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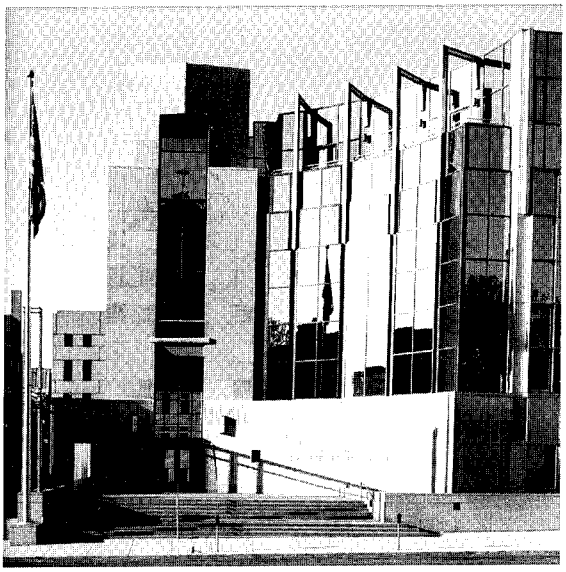
Carnegie Mellon University
Software Engineering Institute

Quarterly Update

July-September 1994



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SUMMARY OF ACCOMPLISHMENTS

This section provides a summary of accomplishments from July — September 1994.

The Software Engineering Institute (SEI) hosted its annual **Software Engineering Symposium** in August. This year's theme was "10 Years of Improving the State of the Practice." See page 30 for a summary of the events.

The **Empirical Methods Project** and the **Software Process Measurement Project**, completed a technical report on organizational gains associated with capability maturity model-based software process improvement. See page 35 for information on how to access the report, entitled *Benefits of CMM-Based Software Process Improvement: Initial Results.*

CERT[SM] staff is developing a networked information technology security taxonomy and questionnaire in collaboration with the SEI Risk Program. See page 27 for more information.

The **Process Research Project** announced the availability of a prototype personal software process "teach-the-teachers" course. The course will occur next quarter and will have a capacity of 20 students. For details about this offering, contact the SEI Customer Relations division (see page 35 for contact information).

This quarter, **systems engineering capability maturity model** (SE-CMM) workshops were held to review the content of successive drafts of the SE-CMM model description. See page 3 for details.

This quarter, the SEI reached **business agreements** for commercializing the SEI-developed SCE training. See page 5 for additional information.

This quarter, members from the Software Architecture Technology Initiative Project continued working on an **annotated bibliography** of important documented works concerning software architecture. See page 15 for details.

Software Architecture Attribute Engineering project members completed the industry review of its **structural modeling guidebook**, to be turned over by the Air Force's Aeronautical Systems Command Program Office for Simulators and Training Devices for release during the next quarter.

SOFTWARE PROCESS

The Software Process Program focuses on improving the process of software development. Projects within the program are appraising and teaching others to appraise the actual practice of software engineering in the software 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.

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, deliveries of the course "Engineering an Effective Software Measurement Program" were presented on-site for two customers. The course has been well attended and well received by the attendees. Course offerings were held at the Army Missile Command site and for the U.S. Marines at the Quantico site.

The technical report *Benefits of CMM-Based Software Process Improvement: Initial Results* was completed and distributed at the 1994 Software Engineering Institute (SEI) Software Engineering Symposium. The authors included members of the SPM and Empirical Methods Projects.

Two project members held a planning session for fiscal year 1995 with the U.S. Treasury customer in early August. In support of the continued effort with U.S. Treasury, one project member has completed a draft of quality, testing, and release measures.

The project leader chaired a measurement panel session for the 1994 SEI Software Engineering Symposium. The panelists included representatives from Hughes, Motorola, Naval Undersea Warfare Center, and the SEI. Another member of the project hosted a

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birds-of-a-feather session on cost estimating improvement at the symposium.

An SPM project member completed a draft of cost, schedule, and size estimating processes, guidelines, and templates. This project member also met with representatives of Texas Instruments and Electronic Data Systems, Inc. to provide them with information on SPM efforts to assemble guidelines, criteria, and templates and to solicit their inputs on the SEI cost estimating efforts.

Several goals were met this quarter in support of the Defense Information Systems Agency/Center for Information Management (DISA/CIM) technical objectives and plans (TO&P). Two staff members completed a draft of the technical report "The DISA Software Measurement Pilot: Lessons Learned Applying the SEI Core Measures," which was delivered to DISA in July. A customer technical review as well as an internal project technical review was held on the DISA measurement pilot technical report. A teleconference was held in August to discuss FY95 support with DISA and all of the pilot project site champions. And in September, a pilot project working group meeting was held to discuss and summarize the conclusion of the pilot project effort.

A new TO&P agreement was signed with Defense Finance and Accounting Services. An SPM project member—the leader for this new effort—held a kick-off meeting at the customer site in Indianapolis in September.

Two members of the project attended the Cooperstown II Workshop, which was sponsored by Lloyd Mosemann. One project member participated in Working Group 1, which provided an assessment of Order 1 and a set of recommendations for proceeding with an Order 2 prototype repository. The other project member participated in Working Group 3 to discuss the needs for a national center for software data and information. To follow up, a meeting is scheduled with Mosemann at the end of September to discuss SEI support for the national software initiatives.

