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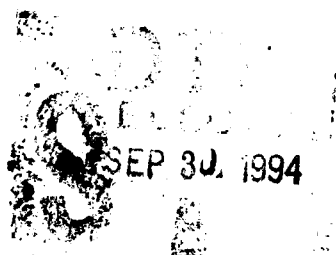
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Carnegie Mellon University  
Software Engineering Institute

# Quarterly Update



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January-March 1994

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Carnegie Mellon University  
Software Engineering Institute

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# 1Q94 Quarterly Update

■ January – March 1994

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**This report is published by the Software Engineering Institute and fulfills the deliverables for SEI-94-103-1.**

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■ SOFTWARE ENGINEERING INSTITUTE ■

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## SUMMARY OF ACCOMPLISHMENTS

This section provides a summary of accomplishments from January – March 1994.

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The SEI will host the next **Software Engineering Symposium** in August. See page 30 for additional information.

The course entitled **Introduction to the CMM** was delivered to the public. See page 1 for more details.

Version 0.2 of the **Software Risk Evaluation (SRE)** was published and has been under review by the originating Department of Defense office and other service and agency representatives since its publication. Page 21 offers more details about the SRE.

**Academic Education** project members are teaching four courses via satellite. See page 23 for details.

The **Computer Emergency Response Team** released six new advisories this quarter. See page 25 for a complete listing of the advisories.

The course entitled **Managing Technological Change** was presented to the public. Turn to page 27 for more details.

A **Technical Assistance** staff member participated in review and selection activities for the 16th International Conference on Software Engineering Tutorials Program. Page 27 offers more details.

The next **Visitor's Day** will take place on 10 November. See page 30 for further information.

As of 31 March, the SEI has signed **technical collaboration agreements** with the SEI. Table 1 on page 31 lists these organizations.

This quarter, the SEI produced 11 **technical reports** many of which are available via electronic distribution. For information on how to access these reports, turn to page 33.

## SOFTWARE PROCESS

The Software Process Program focuses on improving the process of software development. Projects within the program are assessing the actual practice of software engineering in the defense community, training organizations to gain management control over their software development processes, supporting the use of quantitative methods and measures as a basis for process improvement, and developing improved methods for software process management.

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### ■ CAPABILITY MATURITY MODEL

The Capability Maturity Model (CMM) Project maintains stewardship over a model that software organizations can use to guide improvement to their technical management processes and their software process maturity. This model is continually updated to reflect evolutions in the state of the art of software engineering, total quality management, and other relevant areas of organizational improvement. It will elaborate on software development goals and practices that provide clear strategies for software organizations to grow and improve their capability.

This quarter, the course entitled "Introduction to the CMM" was made publicly available and was delivered six times. The course is aimed at providing software process assessment and software capability evaluation teams with a working knowledge of CMM process area profiles and an understanding of the process management problems that they encounter during a site visit. The course is also valuable to software engineering process group

members who are leading software process improvements efforts.

The CMM Project and other projects within the SEI are active in the International Standards Organization's (ISO) Software Process Improvement and Capability dEtermination (SPICE) Project. The SEI has been selected as one of four technical centers for this effort and is responsible for coordinating U.S. activities. One member of the CMM Project serves as Technical Center Manager for the U. S. and is responsible for coordinating U.S. participation, helping set technical direction, and establishing schedules for the SPICE project. Currently, more than 50 individuals from more than 30 companies are involved in writing and/or reviewing the various SPICE standards and

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guide books. Another member of the project is convener of Task Group 10 for the U.S. Technical Advisory Group to ISO SC7, the subcommittee that has authorized SPICE to develop the draft standard. Through these two modes of involvement, the CMM Project is playing an active role in helping to ensure appropriate U.S. representation in the SPICE standardization effort and increasing U.S. participation in and awareness of the SPICE effort.

## ■ EMPIRICAL METHODS

The Empirical Methods (EM) Project develops, evaluates, and validates products (e.g., questionnaires, methods, and models) for use in baselining and measuring software process improvement. EM staff members manage the software process database and generate periodic reports on the status of software process maturity and results of software process improvement.

During the first quarter, major efforts were directed at completing the capability maturity model (CMM) v1.1-based maturity questionnaire, completing development of and commercializing the instant profile appraisal method, growing and enhancing the SEI software process database, and conducting an empirical study on the actual results of investments in software process improvement.

The CMM v1.1-based maturity questionnaire underwent its final technical reviews this quarter. Drafts of the material that will accompany the questionnaire as a stand alone product were also produced. The

questionnaire is expected to be available in the spring of 1994.

Instant profile is a supplemental appraisal method used to rapidly check software process improvement between software process assessments. Data collection for this method relies heavily on a variant of the CMM v1.1-based maturity questionnaire. Work on the commercialization of the method is ongoing.

The SEI software process database continued to gather data on the process maturity of software organizations. The database now houses reports from over 286 software process assessments, 11 instant profiles, and several alternative appraisal methods. An update to the community maturity briefing, which was presented at the 1993 SEI Symposium, was drafted.

EM project members and members of the Software Process Measurement Project are working on a study of the results of software process improvement. A presentation based on this work was developed and will be made at the Software Engineering Process Group National Meeting in April. This work marks the beginning of a larger effort to validate the CMM and document the benefits of investing in software process improvement.

Other efforts within the SEI that are supported by EM project members include a market survey and analysis of software process assessment stake holders, questionnaire design work for the Joint Program Office and Risk Program, development of the CMM-Based Appraisal internal process improvement method, and technical work on the leadership through

quality customer value determination method.

## ■ SOFTWARE PROCESS MEASUREMENT

The objective of the Software Process Measurement (SPM) Project is to promote and improve the use of measurement in managing, acquiring, and supporting software systems. The project is formulating reliable measures of the software development process and products to guide and evaluate development. To expedite Department of Defense and industry transition, the project is actively working with professionals from industry, government, and academia in encouraging organizations to use quantitative methods to improve their software processes.

This quarter, a meeting was held with the SEI Measurement Steering Committee (MSC). The focus of this meeting was to review and discuss the new SEI course, "Engineering an Effective Software Measurement Program." In general, the course materials were well received and MSC members felt that this course would be a valuable contribution to the software community.

During this quarter, project members completed an internal product review, a course pricing review, a project dry-run, a final dress rehearsal, and the first offering of the course, "Engineering an Effective Software Measurement Program." Several project members served as the instructors for the first on-site offering of the SEI measurement course and a video presentation was developed for use in the

course by a former resident affiliate from Siemens Corporate Research.

Members of the project also delivered a presentation at the MITRE Software Engineering Economics Conference in Virginia and conducted a full-day tutorial on "Engineering a Software Measurement Process for Your Organization" at the Association for Computing Machinery Computer Science Conference in March.

This quarter, the project leader presented a briefing at the Pentagon to the Deputy Assistant Secretary, Communications, Computers, and Support Systems, Department of the Air Force, regarding the current thrusts of SEI software measurement activities, activities the SEI could undertake to better support national initiatives, and ways in which the SEI could better assist the software community in adopting measurement practices, principles, and processes.

