERT/CC, a nonprofit, federally funded group that played a major role in the joint government-industry response to the Code Red worm, is still collecting information about how wide Nimda has spread.

Washington Post ■ "Computer Worm Called More Potent Than Predecessors." September 20, 2001 ■ Chad Dougherty, an Internet security analyst with CERT, said that Nimda does not appear to damage or erase data, but it can still cause adverse effects.

References in Leading Software Engineering Publications

More than one-third of all articles appearing in *IEEE Software* this fiscal year referenced the SEI's research. Fifty-six percent of the articles published in *Crosstalk* in fiscal year 2001 referenced the SEI. Twelve percent were written by SEI authors.

Transition Partners

The SEI licenses the packaging and transitioning of improved technologies into wide use by working with developers and acquirers as well as with DoD and industry organizations that help others adopt new technology—what the SEI calls "transition partners."[62] The following list shows SEI transition partners according to the SEI technologies they provide (e.g., courses, assessment services).

CERT Coordination Center Courses

eCom Universal, Inc.
Taipei, Taiwan

Internet Security Solutions
Taipei, Tawan

Klaus-Peter Kossakowski
Telgte, Germany

Consulting Skills Workshop Course

ChangeShop, Inc.
Orlando, FL

Gateway Associates Consulting Services
Annapolis, MD

Implementing Goal-Driven Software Measurement Course

Theta Information Systems
Tampa, FL

Interim Profile

Process Focus Management
Algonac, MI

Introducing New Software Technology Course

Abelia Corporation
Fairfax, VA

Introduction to the Capability Maturity Model Course

3Com
INTERNAL USE ONLY

Abacus Technology Corporation
Chevy Chase, MD

Accenture
INTERNAL USE ONLY

aimware, Ltd.
Pittsburgh, PA

American Management Systems, Inc.
Fairfax, VA

European Software Institute (ESI)
NON-U.S. DELIVERY ONLY
Bilbao, Spain

First Data Corporation
INTERNAL USE ONLY

Hilbing & Associates, Inc.
Pittsburgh, PA

iNautix Technologies, Inc.
INTERNAL USE ONLY

Integrated System Diagnostics, Inc.
Pocasset, MA

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Work With DoD Software Collaborators

The DoD Software Collaborators[63] are a network of providers of software research, services, and products that help both program managers and software developers.

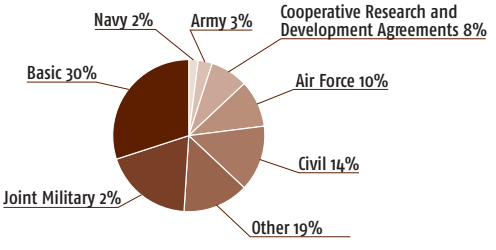
In FY2001, the SEI worked with many organizations in the DoD Software Collaborators network, including

- Aeronautical Systems Center Engineering Directorate (ASC/EN)
- The Aerospace Corporation
- Air Force Engineering and Technical Management Division (AF/AQRE)
- Aviation and Missile Command (AMCOM) Software Engineering Directorate
- Computer Resource Support Improvement Program (CRSIP)
- Defense Contract Management Agency
- Headquarters Air Force Materiel Command/Directorate of Engineering and Technical Management, Engineering Policy Maintenance Branch (HQ AFMC/ENPM)
- MITRE Corporation
- Naval Air Systems Command (NAVAIR)
- Naval Postgraduate School (NPS)
- Office of the Secretary of Defense Tri-Service Assessment Initiative
- Oklahoma City Air Logistics Center
- Open Systems Joint Task Force (OSJTF)
- Office of the Secretary of Defense Tri-Service Assessment Initiative
- Practical Software Measurement (PSM)
- Space and Naval Warfare Systems Center San Diego (SPAWAR SSC SD)
- U.S. Communications-Electronics Command (CECOM) Software Engineering Center
- U.S. Air Force Software Technology Software Center
- U.S. Army Tank-Automotive and Armaments Command (TACOM) Life Cycle Software Engineering Center
- Warner Robins Air Logistics Center, Software Engineering Division (WR/ALC-LYS)

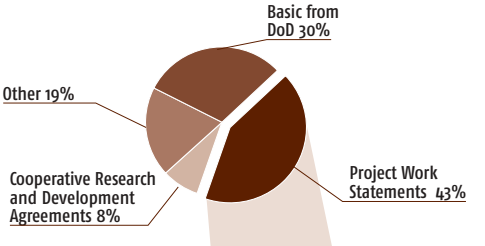
Funding for FY2001 and Support for the SEI's DoD Sponsors

The SEI received $50.1 million in funding for FY2001. The two charts below show this funding organized by funding organizations and by type of funding. A "project work statement" (PWS) is a task order from a specific government program to perform specific work. A "cooperative research and development agreement" (CRADA) is an agreement with industry and academic collaborators. "Basic" funding is funding provided by the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, the SEI's primary DoD sponsor, to execute the SEI technical program. "Other" funds come from course and conference fees, and other recovered costs.