With respect to supporting the national software data and information repository (NSDIR), an SPM staff member worked with members from Unisys in conducting phone interviews with potential NSDIR stakeholders to better understand the ways in which they might use an NSDIR and understand the issues involved in establishing a viable NSDIR. Much of the interview content was factored into the NDSIR Order I presentation at Cooperstown II. The SPM staff member also worked with Unisys personnel in July and August to construct the briefing for a Cooperstown II presentation, which outlined NSDIR strategic directions. In September, this staff member participated in a working meeting at the Unisys site in West Virginia to further define the scope of the NSDIR strategic plan and to conduct a tool analysis of MAINSTAY, an analytical tool for data analysis and presentation.

Capability Maturity Models

The Capability Maturity Models Project maintains stewardship over three capability maturity models (CMMs) that organizations can use to improve their capability to develop

and maintain systems and software products. These are:

- Software capability maturity model (CMM)
- Systems engineering capability maturity model (SE-CMM)
- People management capability maturity model (PM-CMM)

These models are periodically updated to reflect evolutions in the state of the art of software engineering, systems engineering, human resources development, total quality management, and other relevant areas of organizational improvement. In addition, the project is involved in three efforts:

- Developing guidance in tailoring each model to make it more applicable to a particular organization, market sector, and small organizations.
- Developing, delivering, and licensing training in the models.
- Participating in or leading relevant standards development efforts.

This quarter, progress was made toward planning for version 2 of the CMM and in disseminating more practical information on use of the CMM. The CMM Advisory Board selected new members and began discussion of the technical approach to be taken in the development of version 2 of the CMM. Two articles were accepted for publication: (1) changes from version 1.0 to 1.1 of the CMM (to appear in *CrossTalk*), and (2) a technical report comparing the CMM with International Standards Organization 9001 (accepted for publication in *IEEE Software*). A presentation on the project's initial plans for version 2 of the CMM was given at the Software Engineering Institute (SEI) Software Engineering Symposium.

The systems engineering capability maturity model (SE-CMM) effort was instituted in August 1993 in response to industry requests for assistance in coordinating and publishing a model analogous to the software CMM for the systems engineering community. This quarter, workshops were held to review the content of successive drafts of the SE-CMM model description. The first workshop was held in Pittsburgh in July; the second workshop took place at the Electronics Industries Association Conference in Denver in September. In preparation for the second workshop, release 2 of the SE-CMM model description was issued and for this work, one project participant received a best paper award at the National Council on Systems Engineering (NCOSE) Conference in August. Additionally, an overview of the SE-CMM effort was given at the SEI Software Engineering Symposium.

The people management capability maturity model (PM-CMM) effort is a continuation of the human resources maturity model effort. Sponsors for continuing the effort were established late in the second quarter of 1994. The purpose of the effort is to enhance the readiness of software development and information systems organizations to undertake increasingly complex applications by helping them attract, grow, motivate, deploy, and retain the talent necessary to improve their software development capability. Though targeted for the software and information systems communities, the principles and many of the practices apply equally to systems engineering. As both

the PM-CMM and SE-CMM efforts proceed, closer synergy and compatibility is expected between these two efforts.

This quarter, the PM-CMM advisory board met and provided information on best practices in their areas of expertise to help elaborate the key practices (written at a high level) in version 1 of the PM-CMM. By the end of the quarter, subpractices were written for the repeatable maturity level, and internal reviews of these began.

The project is developing guidance in how to tailor a capability maturity model to help make it more applicable to particular organizations, market sectors, and small organizations. Tailoring is needed for two reasons:

1. The degree to which processes, work products, and roles need to be formalized differs according to business need, type of domain, and nature of the organization.

2. Special concerns (e.g., reliability and security) require greater rigor in the implementation of the key process areas.

This quarter, progress was made in CMM education and course delivery. A draft instructor's guide for the "Introduction to the CMM" course was completed and the newly-developed course entitled, "CMM Train the Trainer" was piloted. This course will aid in transitioning the "Introduction to the CMM" course more broadly. A decision was made to suspend development of a CMM knowledge test to help those who are required to take the CMM introductory course—but who already have the knowledge covered by the course—qualify without having to take the course. This decision was based on the small demand for the test, the beyond-expected effort required for such a test, and the desire to focus project efforts on more mission-critical areas. The CMM Advisory Board met to discuss the content of the "Advanced CMM" course, now being planned for development in 1995.

The SEI hosted a quarterly meeting of Software Process Improvement and Capability dEtermination (SPICE) at the SEI in August. Also, the SEI continues in a leadership position both in managing the SPICE Project and in development of the SPICE baseline practices guide, whose purpose is to guide process improvement and process assessment. Project members participated in writing two drafts of the baseline practices guide and contributed to the development and trials planning for other components of the SPICE product suite. In addition, one CMMs project member has begun coordinating the trials of the SPICE products in the U.S. Another member of the Software Process Program has begun working with international colleagues to devise an appropriate plan for trial testing the full suite of SPICE products.

Also this quarter, discussions continued on how to best accomplish architectural integration of the three CMMs. Project members will plan periodic team meetings (consisting of the leaders of all three efforts developing a CMM) to discuss how the architectures across models might best be integrated. Full integration is not expected until 1996, at best, given that the different communities have taken different directions (architecturally) and also due to the timeframes of the different efforts.

Capability Maturity Model-Based Appraisal

The Capability Maturity Model-Based Appraisal (CBA) project consists of the former Software Capability Evaluation (SCE) and Software Process Assessment Projects. 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 Software Engineering Institute (SEI) resources.