SPM staff and members of the Empirical Methods Project completed case study write-ups in support of the task for obtaining results of software process improvement efforts from industry and government organizations. These case studies will be used in the development of a technical report summarizing the study of organizational process improvement efforts.

## ■ SYSTEMS ENGINEERING CAPABILITY MATURITY MODEL

The Systems Engineering Capability Maturity Model (SECMM) Project was instituted in August 1993 in response to industry requests for assistance in

coordinating and publishing a model analogous to the Capability Maturity Model (CMM) for Software for the systems engineering community.

The SECMM Project will continue through December 1994 and has the following goals:

1. To provide a prototype SECMM and an associated assessment method that support improvement of system engineering processes and provide an industry-wide frame of reference for the assessment of system engineering capabilities.
2. To avoid conflict between the CMM for Software, other related standards, and the SECMM.

These goals will be refined and elaborated by the SECMM steering group.

This quarter SECMM project members established an architecture for the SECMM by developing the semantic and syntactic guidelines for writing the model, obtaining consensus within the collaboration related to planning issues such as review processes for remote work group reviews, and establishing and testing the communications infrastructure for the remote work groups.

The project master plan, which delineates the processes used and the roles and responsibilities for the project, was released in March. In addition to its role in helping to guide the process of developing the model, the plan could be used by other similar collaborations as a guide for key processes related to remotely-distributed project work groups.

Accomplishments of the first quarter of 1994 include the documentation of the SECMM requirements, establishment of the SECMM development architecture, selection of a set of candidate key process areas (KPAs), and writing of the first draft KPA descriptions and base practices. Two author meetings and one steering group meeting were held in the first quarter of 1994, and several community events were attended where project information was shared with interested parties. Also this quarter, a National Council on Systems Engineering Capability Assessment Working Group meeting was held. This meeting was supported by SECMM project members.

## ■ PROCESS RESEARCH

The Process Research Project investigates the factors that limit software development performance by conducting research on the use of software process principles by individuals and small teams. This research seeks insight into the processes, tools, and methods that will be most helpful in improving the performance of software engineering professionals and their organizations.

While early results indicate that the methods developed by this project offer significant benefits, they also demonstrate that substantial changes will be required in both individual and management attitudes and practices. It is thus expected that adoption of the method will be slow and that long-term improvement programs will be required.

The project has completed its early research phase and is now exploring more general application of the personal software process (PSP) methods. To facilitate development of an effective transition plan, the project has established a two-track approach, one for academia and one for industry. The academic track concerns PSP introduction into university software engineering curricula. The industrial track is working with industrial software organizations to obtain early experience with the issues, problems, and benefits in using PSP principles in their work. Industrial work continued with Siemens Corporate Research in Princeton, NJ, and with Advanced Information Services Corporation in Peoria, IL.

This quarter, work progressed with Digital Equipment Corporation (DEC) on introducing the PSP methods. DEC selected several small project teams that have started the introductory PSP materials and exercises. DEC management allocated the engineers 10% of their working time to work on the PSP materials. In a meeting in February, the engineers were positive about the PSP materials and described several ways in which this work could be incorporated into their projects.

The project leader also met with an executive of Hewlett Packard (HP) Corporation who agreed to have some of the projects in his division introduce the PSP methods. The approach to be used with HP will be to conduct monthly meetings with the engineers to present the PSP materials, review the engineers' progress, and guide their further work. HP will assign a process specialist to support this work.

With the addition of DEC and HP, the PSP development work on industrial transition is adequately established and no further partners are being sought.

The academic transition work includes courses currently being offered at McGill University, Embry-Riddle Aeronautical University, Bradley University, and Carnegie Mellon. Each of these universities is providing the project with student data, which will permit continuing studies on the value of the PSP methods and will facilitate the further development of transition materials.

#### ■ CAPABILITY MATURITY MODEL BASED APPRAISAL

The CBA project consists of the Software Capability Evaluation (SCE) and Software Process Assessment (SPA) projects. The project will maintain the current commitments of SCE and SPA, complete the Common Rating Framework (CRF), develop a common approach between the two which uses the CRF, and develop future CMM-based diagnostics using the CRF.

The mission of the CBA project is to develop, transition, and support a CMM-based appraisal architecture and selected appraisal methods that are effective vehicles for meeting the needs of the software community. This merger was brought about to better meet community needs and make more effective and efficient use of existing SEI resources.

This quarter, project members delivered SCE team training to 25 students from both government and industry. Preliminary review of critiques indicates a high level of satisfaction.

The first drafts were completed of two documents that are essential to the Internal Process Improvement (IPI) training classes--the CBA:IPI Team Member's Guide and the CRF document. The documents are being used in pilot IPI classes; several more iterations will be needed to accommodate SCE applications and incorporate feedback from the pilot IPI class.

A project member presented the CBA overview seminar at the U.S. Patent and Trademark Office (PTO) in February. The PTO will orchestrate a Washington presentation of SCE team training to serve a variety of Federal agencies.

This quarter, a project member presented material on the application of the SCE method to select vendors in the commercial marketplace to the Ford Automotive Components Group. Ford will send two teams to April team training, and the SEI will enter into an agreement to support Ford as they apply the method. If successful, additional SEI products would be brought into Ford and the whole suite would be deployed across other Ford groups.

This quarter, ten organizations were selected to perform CBA:IPI field exercises. The SEI will participate on site with five of these organizations.

This quarter, a project member presented a tutorial on "SCE Preparation; The Evaluators Perspective" at the 10th National Joint Conference and Tutorial on Software Quality and Productivity.

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SOFTWARE PROCESS REPORTS  
January - March 1994

*A Survey of Commonly Applied Methods for  
Software Process Improvement*  
CMU/SEI-93-TR-27

*Process Guide for the Domain-Specific Software  
Architectures (DSSA) Process Life Cycle*  
CMU/SEI-93-SR-21

*Instant Profile: Development and Trial of a  
Method to Measure Software Engineering  
Maturity Status by Whitney, et al.*  
CMU/SEI-94-TR-4

*Software Capability Evaluation (SCE), Version  
2.0, Implementation Guide*  
CMU/SEI-94-TR-5

## PRODUCT ATTRIBUTE ENGINEERING

The objective of this focus area is to increase predictability and reduce technical risk in the development of software-intensive systems. The approach is to develop and demonstrate methods and tools for analyzing, predicting, and ensuring quality attributes of software-intensive systems.

In the past, the Real-Time Distributed Systems Program concentrated on "point solutions" addressing selected quality attributes, such as efficiency (rate monotonic analysis, Hartstone benchmark) and maintainability (Serpent user interface management system, structural models). The SEI is now addressing applications in which additional quality attributes such as reliability and portability are important. Future activities will also address metrics and tradeoffs between multiple quality attributes.