FY2001 Funding by Organization



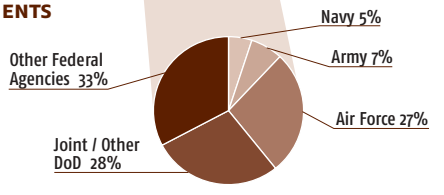
FY2001 Funding by Type



In FY2001, the SEI received $21.2 million in funding for specific projects in the form of project work statements with the armed forces or federal agencies. That funding came from the following sources:

- Navy
- Army
- Air Force
- Joint / Other DoD
- Other Federal Agencies

Project Work Statements



Abbreviations, Acronyms, and Initialisms

AF/AQRE	Air Force Engineering and Technical Management Division
AIS	Advanced Information Services, Inc.
AMCOM	Aviation and Missile Command
ASTA	Accelerating Software Technology Adoption
ASC/EN	Aeronautical Systems Center Engineering Directorate
ATAM℠	Architecture Tradeoff Analysis Method℠
CBA IPI	CMM®-Based Assessment for Internal Process Improvement
CCT	Control Channel Toolkit
CECOM	U.S. Communications-Electronics Command
CERT/CC	CERT® Coordination Center
CMM	Capability Maturity Model®
CMMI℠	Capability Maturity Model Integration
CMMI-SE/SW	Capability Maturity Model-Integrated for Systems Engineering/Software Engineering
CMMI-SE/SW/IPPD	Capability Maturity Model-Integrated for Systems Engineering/Software Engineering/Integrated Product and Process Development
COTS	commercial off-the-shelf
CRADA	cooperative research and development agreement
CRSIP	Computer Resources Support Improvement Program
CURE	COTS Usage Risk Evaluation
DD21	21st Century Land Attack Destroyer
DISA	Defense Information Systems Agency
DMSO	Defense Modeling and Simulation Office
DNS	domain name system
DoD	Department of Defense
DSIP	Defense Strategic Impact Program
DSU	Dependable Systems Upgrade
DTIC	Defense Technical Information Center
EA	evolutionary acquisition
EBS	Electronic Brokering Services
EIA	Electronic Industries Alliance
EIA/IS	Electronic Industries Alliance Interim Standard
HIPAA	Health Insurance Portability and Accountability Act
HLA	High Level Architecture
HQ AFMC/ENPM	Headquarters Air Force Material Command / Directorate of Engineering and Technical Management, Engineering Policy Maintenance Branch
IATAC	Information Assurance Technology Analysis Center
ISA	Internet Security Alliance
ITA	independent technical assessment
MBV	model-based verification
NASA IV&V	National Aeronautics and Space Administration Independent Verification and Validation Facility
NAVAIR	Naval Air Systems Command
NDIA	National Defense Industrial Association
NPS	Naval PostGraduate School
NRO	National Reconnaissance Office
OCTAVE℠	Operationally Critical Threat, Asset, and Vulnerability Evaluation℠
OSD	Office of the Secretary of Defense
OSJTF	Open Systems Joint Task Force
OUSD (AT&L)	Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics)
PAIS	Process Appraisal Information System
P-CMM	People Capability Maturity Model
PEO	Program Executive Office
PEO/SYSCOM	Program Executive Officers / Systems Command
PLP	Product Line Practice
PSM	Practical Software Measurement
PSP	Personal Software Process
QAW	Quality Attribute Workshop
SAE	service acquisition executive
S&T	science and technology
SA-CMM	Software Acquisition Capability Maturity Model
SBIRS	Space Based Infrared Systems
SCAMPI	Standard CMMI Assessment Method for Process Improvement
SE-CMM	Systems Engineering Capability Maturity Model
SEI	Software Engineering Institute
SEIR	Software Engineering Information Repository
SEPG	Software Engineering Process Group
SIM	security improvement module
SPAWAR SSC SD	Space and Naval Warfare Systems Center San Diego
SPIN	Software Process Improvement Network
SPS	Standard Procurement System
SR	special report
SRE	Software Risk Evaluation
SSEPG	Software Systems Engineering Process Group
STR	Software Technology Review
SW-CMM	Capability Maturity Model for Software
TACOM	U.S. Army Tank-Automotive and Armaments Command
TIDE	Technology Insertion, Demonstration, and Evaluation
TN	technical note
TR	technical report
TSP	Team Software Process
TTW	Technology Transition Workshop
WR/ALC-LYS	Warner Robins Air Logistics Center, Software Engineering Division