The Common Rating Framework (CRF) is a framework for developing, defining, and using appraisal methods based on the SEI Capability Maturity Model (CMM). This quarter, an initial draft of a document describing the CRF was completed and sent to external reviewers for comments.

This quarter, the SEI reached business agreements for commercializing the SEI-developed SCE training. A joint agreement was reached among the SEI and Abacus Technology Corporation and the Institute for Software Process Improvement. An agreement was also reached between the SEI and Integrated System Diagnostics, Inc. The SEI will retain the basic SCE methods and frameworks, including standards, authorization, assessment and monitoring of the state of the practice. The SEI will also retain the right to conduct limited training for course development, and verification and validation as needed for prototyping, improving, and extending the underlying technology. It is anticipated that the transfer of the SCE training technology will occur over time. With the signed agreements.

This quarter, field exercises for the CBA for Internal Process Improvement (IPI) Method were conducted. CBA methods are used for appraising the software process of an organization to gain insight into its software development capability. The objectives of the exercises were to verify that requirements identified by the SEI have been met in the new assessment method and to validate that customers' needs are satisfied.

Currently, the CBA Project is incorporating lessons learned from the field exercises into the CBA IPI assessment method. CBA IPI version 1.0 is scheduled to be released during the next quarter.

This quarter, the following courses were delivered by CBA project members: SCE v2.0 Refresher Training, SCE Overview, SCE Team Training (including two on-site courses), CBA IPI Team Training, and CBA IPI Lead Assessor training.

Empirical Methods

The Empirical Methods (EM) Project works to develop methods for generating information to guide and inform decisions regarding process change and technology adoption. EM work also addresses the state of software engineering with respect to process maturity and the organizational impacts of software process improvement. Finally, EM provides empirical research expertise to other efforts within the Software Engineering Institute (SEI).

The EM project, along with the Software Process Measurement Project, completed a technical report on organizational gains asso-

ciated with capability maturity model (CMM)-based software process improvement. *Benefits of CMM-Based Software Process Improvement: Initial Results* contains general results from 13 participating software organizations and 5 case studies. A summary of the work appeared in the September issue of *American Programmer.* Plans for follow-up efforts have been developed. EM also released the special report, *Software Process Maturity Questionnaire* (MQ SR). For more information on the MQ SR, contact the SEI Customer Relations Office (see page 35 for contact information). The MQ SR is also available via FTP (see page 35 for details on how to access SEI documents electronically).

This quarter, progress was made with the CMM validation effort. The birds-of-a-feather session, held at the Software Engineering Institute (SEI) annual Software Engineering Symposium, addressed customer perspectives for validating the CMM. Representatives from government and industry attended the session which resulted in a list of issues slated to be addressed in the coming months.

The SEI continues to receive data on the process maturity of software organizations. The software process database now houses reports from over 360 software process assessments, 11 interim profiles, and 32 appraisals conducted using other methods. Development work on the database focused on accommodating results from the new CMM-based appraisal internal process improvement method and improving the data entry and reporting functions. An updated community maturity profile briefing covering 284 software process assessments conducted through the end of 1993 was presented at the 1994 Software Engineering Symposium. Work has begun on an update, which will be released in October.

This quarter, the EM Project supported the survey efforts of several other parts of the SEI. These included surveys addressing customers of SEI educational products, SEI subscribers, the students in the personal software process course, and evaluations of SEI events.

Process Research

The objective of the Process Research Project is to identify the factors that limit the performance of software development professionals by exploring 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 professionals and their organizations.

As a result of this work, the project has produced the personal software process (PSP). The project has shown that process improvement principles can be applied to the work of individual software engineers. In several university courses, student data demonstrate that the PSP helps students to substantially improve the quality of their work, while providing them a sound method for project planning and management. Students and engineers have reduced their numbers of test defects by 3 to 10 times while improving their productivity. Engineers also find that the PSP helps them to plan and manage their personal commitments.

The project continues to work with academia and industry on PSP introduction methods. The industrial track is working with several

software organizations on the issues, problems, and benefits of using the PSP in their work. The academic track is aimed at PSP introduction into university software engineering curricula.

This quarter, work continued with Digital Equipment Corporation (DEC) on introducing and using the PSP. Several teams in Nashua, New Hampshire are applying the PSP to software development and maintenance. Early results indicate that the PSP has helped them to define their work processes, make meaningful measurements, and use the results to better manage their work. DEC is now broadening PSP introduction to other divisions.

The project leader gave an additional 9 lectures in the Hewlett Packard Corporation (HP) PSP training program. From the six several exercises, the 19 experienced engineers show somewhat lower initial defect levels than the university students but comparable improvement rates. As shown in the next table, the improvement rates for the groups vary, but all are significant.

	Total Defects % Improvement		Test Defects % Improvement	
Group	Total Course	First Six Exercises	Total Course	First Six Exercises
Carnegie Mellon	60.0	56.5	88.9	6.2
Embry-Riddle Aeronautical University	73.3	33.6	62.1	12.5
Hewlett-Packard	—	56.6	—	47.5

Industrial transition work continues with the Advanced Information Services Corporation in Peoria, Illinois. The project leader visited this group in September and interviewed the engineers who completed the PSP course. They have found the PSP materials help them in planning and managing their work and in coordinating with their customers.

Because of the rapidly growing industrial interest in the PSP, the SEI will not likely have sufficient resources to train the numbers of engineers industry will require. The project is therefore offering a prototype PSP teach-the-teachers course. The objective is to enable organizations to train their own engineers. The course is planned to take place in the fourth quarter of 1994 and will have a capacity of 20 students. In the first week since its announcement, 16 slots have been reserved.