### ■ OPEN SYSTEMS ARCHITECTURES

The Open Systems Engineering Project includes three major efforts:

- Standards activities that aim at securing a set of open standards for mission-critical systems with real-time and dependability requirements.
- A software architecture based on open system components that is designed to enable mission-critical systems to be safely upgraded without having to shut them down and in spite of design and implementation errors in new software.
- Education for program managers about the promises and pitfalls of using open system standards, and workshops for practitioners on state-of-the-art real-time and fault tolerant technology.

Major activities in the standards arena are the development of a real-time distributed systems communication interface and the development of a new high-performance network standard for the U.S. Navy based on the asynchronous transfer mode (ATM) standard.

This quarter, project members supported the Institute of Electrical and Electronic Engineers (IEEE) Portable Operating System Interface (POSIX) IEEE P1003 project. Project members work with the Real-Time

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Distributed Systems Communications Working Group (P1003.21), which is developing standards for the real-time domain. Project members are chair and technical editor for this group. As part of this effort, a requirements document has been developed and the IEEE has requested permission to publish as part of its Emerging Practices Series.

As part of the paradigm shift to open systems, there is concern that application developers may not have visibility into the performance of implementations of standards. There is therefore concern that the integration of applications with implementations of open standards may have performance problems that cannot be identified until system integration. To minimize risk in the application of open system components, particularly in time-critical domains, project members have developed a set of *schedulability metrics*. These metrics would provide applications with behavioral knowledge of an implementation, without a vendor having to expose detailed design. The P1003.21 working group is investigating ways of standardizing schedulability metrics, and is working with a major vendor to perform a pilot application of their use.

Project members continue to work in the area of formal description techniques in association with the POSIX effort. They are working with the newly-formed American National Standards Institute X3J21 committee to support the development of the U.S. position on the Z language.

In January, project members attended the High Performance Network Working Group meeting in San Diego and participated in the

requirements and available technologies subgroups. The ATM study, which is sponsored by Next Generation Computing Resources, has been making progress on many fronts. First, objectives and strategies to support real-time traffic on ATM have been made explicit. Second, the first level of hardware changes that would be required on ATM switches to support real-time traffic have been drafted. Project members have also begun investigating the impact of these changes on buffer sizes in ATM switches and end-to-end latencies seen by application traffic. Finally, a paper that investigates the cascading effect of jitter and its schedulability impact in ATM networks has been completed.

The current version of the uniprocessor demonstration has generated interest in many forums. The project has now received invitations from a majority of national conferences dealing with real-time and dependability issues. The existing prototype has been demonstrated to many visitors to the SEI, including the president of Texas Instruments Defense Electronics Group; the chief of the Navy's information systems; and the program manager from the National Institute of Standards and Technology (NIST) Advanced Technology Program (ATP). NIST has expressed strong interest in transitioning this technology to the industry sector.

The design of the project's application software architecture for the distributed version of the demonstration of fault-tolerant real-time systems is nearly complete. Both high- and low-level requirements were identified and documented. The interfaces to many modules—including the key modules of interprocess communications, replacement unit, and many support modules—have been

completed. In addition, prototyping of key modules has begun, and many support modules have been implemented. The design of the hardware voting box has been completed and a circuit design is currently in progress. Design of the replacement unit modules and high-level manager modules of the simplex architecture is continuing.

The two major activities of education are the development of a course for program managers on the use of open standards (discussed on page 7) and the technology exchange workshops for researchers and practitioners.

The project was invited to give a presentation and demonstration at International Conference on Reliability and Quality in Design and the International Workshop on Configurable Distributed Systems.

#### ■ ENGINEERING MATURITY MODEL

This effort focuses on the development of an engineering maturity model (EMM) to complement the capability maturity model (CMM). While the CMM aims to stimulate the evolution of organizations to a continuously improving, controlled state, the EMM seeks to stimulate the evolution of product engineering practices used to predict and control properties of software artifacts. The CMM is typically used to evaluate the maturity of organizations; the EMM will be used to determine how practices can best be improved to gain better predictability and control over properties of software systems.

During the next quarter, EMM project members will be investigating the utility of

the EMM concept for a specific property of software, namely software performance. The goal is to develop a framework that can provide guidance for using, assessing, and improving the knowledge base that underlies performance engineering practice. An initial step in developing this framework is to survey the practitioner community to determine current best practice and uncover common problem areas in performance engineering. Project members are working with the Risk Program to develop a questionnaire in the spirit of the risk taxonomy-based questionnaire. A first draft of the questionnaire has been developed and will be piloted within the SEI.

#### ■ ADA 9X REVIEW

The SEI is supporting the revision of the Ada programming language in a variety of ways. One member of the technical staff is a participant in the Ada 9X Distinguished Reviewers Group, which is responsible for reviewing the ongoing revision work. This group meets periodically to review the progress of the revision. Another staff member chairs the Ada Compiler Validation Capability Review Team, which is responsible for reviewing the direction and content of the test suite that will be used to validate Ada 9X compilers. The SEI also supports outside experts who participate in the Ada 9X effort as distinguished reviewers and as Ada Compiler Validation Capability Review Team members. Finally, the SEI provides electronic mailing facilities to the Ada 9X project and to the Ada Joint Program Office, facilitating communication among the

various groups interested in the Ada standard and its revision.

This quarter, meetings of both review groups were held, and documents pertaining to the efforts were reviewed. Comments on the draft standard were reviewed at an international meeting.

Approval of the standard is expected in December 1994.

#### ■ SOFTWARE ARCHITECTURE ATTRIBUTE ENGINEERING

Traditionally, designers achieve non-functional qualities of the systems they design through *ad hoc* techniques. There is no systematic method for analyzing a design at an early stage to determine the quality of the resulting system. The goal of the Software Architecture Attribute Engineering Project is to develop quantitative methods for analyzing and predicting important qualities from software architectural description. The project is initially focussing on the qualities of modifiability and efficiency.

This quarter, the project began work on establishing a training simulator testbed to be used both to explore simulator design issues and to test and validate models for predicting efficiency and modifiability.

Exploratory work on the foundations of software architecture also continued this quarter. Project members prepared a tutorial on the architectural basis for evaluating user interface tools, to be given at the Computer Human Interaction Conference in April. Project members also prepared several papers, which will be presented at the

International Conference on Software Engineering in May.

#### ■ TRANSITION MODELS

The Transition Models (TM) Project integrates technology transition research and best practice into frameworks and develops planning tools and assessment instruments for:

- Change agents who help organizations adopt new software engineering technology.
- Researchers and new product developers.

Transition Models products are based on research and experience (including tacit know-how) in technology transition, integrated and synthesized for use by the software engineering community. TM strategies include information dissemination and outreach (workshops, colloquia, courses), partnerships (co-development and co-evolution of materials), and the development of pull capability (working with technology receptors, especially software engineering process groups (SEPGs)). The ultimate goal is concurrent software technology transition: near-simultaneous technology creation, adoption, and application.

A TM project member attended a meeting of the Council of Consortia Technology Transfer Committee held jointly by Semiconductor Research Corporation and Microelectronics Corporation of North Carolina in February.

Project members presented a paper "From Theory to Practice: Technology Transition at

the SEI," at the International Conference on System Sciences in January.