Endnotes

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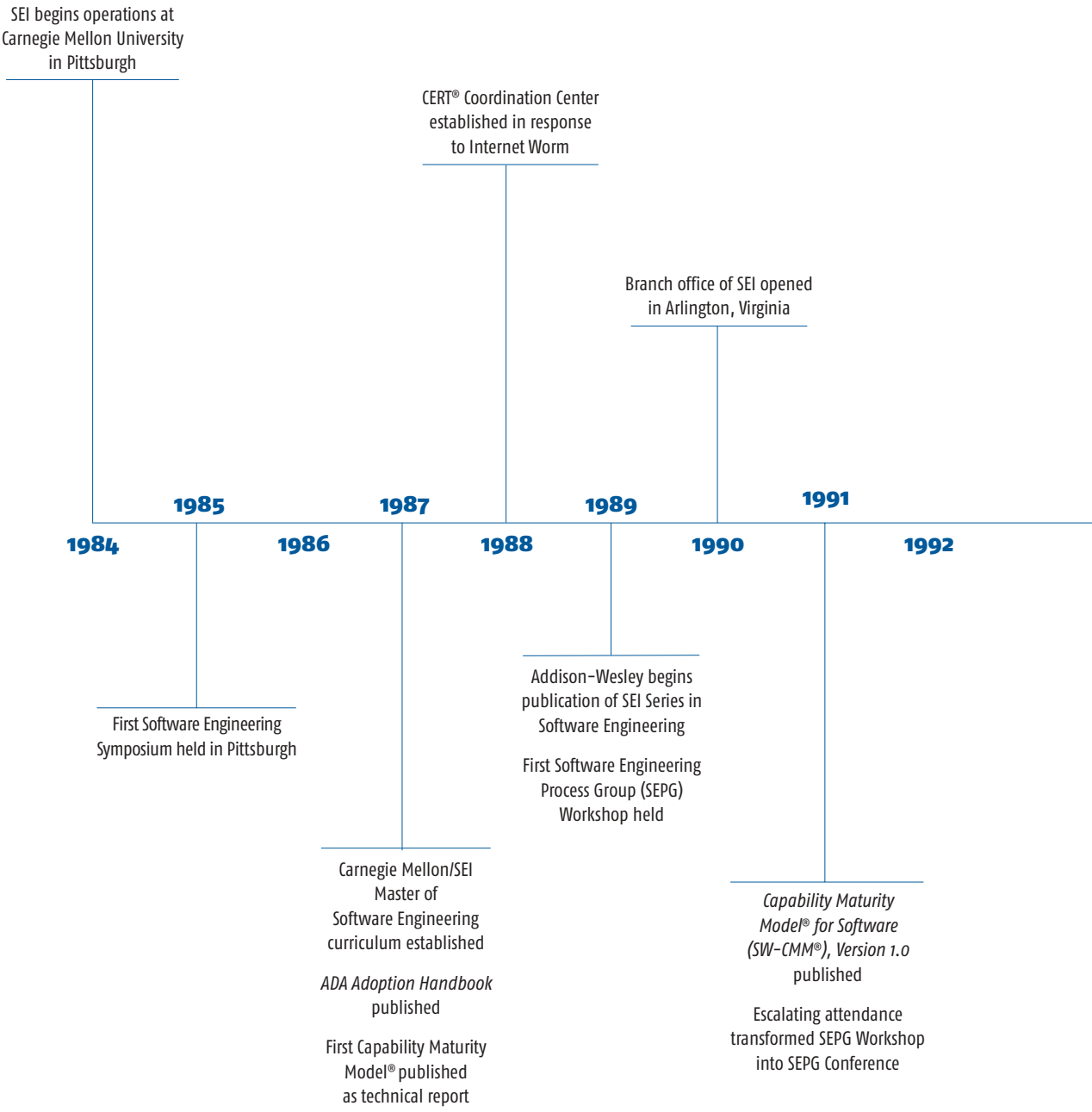