Academic transition work continues with 1994-1995 school year offerings planned at the University of Massachusetts, McGill University, Embry-Riddle Aeronautical University (ERAU), George Washington University, and Carnegie Mellon (CMU). At ERAU, the PSP course is the first required course for incoming masters students in software engineering. The University of Massachusetts now also requires the PSP as part of one of their masters in software engineering programs.

This quarter, the project leader supported two groups of students in applying what they learned from the CMU PSP course to their Masters of Software Engineering development project. Also this quarter, the project leader gave PSP presentations to the software process improvement network groups in the California Bay Area, Chicago, Los Angeles, and Irvine.

This quarter, the project leader presented the Software Process Achievement Award to the

Software Engineering Laboratory at the National Aeronautics and Space Administration, Goddard. This laboratory is jointly operated by NASA Goddard, the Computer Sciences Corporation, and the University of Maryland.

SOFTWARE PROCESS REPORTS
July – September 1994

A Comparison of ISO 9001 and the Capability Maturity Model for Software
CMU/SEI-94-TR-12

Benefits of CMM-Based Software Process Improvement: Initial Result
CMU/SEI-94-TR-13

This document is available via anonymous FTP and through the SEI Mosaic page (www.sei.cmu.edu). See page 35 for additional information.

Software Process Maturity Questionnaire
CMU/SEI-94-SR-7

ENGINEERING

Effective 1 July 1994, the Software Engineering Techniques (SET) Program and the Product Attribute Engineering (PAE) Program combined to form the Engineering Program. The Engineering Program primarily represents the focus area described as Disciplined Engineering of Software-Intensive Systems in the 1995 1&5 Year Plan [95 1&5]. The SET part of the Engineering Program is focused on identifying, developing, evaluating, and transitioning technologies for architectures and domain models for software-intensive systems. The PAE part of the Engineering Program is focused on identifying, developing, evaluating, and transitioning technologies to predict and control the quality attributes of software-intensive systems.

The goal of the Software Engineering Techniques part of the program is to improve effectiveness and efficiency in engineering and reengineering of large software-intensive systems through increased use of engineering knowledge. This will 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. This goal is accomplished through four projects and through leverage of work in the PAE part of the 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 Software Engineering Institute (SEI) projects, both within the program and within other programs, including the PAE and Risk Programs, as well as from the external community.

The objective of the PAE (or Real-Time Distributed Systems) part of the program, 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.

This part of the program consists of several projects. The Software Architecture Attribute Engineering Project deals with architectural attributes and has a strong focus on flight

simulators. The Open Systems Engineering Project addresses open systems issues as well as dependable, flexible software architectures (Simplex). The Engineering Maturity Model (EMM) Project focuses on the instantiation of the EMM in the context of performance engineering. The Transition Models Project focuses on models of technology transition and their realization in transition planning. The Ada 9X Review Project is a customer-sponsored effort to facilitate the community review of revisions to the Ada programming language, referred to as Ada 9X.

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.

Application of Software Models

For systematic software reuse or reengineering, organizations must invest in software assets such as domain-specific architectures 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 development 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 promoted by the Software Engineering Institute (SEI) Engineering Program. The MBSE approach establishes a framework for relating several types of models:

- Abstract models give us basic modeling concepts. These 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

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concrete models constitute a domain-specific software architecture, as has been defined by the Domain-Specific Software Architecture (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 (FODA) 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.

The project is now working to transition the domain engineering approach piloted and documented over the last several years.

Project members have created an interactive document available through the SEI Mosaic page (`www.sei.cmu.edu`). This document describes the principles of domain and application engineering and illustrates their use within the Army movement control domain. In addition, it contains an animated demonstration of an application built using the domain engineering approach.

Project members are completing a new version of the domain engineering training course. This course will cover the fundamentals of domain analysis through a FODA tutorial. The course will also provide a comprehensive exercise to reinforce the understanding of the methods. Customers wanting to initiate a domain analysis pilot project will have a facilitated workshop that builds a "quick start" domain model.

Over the past five years, the project has produced a series of reports on the domain analysis method. Project members are now developing a FODA guidebook to provide step-by-step procedures for developing each of the models.

Project members continue to support several technical objectives and plans (TO&P) customers and to work with resident affiliates. These efforts include domain analysis and domain engineering support. The project has also begun a new effort with the Electronic Systems Center (ESC). Under that TO&P the project will:

- Lead an effort to define product lines developed at ESC.
- Support the Central Archive for Reusable Defense Software (CARDS) in its domain analysis activities with Scott Air Force Base.
- Support the CARDS Organizational Analysis for Reuse work.

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 continued to work with 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.

The prototype, Informedia, integrates subsystems of Scout, a CMU natural language understanding system, and communicates with Sphinx II, a CMU speech recognition system. This quarter, the expansion of the data accessible from Informedia continued. In particular, a large requirements engineering information set was also added. A hypertext markup language parser was added to permit the presentation of Software Engineering Institute (SEI) Mosaic pages in addition to the more complex video information in Informedia.

This quarter, the project demonstrated Informedia at the SEI Software Engineering Symposium in August.