Final analysis and documentation of findings for "Technology Transition Pull: A Case Study of Rate Monotonic Analysis (RMA) (part 2)" continues. This study reports on efforts to introduce RMA into several projects within a large software company. It describes lessons learned and success factors in the early use of the technology, including evidence in support of the "whole product" concept for technology transition. An early version of a report on the case study of RMA entitled "The Role of Infrastructure in the Adoption of an Immature Technology" was accepted for presentation at the 13th World Computer Congress, International Federation for Information Processing (IFIP) Congress '94.

Two position statements ("Beyond Mature Technology: The Whole Product" and "Using A Focus Group to Determine Requirements for Change Agent Tools") were prepared, submitted and accepted for the 4th IEEE Computer Society Workshop on Software Engineering Technology Transfer, to be held in conjunction with the SEPG national meeting. The TM project leader is also on the program committee for the workshop.

Two technical reports completed in December 1993: *Technology Transition Push: A Case Study on Rate Monotonic Analysis (Part 1)* and *A Conceptual Framework for Software Technology Transition* were made available for distribution.

*Diffusion, Transfer and Implementation of Information Technology, Proceedings of the IFIP TC8 Working Conference, Pittsburgh, PA, USA, 11-13 October 1993,* edited by a project

member, was published by Elsevier North Holland in March and includes approximately 30 contributions.

An international working group on Diffusion, Transfer, and Implementation of Information Technology, proposed by project members and participants in the IFIP Working Conference of the same name, was approved by IFIP and will operate under the auspices of IFIP Technical Committee 8 (TC8) on Information Systems.

The project leader was invited to prepare and present a paper, "The Challenge of Software and Information Technology Transfer," at the IFIP TC8 Open Conference: Business Process Re-engineering: Information Systems Opportunities and Challenges, in May 1994.

This quarter, project members travelled to Xerox to gather feedback on the use of the Transition Models process in the introduction of code inspections.

A project member delivered a briefing on "A Conceptual Framework for Software Technology Transition" to the Industrial College of Armed Forces during their visit to the SEI.

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#### PRODUCT ATTRIBUTE ENGINEERING REPORTS

January - March 1994

*An Ada Binding to the SAFENET Lightweight Application Services*

CMU/SEI-93-TR-19

This document is available via anonymous FTP. See page 33 for additional information.

*Technology Transition Push: A Case Study of  
Rate Monotonic Analysis (Part 1)*  
CMU/SEI-93-TR-29

*A Conceptual Framework for Software  
Technology*  
CMU/SEI-93-TR-31

This document is available via anonymous FTP. See page 33 for additional  
information.

# SOFTWARE ENGINEERING TECHNIQUES

The goal of the Software Engineering Techniques Program is to improve effectiveness and efficiency in engineering and reengineering of large software-intensive systems through increased use of engineering knowledge. We envision this to be accomplished through systematic application of product models supported by methods and automated by tools. The approach is referred to as model-based software engineering.

The program accomplishes this goal through four projects and through leverage of work in the Product Attribute Engineering Program. The Application of Software Models Project addresses the systematic creation of domain models and domain-specific architectures (domain engineering) and their use in building applications (application engineering) with an emphasis on reuse and product line engineering. The Software Engineering Information Modeling Project addresses issues of capturing, representing, and making accessible through computer-based support increasing amounts of engineering information ranging from requirements elicitation and system understanding to engineering knowledge typically found in handbooks. The Computer-Aided Software Engineering Environments Project focuses on automation of the software engineering processes and addresses issues of integration, interoperability, and adoption of environments. The Reengineering Center Project focuses on providing the practitioner community with a systematic approach to evolving legacy systems. It draws from the insights and results of other SEI projects, both within the program and within other programs, including Product Attribute Engineering and Risk, as well as from the external community.

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## ■ APPLICATION OF SOFTWARE MODELS

For systematic software reuse or reengineering, organizations must invest in software assets such as domain-specific software architectures (DSSA) and models. As these assets evolve, the process for developing, maintaining, or reengineering software applications will allow mapping needs to existing software solutions rather than require a synthesis activity of building from scratch. This process will center on developing applications within a product

family from a generic design founded on software and hardware architectures.

This approach to software development is a component of the Model-Based Software Engineering (MBSE) approach being

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promoted by the SEI Engineering Techniques Program. The MBSE approach establishes a framework for relating several types of models:

- Abstract models give us basic modeling concepts. They address questions such as: What is a domain model, what is an architecture, and what are the structures for reusable components?
- Concrete models apply the abstract models by adding domain information. They include the domain model of a particular class of applications, a generic design, a collection of components, and an application generator. For a specific domain, the concrete models constitute a domain-specific software architecture, as has been defined by the DSSA Program.
- Instances are the applications built upon the concrete models.

The creation of abstract models is chiefly a research and development activity. The SEI has produced abstract models such as those that form the Feature-Oriented Domain Analysis method, the Object Connection Update model, and the Object Connection Architecture model. The project also uses abstract models created by other organizations. MBSE includes a process for creating concrete models (domain engineering) and a process for using concrete models in the construction of applications (application engineering).

Project members are currently developing a set of support services, training, and documentation for organizations wishing to develop a software architectures and models competence. Project members are currently refining:

- An overview briefing describing the evolution to MBSE.
- An overview briefing on models and architectures to support design.
- A multi-day tutorial/workshop on domain analysis.

To support the development of these products, the SEI has established a Technical Collaboration Agreement with Bell Northern Research (BNR) Inc. Under the terms of this agreement, the SEI and BNR will jointly develop and pilot the training and its use within BNR. Project members have already held discussions with BNR sites at Research Triangle Park, North Carolina, and Montreal, Canada, on possible transition.

#### ■ SOFTWARE ENGINEERING INFORMATION MODELING

The Software Engineering Information Modeling Project is investigating the creation, maintenance, and use of models that are critical to software engineering. The project is conducting research into the techniques and tools that will improve a software engineer's ability to capture, represent, and access reusable software engineering information, knowledge, and models. Work continues to develop pilot technology that facilitates access to software engineering information.

Project members continue to work with the Carnegie Mellon University (CMU) Robotics Institute researchers applying CMU work in speech recognition, natural language understanding, and image understanding

technologies to aid in searching, browsing, and retrieving software engineering information from large multimedia databases.

Project members also completed a joint effort with Texas Instruments to develop multimedia engineering experience modules. The creation of these modules was based on ongoing project work to develop software engineering, multimedia, knowledge-representation techniques.

This quarter, the project leader became vice-chair for the Institute of Electrical and Electronic Engineers-Computer Society (IEEE-CS) Technical Committee on Multimedia Computing and Systems and was appointed multimedia editor for the IEEE-CS Press. The project leader was also appointed to the editorial boards of the IEEE-CS Press; the IEEE-CS magazine, *Multimedia*; and Kluwer Academic Publishers *Journal of Multimedia Tools and Applications*; and was appointed guest editor of the Association for Computing Machinery publication, *ACM Transactions on Information Systems*, 1995 *Special Issue on Multimedia Information Systems*. Also this quarter, a Software Engineering Information Modeling project member was appointed secretary/treasurer of the IEEE-CS Technical Committee on Multimedia Computing and Systems.