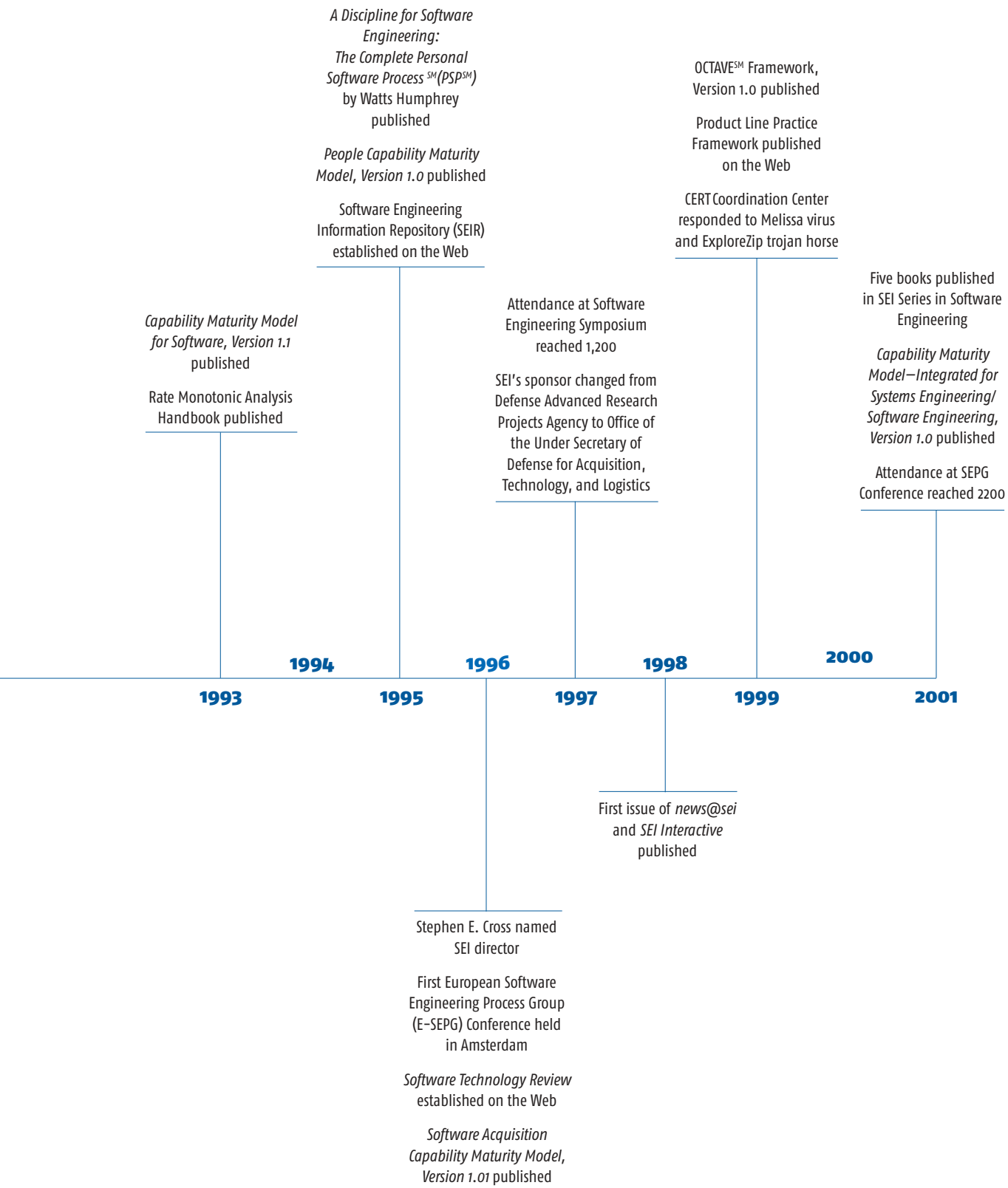
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Rate Monotonic Analysis Handbook published
A Discipline for Software Engineering: The Complete Personal Software Process SM (PSP SM) by Watts Humphrey published
People Capability Maturity Model, Version 1.0 published
Software Engineering Information Repository (SEIR) established on the Web
Stephen E. Cross named SEI director
First European Software Engineering Process Group (E-SEPG) Conference held in Amsterdam
Software Technology Review established on the Web
Software Acquisition Capability Maturity Model, Version 1.01 published
Attendance at Software Engineering Symposium reached 1,200
SEI's sponsor changed from Defense Advanced Research Projects Agency to Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
First issue of *news@sei* and *SEI Interactive* published
OCTAVE SM Framework, Version 1.0 published
Product Line Practice Framework published on the Web
CERT Coordination Center responded to Melissa virus and ExploreZip trojan horse
Five books published in SEI Series in Software Engineering
Capability Maturity Model—Integrated for Systems Engineering/ Software Engineering, Version 1.0 published
Attendance at SEPG Conference reached 2200

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13. **ABSTRACT** (maximum 200 words)

The 2001 Annual Report of the Software Engineering Institute (SEI) describes the accomplishments of the SEI during Fiscal Year 2001 (October 1, 2000 through September 30, 2001). For each of the SEI's technical initiatives, the report summarizes key research and support that the SEI provided for developers and acquirers of software-intensive systems. The report also presents information about the SEI, its staff members, and its organization, including staff accomplishments, publications, leadership positions, demographics, dissemination activities, and funding data.

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