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:

- Two different implementations of the Common Object Request Broker Architecture have been installed, and experiments have begun to understand its usefulness as a CASE tool integration mechanism.
- During a five-week visit to the Software Engineering Institute (SEI) by Dr. Fred Long of the University of Wales, Aberystwyth, UK, project members expanded project experiments through the use of the Tool Connection Language. This is being examined as a possible lightweight approach to CASE tool integration that can be readily installed, introduced, and evolved.

The second concern is being addressed through various practical and conceptual means. This quarter, project members participated in conferences and workshops, including an Advanced Research Projects

Agency Environments workshop in St. Louis, and various Integrated Software Engineering Environment workshops organized by the National Institute of Standards and Technology (NIST). In addition, the project presented a half-day tutorial and several papers at the SEI Software Engineering Symposium in Pittsburgh in August.

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. Progress in this standards activity is continuing, with the latest IEEE draft being put forward for balloting. In addition, several project members have been actively involved in working with NIST to develop technology transition and technical interchange opportunities.

In the area of open systems, one project member, in conjunction with others in the SEI, carried out further deliveries of the open systems course. This course is being substantially revised based on the feedback from these presentations.

During this quarter, project members spent time participating in previously unscheduled activities, including:

- Participation in a software audit for the Federal Aviation Administration.
- Involvement in developing liaisons and draft work statements for potential future technical objectives and plans customers.

Reengineering Center

The goal of the Reengineering Center Project is to capture and improve 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 Software Engineering Institute and within the software community.

This quarter, the project issued draft proceedings to attendees at the May workshop, and received concurrence on these proceedings. In addition the draft for the "Guide to Best Practice" was revised, and assignments were made for writing several of its sections. The guide will address of the following issues:

- Planning reengineering projects
- Reengineering process models
- Legacy system understanding
- Organizational readiness for reengineering
- Reengineering technologies
- Reusing available software assets
- Acquisition policy considerations
- Business process reengineering
- Case studies and lessons learned
- Information resources

Software Architecture Technology Initiative

The purpose of the Software Architecture Technology Initiative is to provide a focused effort in evaluation of architectural represen-

tation languages and analysis tools as well as in methods for evaluating software architectures.

This quarter, project members produced two technical papers that will appear in *Bridge*, the Software Engineering Institute (SEI) newsletter, and the Institute of Electrical and Electronic Engineers publication, *Crosstalk*. Each paper provides a general overview of the field of software architecture, emphasizing its role in system development. Each paper targets high-level technical managers who are interested in pursuing architecture technology.

Project members participated in a panel at the SEI Software Engineering Symposium entitled "The Complimentary Nature of Programs with Architecture/Reuse Focus." The presentation illustrated the various ways in which SEI technology projects revolve around the theme of architecture in a non-competing fashion.

Project members also prepared a briefing entitled "What Are Software Architectures, and Why Do I Care?" for presentation at the National Oceanic and Atmospheric Administration Software Engineering Symposium in September.

Candidate applications for the best practices case study were identified this quarter. The leading contenders represent a broad spectrum of application areas and technology levels, as well as a cross-section of quality attributes that drove each architecture choice. The leading contenders for case studies are:

- Real-time machine controllers (National Institute of Standards and Technology).
- Ultra-high availability air traffic control systems (Federal Aviation Administration).
- Structural modeling, emphasizing high maintainability and evolution.
- Architectures for telecommunications (Motorola and/or others).
- Architecture-based application generators such as GenVoca (University of Texas).
- Architecture-based development of product-line families, such as shipboard fire-control systems (CelsiusTech).

A standard outline for the case studies to facilitate comparison among applications has been drafted and is being circulated for review.

Project members continued work on the Software Architecture Analysis Method, a method in which architectures are analyzed for their support of specific quality attributes. Analysis of Internet-style communication networks is underway; systems such as Mosaic and WAIS are being examined for quality attributes that exist in a domain-standard conceptual model.

Project members continued refining the draft of a taxonomy for software architecture representation languages (textual or graphical languages for representing architectures). Languages vary in their ability to support analysis, expressiveness, tool and environmental support, applicability, and the development process they assume or facili-

tate. Future work calls for refinement of the taxonomy, applying it to a select handful of important languages such as Shaw's UniCon or TRW's UNAS, and for publishing the results in a major journal or conference proceedings.

Work continued this quarter on an annotated bibliography of important documented works concerning software architecture. This bibliography will be made available over widely used computer networks so that beginning practitioners may take advantage of a completed literature search to reduce learning time in the field. An initial corpus has been collected and entered in machine-readable form, and a standard organization for the bibliography has been adopted. In addition, work continued on the process of refining a previously produced draft prospectus on software architecture. This prospectus will help prospective customers understand SEI work in the area and how that work relates to other research and development efforts in the field.

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 descriptions. The project is initially focussing on systems engineering related to architecture, specifically the extent to which an architecture provides an early synthesis of large, complex systems. The synthesis, in the form of a structural model, is used to organize information about the system under development and provides the basis for using information about the evolving system to predict qualities of the completed system.

This quarter, project members continued work on an architecture testbed to explore simulator design issues and to test and validate models of system synthesis. The project obtained key support from the simulator community and began work on enhancing and extending the structural models for the testbed. As now scoped, the testbed will encompass complete functionality for a broad range of simulators.

Also this quarter, the project completed the industry review of its structural modeling guidebook to be turned over by the Air Force's Aeronautical Systems Command Program Office for Simulators and Training Devices for release during the next quarter. In the area of transition, the project also began work on the first of a series of training courses, a course for managers on the role of architectures in systems engineering.