## ■ CASE ENVIRONMENTS

The Computer-Aided Software Engineering (CASE) Environments Project is addressing the needs of many software engineering projects by helping them to make more

effective use of CASE tools and environments. The main concerns of the project are to:

1. Engineer CASE environments from their constituent parts.
2. Evaluate different CASE environment products, strategies, and technology trends to provide predictable, measurable improvement in software development organization.
3. Adopt CASE environments into an organization in a cost-effective manner.

To address the first concern, project members continued work on carrying out leveraged experiments with representative samples of CASE environment technologies and strategies, for example:

- Project members began examining the costs and benefits of two different strategies of CASE tool integration in support of a typical reengineering scenario by taking a selection of vendor-supplied reengineering and maintenance tools and integrating them using two competing integration strategies: point-to-point using vendor-provided interfaces, and framework-based, using message passing technology.
- Detailed experiments with an implementation of the portable common tools environment have been carried out to determine the effectiveness of different strategies for its use. An example of this

effort is the completion of an experiment looking at the use of different schema design approaches and their impact on system performance.

The second concern is being addressed through a number of practical and conceptual means. This quarter, project members wrote several papers that scope the problem of evaluating a CASE environment and that suggest alternative solutions. One of these papers will be presented at the Software Technology Conference in April, and another at the Quality Software Development Tools conference in June.

The third concern is being addressed through the transition of earlier project work on developing a guide to CASE adoption through an Institute of Electrical and Electronic Engineers (IEEE) recommended practice in this area. In this quarter, a further draft of this recommended practice was developed. This draft will be discussed at an upcoming meeting of the relevant IEEE working group.

In the area of Open Systems, one project member, in conjunction with a member of another SEI project, completed a dry run of a prototype for a three-day course on Open Systems. Much of the material for this course was developed this quarter and the dry run was attended by SEI employees and selected government personnel from the Department of Defense. The audience appreciated the material and made a number of valuable comments, all of which will be incorporated into the course.

This quarter, significant progress was also made on the effort to analyze process enactment tools. A detailed analysis of a representative sample of the current process

enactment tools has just been completed. As part of this work, a visit was made to an Air Force site that is making use of this technology in a significant software maintenance situation. Following this analysis, project members are now in a strong position to provide advice on the use of these tools and their likely impact on the software development practices of an organization. Project members intend to capitalize on this work in the coming months through more detailed experiments with this technology, and through working more directly with projects planning to make use of the technology.

#### ■ REENGINEERING CENTER

The Reengineering Center Project was initiated in the fourth quarter of 1994 and has the goal of capturing and improving best practice in reengineering legacy systems. The approach is to view reengineering of legacy systems as a software engineering problem. As such, the project draws from expertise, insights, and the results of existing work at the SEI and within the software community.

Project members circulated the draft proceedings from its October workshop and are now preparing the proceedings for public release. A follow-up workshop is being planned to take place in May. This workshop will start with the issues identified by the October workshop and will present an initial agenda for the Reengineering Center, seek additional community input, and present selected issues for more follow up at some of the working sessions.

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SOFTWARE ENGINEERING TECHNIQUES  
REPORTS

January - March 1994

*Exploring Hypermedia Information Services for  
Disseminating Software Engineering  
Information*

CMU/SEI-94-TR-3

This document is available via anonymous FTP. See page 33 for additional  
information.

*A Practical Guide to the Technology and Adoption  
of Software Process*

CMU/SEI-94-TR-7

This document is available via anonymous FTP. See page 33 for additional  
information.



# SOFTWARE RISK MANAGEMENT

The objective of the Software Risk Management Program is to improve the management of risks that arise in the acquisition and development of software-intensive systems. The projects are focusing on processes and methods that enable the acquisition and development community (managers and engineers) to make better decisions by:

- Identifying risks before they become problems.
- Communicating risks in a positive, non-threatening way.
- Resolving technical risk cost-effectively.

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## ■ TEAM RISK MANAGEMENT

The goal of the Team Risk Management Project is to establish a cooperative working environment throughout all levels of a program, thus giving everyone in the program the ability and motivation to notice and handle risks before they become problems. The project works toward its goal by developing a framework for acquisition and development that fosters cooperation and partnership through cooperative or team processes, explicit methods to structure and sustain the processes, and supporting tools to aid practitioners and managers.

The scope of this project is to develop and transition into practice a comprehensive set of software risk management products for effective support in managing the acquisition and development of large, software-intensive systems. The team risk management product set will focus on issues of modeling acquisition processes, developing team risk

management methods to support these processes, and improving communications about risk within and between government and industry program offices. The primary emphasis is on enhancing the capability of the customer and supplier to manage risks as a team in software development.

The project continues its strategic partnership with the Navy Program Executive Office for Anti-Submarine Warfare, Air Assault and Special Missions Programs. Currently two Program Executive Officer PEO(A) programs are actively installing team risk management into their programs.

This quarter, the project team completed a quarterly team review with the government

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and contractor in March. In addition, project members supported the Navy PEO(A) by participating on a special task force to review laboratory requirements.

The project team also started planning with a commercial client this quarter to introduce team risk management in a rapid development commercial environment, and presented the RTeam Risk ManagementS concept and methods to the Defense Systems Management College in the Management of Software Acquisition course in March.

## ■ TECHNOLOGY ASSESSMENT

The Technology Assessment Project (previously known as the Risk Management Improvement Project) is focused on improving the state of the practice of identifying risks in the development of software-dependent systems in the Department of Defense (DoD) industrial community and in the commercial community. The project strategy is to work in a collaborative manner with key industrial companies to develop, test, and transition risk identification methods for the development of software-dependent systems.

The first goal of the Technology Assessment Project is to make the Taxonomy-Based Risk Identification process as practical and efficient as possible. To this end, a tailorable Taxonomy-Based Questionnaire will be produced. This product will take into account the characteristics of projects being assessed, including the domain, life-cycle phase, and type of project.

The second goal of the project is to develop risk identification training material to be included in the risk identification training course for companies and appropriate third-party groups so they can apply risk identification methods, processes, and tools without the aid of SEI Risk Program personnel.

The third goal of the Technology Assessment Project is to develop and populate a risk data repository. The risk data repository will be populated initially with data collected from field tests and risk assessments conducted by the SEI and strategic partners. The data in the repository will include common risks, risk mitigating actions, results, and lessons learned. Once obtained, structured, and analyzed, the data will also yield rich information on the relationships among risks, risk causes and attributes, and relative values of risks that will, in turn, be used to support the determination of risk ordering. The risk repository will provide reliable information on what risks programs have faced for particular situations and over their lifetime, and how they dealt effectively with those risks. The repository will provide a two-way avenue of information to clients and will become more robust over time as new information is received and validated. The repository is under development and is planned for release for DoD community usage in 1995.

Project members developed the Taxonomy-Based Risk Identification training material. The first in-house delivery of the training course occurred in January and revisions are being made based upon the feedback from the training session.

Project members also developed data-gathering methods to extend the Taxonomy-Based Questionnaire (TBQ) to domain-specific areas. Work is being done with two SEI projects (the Computer Emergency Response Team (CERT) and the Engineering Maturity Models (EMM) Project) to formulate interview questionnaires to gather data on system performance and system security risks and to extend the TBQ to in-depth coverage of real-time and security domains. Initial field work with the CERT and the EMM Project will begin in the next quarter.

## ■ ENTERPRISE RISK MANAGEMENT

The Independent Risk Assessment Project broadened its scope and project title in January by becoming the Enterprise Risk Management (ERM) Project. This project assists government and acquisition activities, program management, software development, and software support managers in executing risk management within their applicable spheres of interest. This base is always associated with acquiring good software to perform tasks and to span all phases of the normal life cycle of software: concept, demonstration and validation (or Advanced Technology Demonstration), buying, development, and software support. Therefore, the principal focus of the ERM Project is aimed at the overall software acquisition life cycle.

Initial project work, performed under the project called Independent Risk Assessment, applied actual risk techniques that had been developed within the SEI Risk Management

Program to develop version 0.1 of the Software Risk Evaluation (SRE) and the conceptualization of the Independent Risk Assessment (IRA) mechanism. Both techniques are based on the software risk taxonomy that was developed within the Risk Program. The fundamental difference between the SRE and the IRA is that the IRA is designed for quickly looking into a specific software project and providing a comprehensive risk profile and the associated conclusions. The SRE, on the other hand, goes beyond the risk profile findings and assists users in creating recommendations concerning found risks, developing a set of risk mitigation strategies for addressing the most important risks initially, applying resources in the most effective manner possible, and populating these strategies with specific activities that would be required to accomplish them.

Version 0.2 of the SRE was published in February and has been under review by the originating Department of Defense office and other service and agency representatives since its publication. It is anticipated that the SRE Handbook, which will be published as a technical report, will be available by July 1994.

In the continuing development of the SRE mechanism, a series of program-level test cases have been arranged throughout the community of federal government that acquires software. These SRE events, conducted under the auspices of ERM project members, have now occurred in both government and commercial software development programs and projects. This work has led program offices in the Department of Defense to request that the same SRE approach be studied for the

feasibility of modifying it for application during the actual "buying" portion of the software life cycle. This work is being sponsored by the U.S. Army and should be available for full field tests within the year.

The ERM Project has also entered into the feasibility phase of developing a predictive decision model/tool that will assist the acquisition source selection authority in the complex steps of deciding which contractor can best accomplish a program manager's goals and objectives.

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#### SOFTWARE RISK MANAGEMENT REPORTS

January - March 1994

*An Acquisition Process for the Management of  
Risks of Cost Overrun and Time Delay Associated  
with Software Development*

CMU/SEI-93-TR-28

## SEI EDUCATIONAL PRODUCTS

With the goal of helping end-users help themselves, SEI Educational Products works with other groups in the SEI to develop an integrated set of products and services for managers, practitioners, and educators. SEI Educational Products ensures that the results of SEI work are in a form that the software community can easily and effectively use to improve software practice and that educators can use to improve software engineering.

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### ■ ACADEMIC EDUCATION

The Academic Education Project focuses on the long-term development of a highly qualified work force. The project promotes and accelerates the development of software engineering as an academic discipline. The project is developing model curricula and promoting the establishment and growth of software engineering programs, as well as working to increase the amount of software engineering content in computer science programs. The project produces educational materials that support the teaching of software engineering in universities.

Project members are teaching the courses "Software Design," "Software Creation and Maintenance," "Software Verification and Validation," and "Software Construction with Ada." These courses are taught via satellite through the National Technological University and are reaching over 120 students in software development organizations nationwide. Video tapes of the courses will be available to universities and industrial organizations.

Academic Education project members assisted Kansas State University and SUNY-Buffalo in establishing software engineering programs.

### ■ CURRICULUM RESEARCH

In March, the project conducted two half-day faculty development workshops in conjunction with the 25th Technical Symposium on Computer Science Education, held by the Association for Computing Machinery (ACM) Special Interest Group on Computer Science Education. Approximately 20 college and university professors attended the workshops, which focussed on software requirements elicitation and software reuse.

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Also in March, the project leader was a panelist at the ACM Computer Science Conference, speaking on the issue of professional certification or licensing for software engineers.

The project published the educational materials package "Lecture Notes on Requirements Elicitation." These materials provide information for instructors who plan to introduce the subject of requirements elicitation into their software engineering or computer science courses. The package includes instructor's guidelines, student handouts, transparency masters, and exercises.

## ■ PROFESSIONAL EDUCATION

The Professional Education Project interacts with industry and government to increase the availability of high-quality educational opportunities for software practitioners and executives. The project produces video-based course materials that are designed for practitioners' in-house education, and executive offerings design for decision makers involved in improvement efforts.

The 7th Conference on Software Engineering Education was held in January. Over 20 people attended the Master of Software Engineering Heads luncheon. Two birds-of-a-feather sessions were sponsored by the Professional Education project: "Software Process Improvement: A Curriculum Proposal" and "Software Design and Architecture: Discussion of Key Educational Issues for Design Practitioners."

This quarter, the Program Committee for the 8th Conference on Software Engineering

Education was formed and the Call for Participation was produced. The conference will be held in New Orleans in the early spring.

The executive course entitled "Software Quality Improvement" was offered at the SEI in February. Also this quarter, the executive course "Software Risk Management" was presented.

The executive course "Software: Profit Through Process Improvement" was presented in March via satellite, as a National Technological University course.

A new practitioner course "Software Design" was completed this quarter. A set of courseware (videotapes and an instructor guide) was sold to Logicon. Sets of courseware for the practitioner course "Software Requirements Engineering" were sold to Sandia National Labs and Harris Corporation.

This quarter, 32 Technology Series videotapes were sold.

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## SEI EDUCATIONAL PRODUCTS REPORTS

January - March 1994

*Lecture Notes on Requirements Elicitation*

CMU/SEI-94-EM-10

This document is available via anonymous FTP. See page 33 for additional information.

## SEI SERVICES

SEI Services works with other groups in the SEI to develop, deliver, and transition services that support the efforts of SEI clients to improve their ability to define, develop, maintain, and operate software-intensive systems. To accelerate the widespread adoption of effective software practices, SEI Services works with client organizations that are influential leaders in the software community. SEI Services also promotes the development of infrastructures that support the adoption of improved practices, and transitions capabilities to government and commercial associates for use with their client organizations.

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### ■ COMPUTER EMERGENCY RESPONSE TEAM

The CERT Coordination Center was formed by the Advanced Research Projects Agency (ARPA) in November 1988 in response to the needs exhibited during an Internet security incident. The CERT charter is to work with the Internet community to facilitate its response to computer security problems involving Internet hosts, to take practical steps to raise the community's awareness of security issues, and to conduct research targeted at improving the security of existing systems.