Open Systems Engineering

The Open Systems Engineering Project includes three major efforts:

1. Standards activities that aim at securing a set of open standards for mission-critical systems with real-time and dependability requirements.

2. 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.

3. 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.

This quarter, project members supported the Institute of Electrical and Electronic Engineers (IEEE) Portable Operating System Interface (P1003) project. This work is supported by the Navy Next Generation Computer Resources (NGCR) Program. Project members work with the Real-Time Distributed Systems Communications Working Group (P1003.21), which is developing standards for the real-time domain. Project members serve as chair and technical editor for this group. As part of this effort, a requirements document has been developed that the IEEE will be disseminating as part of its effort to publicize emerging technology practices. The pace of this work has been slowed by the chair's participation in the Federal Aviation Administration effort.

Project members have continued the effort to help NGCR define candidate high-performance network standards. In addition to participating in the meetings, project members developed the draft real-time extensions to the existing asynchronous transfer mode standard and analyzed the properties and schedulability of the proposed extension. A report was prepared and sent to NGCR.

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. Project members have continued to demonstrate the existing prototype to many important visitors to the Software Engineering Institute (SEI), including a demonstration to the Deputy Undersecretary of Advanced Technologies.

The design of the project's application software architecture for the distributed version of the demonstration of fault-tolerant real-time systems was completed. This architecture was successfully demonstrated during the 1994 SEI Software Engineering Symposium. It integrates generalized rate monotonic scheduling, analytic redundancy, and membership protocol to support structured system evolution. The SEI demonstration showed:

- The online addition of new applications to an existing system for automatic control.

- The online improvement of an existing software component.

- The online replacement of hardware in a functioning system.

- The ability to tolerate not only hardware faults but also errors in the design, implementation, or modification of complex software applications.

The project has been cooperating with MITRE on the application of the simplex architecture to tracking applications. A MITRE-led demonstration at the SEI Symposium showed:

- Integration of multiple tracking algorithms that enhance tracking system performance, fault tolerance, robustness, and accuracy under hard real-time constraints.

- Online real-time improvement and maintenance for an evolvable and open surveillance system.

- The ability to reliably integrate new technology into older systems through the application of fault tolerance and real-time techniques.

In collaboration with the SEI Computer-Aided Software Engineering Environments Project, the Open Systems Engineering Project is continuing to develop a prototype course on open systems, intended for program management office personnel. The course has been delivered twice to the sponsor and project members continue to examine the large-scale transition aspects of the course. As part of the course transition, the project has developed a reference model for the interaction between the SEI and the external community. An overview was given during the SEI Software Engineering Symposium.

Other activities of projects members in the third quarter included:

- Helping the National Institute for Standards and Technology (NIST) establish a center for dependability (Center for High Integrity Software & System Assurance).

- Helping Sandia Labs with software reliability efforts.

- Working with NIST in its Focused Advanced Technology Workshop on Dependable and Renewable Systems. The simplex architecture was demonstrated at the workshop.

- Chairing the heterogeneous communications focus group for the IEEE P1003.21 effort.

Engineering Maturity Model

This effort focuses on the development of an engineering maturity model (EMM) to complement the capability maturity model (CMM). While the purpose of the CMM is to stimulate the evolution of organizations to a continuously improving, controlled state, the purpose of the EMM is 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.

EMM project members are currently investigating the utility of the EMM concept for a specific property of software, namely software performance. The initial approach is to collect information on current practices and problems by interviewing engineers in aerospace companies associated with the Software Engineering Institute. Seven interviews (with four organizations) have been conducted so far. The information collected in these interviews is being organized into a

framework describing performance engineering problems and practices. Throughout the next quarter, project members will be documenting this information and applying EMM concepts to test the viability of the concepts.

Transition Models

The Transition Models (TM) Project integrates technology transition research and best practices 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.

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

This quarter, project members worked with the Program Development Division (PDD) to define joint work in technology transition. TM continued to work with PDD and a representative of Westinghouse to define a cooperative effort in technology transition, targeted at Department of Energy laboratories. In addition, a number of technical collaboration agreements (TCAs) have been negotiated with industry partners. Three collaborative activities are under way with Xerox, Hewlett-Packard (HP), and CaseWare, Inc; these activities are identified below.

At CaseWare, work has been initiated on a set of workshops: a generic introductory tutorial on technology adoption and implementation (principal, TM) and a specific workshop on adoption of a software configuration management tool (principal, CaseWare). An informal market survey by CaseWare staff reveals significant interest in the workshops.

In the third quarter, project members and a representative of HP Corporate Quality began to beta test the HP technique and template for the planning of product offerings. This technique is derived from "whole product" planning. The potential product that TM is evaluating is the technology transfer project management tool, now existing in prototype form. (the result of an earlier and continuing TCA with the Facultad Informatica of the Universidad Politecnica de Madrid). The technical collaboration with HP is nearing completion, and a special report on the findings from the planning effort is being prepared.

Two new efforts began this quarter. First, a set of fact sheets on software technology transition were developed and produced. These fact sheets are aimed at change agents and include information on models, checklists,

readings, and definitions used in transition efforts. The fact sheets were made available simultaneously in print and through Mosaic on the world-wide web, and were demonstrated at the SEI Software Engineering Symposium. Second, TM project members began an internal collaboration with developers of the Software Engineering Improvement Method on the development of "transition packages" for technologies associated with key practice areas in the capability maturity model.