The following advisories were released this quarter:

- CA-94:01 Ongoing Network Monitoring Attacks
- CA-94:02 Revised Patch for SunOS  
/usr/etc/rpc.mountd Vulnerability
- CA-94:03 IBM AIX Performance Tools Vulnerabilities
- CA-94:04 SunOS  
usr/ucb/rdist Vulnerability
- CA-94:05 MD5 Checksums
- CA-94:06 Writable  
/etc/utmp Vulnerability

The first advisory, released in February, was written in response to a dramatic increase in network monitoring by intruders who were capturing passwords and installing "back doors" for future access to systems. The monitoring was under way previously, but reports of the network monitoring attacks increased in a single week from a few isolated reports to indications that tens of thousands of systems may have been compromised. The advisory provided both a short-term workaround for the problem and recommendations for a long-term solution, including a discussion of one-time passwords. Follow-up activities continued throughout the quarter. Unlike most security incidents, this particular one received much media attention, and this prompted

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information requests from people who had not previously been involved with CERT.

In March, the CERT manager was one of five experts who testified at the House Subcommittee on Science Hearing on Internet Security. The purpose of the hearing was to enable the subcommittee to evaluate the status of security on the Internet today, examine measures currently available to enhance security, assess the effectiveness and degree of implementation of these measures, and identify obstacles to enhancing Internet security.

This quarter, the transition efforts of CERT members included involvement in the following conferences and meetings:

**1994 Federal Information Systems Security Educators Association Conference.** As an invited speaker, a CERT member presented "Security in the Internet: A Current Perspective." The focus was current intruder activities in the Internet and what CERT is doing to address them.

**Federal Networking Council Meeting.** The CERT manager gave brief overview of CERT and a short discussion of the packet snooping activity that led to CERT Advisory CA-94:01.

**College Symposium Series of Colby College.** A CERT member presented the talk entitled, "How Advances in Communications and Computer Technologies Have Affected the Security and Privacy of Users." The focus was on security models appropriate to Internet protection.

**Open Systems Security '94.** A CERT member, an invited speaker, presented sessions on "Understanding and Using the Internet" and

"Security Incident Planning: Resources and Responses."

**Global Networks Conference.** The CERT manager presented a talk on network security and the work of the CERT Coordination Center.

**Internet Engineering Task Force Meeting.** CERT had a representative in the Security Area Advisory Group. The CERT representative also attended the meetings of other security-related working groups.

**Forum of Incident Response and Security Teams (FIRST) Steering Committee Meeting.** FIRST is a group of 26 incident response teams; the primary focus of the meeting was to resolve membership issues. The committee also plans for the FIRST conference that will be held in Boston in the fall. A CERT member is program chair for the conference.

In the first quarter of 1994, CERT received 7,647 e-mail messages and 882 hotline calls requesting information or reporting computer security incidents.

For comparison, during the first quarter of 1993, CERT received approximately 3,450 e-mail messages; the volume of e-mail has more than doubled.

## ■ ORGANIZATION CAPABILITY DEVELOPMENT

The Organization Capability Development (OCD) function supports SEI clients' software process improvement efforts by helping them develop the capability to manage the organizational aspects of

improvement at their sites. Services include organizational assessment, vision setting and dissemination, strategic planning, transition infrastructure development, executive consulting, cross-functional team development, managing technological change, and consulting skills for software engineering process groups. The goal of the function is to provide to clients the self-sustaining capability of managing their own long-term improvement.

This quarter, the SEI course entitled, "Managing Technological Change" was presented to McClellan Air Force Base (AFB), Scott AFB, Citibank, and to the public. The public offering was attended by representatives from the SEI staff and resident affiliates. An average of twenty-five people attended each class.

The Consulting Skills Workshop was held three times this quarter, once at Scott AFB and twice for the public. The public offerings were attended by representatives from Standard Systems Center at Maxwell-Gunter AFB, Scott AFB, and Logicon, Inc. Fifteen people attended each workshop.

#### ■ TECHNICAL ASSISTANCE

The Technical Assistance (TA) function focuses activities with SEI clients who seek long-term support for their software engineering improvement efforts. Staff members provide support in planning and executing continuous improvement programs, including using business and case histories in software process improvement to illustrate benefits achieved. Also, the project

promotes and launches software process and technology improvement programs and coordinates clients' activities with the work of different SEI projects. Staff members act as a bridge to technology groups, minimizing the effort and time required to successfully transition, adopt, and institutionalize emerging technologies and methods.

Acting as Tutorials Committee co-chair, a TA staff member participated in review and selection activities for the 16th International Conference on Software Engineering Tutorials Program. More than 60 tutorial proposals were submitted as proposals; eight were selected for presentation. The conference will be held in Sorrento, Italy, in May 1994.

As a panel chair, a TA staff member participated in planning activities for the annual Software Technology Conference in Salt Lake City. Attendance is projected to exceed 2,000 participants for this April 1994 conference.

Members of TA and Program Development Division participated in an Air Force Materiel Command (AFMC) Software Engineering Process Group Workshop hosted by Tinker Air Force Base. The purpose of the workshop was to gather representatives from all AFMC Air Logistics Centers to discuss command-wide issues, compare lessons learned, and interact regarding software process improvement activities. A member of the Process program also attended to assist in discussions regarding 1994 assessment strategies, scope, and schedules.

A member of TA led an Improvement Planning Guidelines kickoff meeting with support from Software Process, Risk

Management, Organization Capability Development, and Leadership Through Quality programs to pursue interest in a generic guideline to assist customers with improvement planning activities. A first pilot of an Improvement Planning Workshop was conducted in March.

TA members completed, coordinated, and published the Software Process Improvement Roadmap. It is the product of a strategic collaboration with Hewlett Packard (HP), based on the application of software process improvement practices and the lessons learned from SEI and HP experiences.

TA members participated in the delivery of Software Risk Evaluations for Air Force, Army, and Navy customers; Software Process Definition training for an Air Force customer; Managing Technological Change training for an Air Force customers, and Internal Process Improvement training and appraisal for a commercial customer.

## PROGRAM DEVELOPMENT

The vision of the Program Development Division (PDD) is to serve customer needs by being the voice of the customer to the SEI and the voice of the SEI to the customer. The PDD mission is to understand the key requirements of SEI customers, translate these into responsive SEI program specifications consistent with the SEI mission, and facilitate the effective transition of best software engineering practice into use.

PDD accelerates the transition of new SEI software technologies and methods by disseminating information, providing mechanisms for collaboration and technology exchange, and offering customers the opportunity to participate in technical interchange meetings, workshops, and educational offerings. Efforts used to facilitate this transition include the Customer Relations information line, the subscriber program, the resident affiliate program, events such as the annual SEI Software Engineering Symposium and Visitor's Days, and distribution partners.

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The focus of the SEI subscriber program is to keep individuals abreast of current SEI course offerings, initiatives, products, and events. Since its inception in 1992, the program continues to show its commitment to the transfer of software engineering technology to SEI customers. This year, the program has attracted more than 1000 new members from industry, academia, and government. The following is a list of features and benefits that subscribers currently receive:

- A subscription to *Bridge* quarterly magazine. Through *Bridge*, subscribers learn about SEI technical work, products, and services as well as customer experiences in transitioning technology.
- The *Annual Technical Review*, which is a compendium of key technical work that the SEI performed within a given year.
- Advance notice of newly released SEI publications.
- A 10% discount on SEI technical reports through Research Access Incorporated.
- Early notification of SEI conferences and events.
- A substantial discount at the annual SEI Software Engineering Symposium.
- A complimentary copy of the *Key Practices of the Capability Maturity Model, Version 1.1* and the *Capability Maturity Model for Software, Version 1.1*, a \$125.90 value.

The \$100 annual program fee covers the entire year from the date that the subscription is activated. The fee is subject to change. Department of Defense customers receive complimentary subscriptions. The program works on an individual basis and is extended

to those with a U.S. mailing address. If you have questions about SEI work or the subscriber program, contact Customer Relations (see 33 for contact information).

Visitor's Day is hosted by the SEI three times a year to familiarize software practitioners, managers, and educators with the SEI. The next Visitor's Day will take place on 10 November. Visitors must pre-register; walk-ins will not be accommodated. Registration forms are available from Customer Relations (see 33 for more information).

The SEI will host its annual Software Engineering Symposium on 22-25 August 1994 in Pittsburgh. This year the SEI is celebrating its 10th anniversary. The theme for the symposium is 10 Years of Improving the State of the Practice. This year's industry keynote speakers will look back on the past ten years and forward to the next 5-10 years and discuss relevant issues in terms of the state of software engineering practice. The symposium also plans to have 50 exhibitors this year.

The symposium will showcase a variety of topics that are important to corporate and government organizations dependent on software engineering. For registration information, contact:

Software Engineering Institute  
Events  
Carnegie Mellon University  
Pittsburgh, PA 15213-3890  
Phone: (412) 268-6531  
FAX: (412) 268-5758

For general symposium information, contact Customer Relations (see 33 for contact information).

Table 1 reflects those organizations that have active signed technical collaboration agreements (TCAs) with the SEI. A technical collaboration is a fixed-duration, well-defined collaborative relationship between one or more SEI projects and one or more industry partners. This form of collaboration involves a mutual commitment of resources to generate a demonstrable product. Those organizations with current TCAs are listed in Table 1.

As of the end of March, the SEI has signed strategic collaboration agreements with four strategic partners. A strategic collaboration is a long-term, corporate-level relationship between the SEI and an industry organization. The relationship is characterized by a mutual statement of strategic intent and goals, and by the existence of a historical, multi-year association through resident affiliate sponsorship, masters of software engineering sponsorship, or several technical or other forms of collaboration. The current strategic partners are listed in Table 2.

Tables 3 and 4 list the organizations that sponsored resident affiliates during the first quarter of 1994.

The SEI serves as a point of contact for current and emerging Software Process Improvement Network (SPIN) organizations. Through participation in SPINs, people tap into existing SPIN organizations and learn how to start up a SPIN in a new geographic location. Tables 5 and 5 show the locations that have active SPIN organizations.

Table 1  
Organizations with  
current TCAs

|                                                |                                                                      |
|------------------------------------------------|----------------------------------------------------------------------|
| Allied Signal Aerospace                        | Process Enhancement Partners, Inc.                                   |
| Applied Software Engineering<br>Centre, Canada | Siemens Corporate Research                                           |
| Bell Northern Research                         | Software Productivity Consortium                                     |
| Computer Sciences Corporation                  | Texas Instruments                                                    |
| Harris Corporation                             | Unisys                                                               |
| Hewlett-Packard                                | Universidad Politecnica de Madrid<br>Spain                           |
| Hughes                                         | University of Southern California<br>Center for Software Engineering |
| IBM Federal Systems Company                    | Westinghouse                                                         |
| Master Systems                                 | Xerox                                                                |

Table 2  
Strategic Partners

|                 |                             |
|-----------------|-----------------------------|
| Hewlett-Packard | IBM Federal Systems Company |
| Hughes Aircraft | Texas Instruments           |

Table 3  
Industry Affiliates

|                               |                                               |
|-------------------------------|-----------------------------------------------|
| Computer Sciences Corporation | Loral Federal Systems<br>(previously IBM FSC) |
| Pacific Bell                  | SEMATECH                                      |
| GTE Government Systems        | Texas Instruments                             |
| Process, Inc.                 | Unisys CARDS                                  |
| Hughes Aircraft Company       |                                               |

Table 4  
Government Affiliates

|            |                                     |
|------------|-------------------------------------|
| Air Force: | Electronic Systems Center           |
| Other DoD: | Defense Logistics Agency            |
|            | National Security Agency            |
|            | International Government Exchange   |
|            | Applied Software Engineering Centre |

**Table 5**  
Domestic locations that have  
active SPIN organizations

|                                 |                          |
|---------------------------------|--------------------------|
| Washington, D.C.                | St. Louis, MO            |
| Colorado (Boulder and vicinity) | Huntsville, AL           |
| Southern California             | Northern Los Angeles, CA |
| Dallas/Fort Worth, TX           | Northern New Jersey      |
| Seattle, WA                     | Cleveland, OH            |
| Boston, MA                      | Phoenix, AZ              |
| Austin, TX                      | Omaha, NE                |
| Bay Area (Northern CA)          | Albuquerque, NM          |

**Table 6**  
International locations that have  
active SPIN organizations

|                  |
|------------------|
| Montreal, Canada |
| United Kingdom   |
| France           |

## ADDITIONAL INFORMATION

### ■ HOW TO ORDER SEI PUBLICATIONS

For information about purchasing SEI publications, contact one of the following organizations:

**RAI**    Research Access Inc.  
800 Vinial Street  
Pittsburgh, PA 15212  
Telephone: 1-800-685-6510,  
FAX: (412) 682-2994

**NTIS**    National Technical Information Service  
U.S. Department of Commerce  
Springfield, VA 22161-2103  
Telephone: (703) 487-4600

**DTIC**    Defense Technical Information Center  
ATTN: FDRA Cameron Station  
Alexandria, VA 22304-6145  
Telephone: (703) 274-7633

### ■ HOW TO GET ADDITIONAL INFORMATION

For information about the subscriber program and other SEI offerings, contact:

The Software Engineering Institute  
ATTN: Customer Relations  
Carnegie Mellon University  
Pittsburgh, PA 15213-3890  
(412) 268-5800  
Internet: [customer-relations@sei.cmu.edu](mailto:customer-relations@sei.cmu.edu)

### ■ HOW TO OBTAIN COPIES OF ELECTRONIC DOCUMENTS

Some—not all—SEI documents are available electronically, via anonymous file transfer protocol (FTP). Send electronic mail to [info-manage@sei.cmu.edu](mailto:info-manage@sei.cmu.edu) for information about obtaining documents via anonymous file transfer protocol (FTP) on the Internet. Be certain to include your telephone number in the event that we have difficulty contacting you by electronic mail.