In September, project members presented a paper, "Compensating for Immaturity: The Adoption of a New Software Technology," in the hardware and software technology track at the 13th International Federation of Information Processing (IFIP) World Congress in Hamburg, Germany. This paper is based on a case study of rate monotonic analysis (RMA), and the adoption of RMA by a large multinational organization. In conjunction with the congress, the IFIP Working Group on Diffusion, Transfer, and Implementation of Information Technology, WG8.6, hosted a half-day workshop. The TM project leader chairs WG 8.6. The program for this workshop included a presentation of the scope and aims for WG 8.6, a panel discussion on "Information and Software Technology Transfer: Crossing Cultural Boundaries," and a working session on experiences with planning the introduction of software and information technology.

In conjunction with the September trip to the IFIP congress, project members participated in technical exchange meetings:

- At the Polytechnic University of Madrid, project members evaluated the feasibility prototype for the technology transfer project management tool, determined protocols for testing, and negotiated a work assignment for a resident affiliate who will begin working with the project in January 1995.
- At the National Computing Center (NCC) in Manchester, project members sought to better understand the 30-year history of the NCC as a research and development institute and explored areas of technical collaboration.
- At the industry directorate at the Commission of the European Communities in Brussels, project members discussed issues of cooperation and software technology transition.

ADA 9X REVIEW

The Software Engineering Institute (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 (ACVC) 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, the ACVC Review Team met. In addition, draft validation tests continued to be reviewed by team members.

[95 1&5] *SEI Program Plans: 1995-1999* (CMU/SEI-94-SR-19). Pittsburgh, PA: Software Engineering Institute, Carnegie Mellon, July 1994.

ENGINEERING REPORTS
July – September 1994

Toward Deriving Software Architectures From Quality Attributes
CMU/SEI-94-TR-10

This document is available via anonymous FTP and through the SEI Mosaic page (www.sei.cmu.edu). See page 35 for additional information.

Second Dependable Software Technology Exchange
CMU/SEI-94-SR-6

This document is available via anonymous FTP and through the SEI Mosaic page (www.sei.cmu.edu). See page 35 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.

■ 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 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, project members completed a quarterly team review of the Computer Pro-

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cessor Memory Upgrade Project with the government and contractor. The project also completed a software risk evaluation to prepare the way for Team Risk Management on the Airborne Command Post Project with the government program office, the prime contractor, and its major software subcontractor.

The project team conducted two team risk management training sessions and delivered a draft guidebook documenting the concept and procedures for applying team risk management.

Project members presented the Team Risk Management "lessons learned" at the Software Engineering Institute Software Engineering Symposium in August.

Project members have begun work on knowledge integration and how one puts knowledge into the process of risk management. Project members are using the work already accomplished in computer-supported cooperative work and combining this with their work in natural language processing. The framework of team risk management provides a robust environment to apply technologies of cooperative work to assist the decision makers, particularly in managing risk.

Technology Assessment

The Technology Assessment Project is focused on improving the state of the practice of producing software-dependent systems in the Department of Defense (DoD) industrial community and the commercial community through the identification of development risks and improvement of the technical capability to mitigate the risks. The project strategy is to work in a collaborative manner with key DoD and industrial organizations to develop, test, and transition risk identification and technical capability assessment 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 (TBQ) is being 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 and populate a risk information repository. The risk information repository will be populated initially with data collected from field tests and risk assessments conducted by the Software Engineering Institute (SEI) and strategic partners. The information in the repository will include common risks, risk mitigating actions, results, and lessons learned. Once obtained, structured, and analyzed, the data will also yield 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 and prioritizing. The risk repository will provide reliable information on what risks programs have faced for particular situations and how they dealt 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 risk repository is under development and planned for a 1996 release for DoD community usage.

Work this quarter continued on the development of data gathering methods to extend the TBQ into domain-specific areas. Work is also being done with the Engineering Maturity Model and the Computer Emergency Response Team Projects, which has resulted in interview questionnaires to gather data on system performance and system security risks to be used to extend the TBQ to in-depth coverage of the system performance and security domains. Several applications of the interview questionnaires and interview technique were conducted this quarter with both projects.

A presentation was made at the SEI Software Engineering Symposium in August on the results of field testing the taxonomy-based risk identification method.

Finally, the repository operations concepts and design document was released this quarter for review both internal and external to the SEI.

Enterprise Risk Management

The Enterprise Risk Management (ERM) 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 concerned with acquiring quality 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 Independent Risk Assessment Project, applied actual risk techniques that were developed within the Software Engineering Institute (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 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 those strategies with specific activities that would be required to accomplish them.

The project continues its SRE events in both government and commercial software development programs and projects. A new technical objectives and plans agreement has been made with the U.S. Coast Guard for VTS 2000. The Acquisition Risk Management Task for the U.S. Army Materiel Command Communication-Electronics Command should be finished in November 1994.

At the 1994 SEI Software Engineering Symposium in August, project members participated

in two different panels: "Risk Management in the Source Selection Process," and "Transitioning Risk Management to the "Defense Acquisition Community." Additionally, project members continued work on the logistics for the 1995 Risk Conference. The date, location, and theme are being developed.

This quarter, project members continued to work on the development of the ERM technical report for the SRE. The SRE Handbook was given to Information Management for processing and should be available for external distribution next quarter.

Project members continued working on the development of a predictive decision model/tool. Feasibility work is currently going on concerning the applicability of Community of Interest (COI) software to SREs. As a test, the COI technology is being applied to the U.S. Treasury Pacer Project data. Results will be presented in a white paper during the next quarter.

SOFTWARE RISK MANAGEMENT REPORTS
July – September 1994

A Construct for Describing Software Development Risks
CMU/SEI-94-TR-14

Team Risk Management: A New Model for Customer-Supplier Relationships
CMU/SEI-94-SR-5

SEI EDUCATIONAL PRODUCTS

The objectives of the Software Engineering Institute Educational Products Program are to assure that high-quality software engineering education is widely available through traditional channels and existing infrastructure, and to raise the accepted educational standard for practicing software engineers. In addition to development of educational products within the program, support and quality assurance are provided to other Software Engineering Institute organizations developing educational products.

■ ACADEMIC EDUCATION

The Academic Education Project develops software engineering curricula and supports universities in the creation of software engineering programs.

This quarter, Academic Education project members began delivery of two courses over the National Technological University video network. The courses are entitled "Managing Software Development," and "Software Requirements Engineering."

Fifteen new students have entered the joint Software Engineering Institute–Carnegie Mellon Master of Software Engineering Program.

■ 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 designed for practitioners' in-house education, and executive offerings designed for decision makers involved in improvement efforts.

The course "Software: Profit Through Process Improvement" was taught for the Internal Revenue Service in Washington, D.C. The course was also broadcast via National Technological University in August and was taught at the Software Engineering Institute (SEI) D.C. facility in September. The course "Software Quality Improvement" was broadcast via National Technological University in August.

A presentation entitled "What Is Software Quality" was given at the National Oceanic and Atmospheric Administration (NOAA)

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Software Engineering Symposium in September. A program on the SEI educational products and future activities for the D.C. Software Process Improvement Network Training Group was also held in September.

SEI EDUCATIONAL PRODUCTS REPORTS
July – September 1994

Rate Monotonic Analysis for Real-Time Systems: Instructor's Guide

SEI-94-EM-11 (revised September 1994)

This document is available via anonymous FTP and through the SEI Mosaic page (www.sei.cmu.edu). See page 35 for additional information.

SEI SERVICES

The Software Engineering Institute (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, 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.

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 Sixth Annual Computer Security Incident Handling Workshop was held in Boston in July. The workshop was co-sponsored by the Forum of Incident Response and Security Teams (FIRST), the CERT Coordination Center, Digital Equipment Corporation, and the National Institute of Standards and Technology. The focus of this workshop was on tools for incident handling in an international arena. In addition to participating on various panels, Coordination Center staff led three sessions: Incident Handling Teams Status and Update, Nontraditional and Public Domain Network Servers, and Interoperability in the FIRST Community. One member is on the FIRST Steering Committee, helping to guide the direction of that organization.

In July, CERT members participated in Federation of American Research Networks (FARNET) discussions relating to the transition to a new network architecture. Security is a major concern, and CERT staff members were asked to help develop a handbook for network users.

The CERT staff is developing a networked information technology security taxonomy and questionnaire in collaboration with the Software Engineering Institute (SEI) Risk Program. The CERT staff completed two formal field tests, one with a commercial corporation and the second with a division of a government agency.

Three new advisories were released, alerting the Internet community to security problems:

CA-94:11	Majordomo Vulnerabilities
CA-94:12	Sendmail Vulnerabilities
CA-94:13	SGI IRIX Help Vulnerability

The Coordination Center staff also published two papers to raise the awareness of the network community about security issues. "CERT Incident Response and the Internet" was published in the August 1994 issue of *Communications of the ACM*. "Keeping Intruders Away" appeared in the September issue of *UNIX Review*. In addition, the most recent issue of *Bridge* (#1 1994) contained an article, "Secure Software Reuse," describing the joint work of the CERT team and the National Security Agency.

A CERT staff member is chairing two working groups for the Internet Engineering Task Force (IETF): the Site Security Handbook (SSH) Working Group, and the Guidelines and Recommendations for Incident Processing (GRIP) Working Group. The SSH group is producing two documents, a site security handbook for system and network administrators, and one for users. The GRIP group is producing guidelines for security incident response teams and technology vendors.

Two CERT members hosted the first meeting of the CERT Technical Council at the Toronto IETF. This group will provide technical expertise to the CERT Coordination Center during their work on particularly difficult problems.

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

- **NSA TechFest, Maritime Institute** (Baltimore, Maryland in July). About 200 people attended, primarily government employees and contractors. CERT staff members were invited to attend to learn about unclassified research that the National Security Agency is doing in the area of computer security.

- **1994 USENIX LISA Conference** (San Diego, California in September). CERT members held a birds-of-a-feather session on security issues.

- **LAN Summit 1994** (Sydney, Australia in September). A CERT member was the invited chair for a panel discussion of security in a local area network environment.

- **40th Annual ASIS (American Society for Industrial Security) Conference** (Las Vegas, Nevada.) A CERT staff member was an invited speaker, presenting "The Internet: Managing the Risks."

- **Center for Strategic and International Studies Conference on Global Organized Crime** (Washington, D.C. in September). A CERT member was the invited chair for a panel discussing "Vulnerabilities and Manipulation of the International Information SuperHighway."

- **4th Annual ARPA Networking Principal Investigators Meeting** (Santa Fe, New Mexico in September). A CERT staff member spoke on the CERT Coordination Center and Internet security.

This quarter, CERT received 1,490 e-mail messages and 774 hotline calls requesting information or reporting computer security incidents.

PROGRAM DEVELOPMENT

The vision of the Program Development Division (PDD) is to serve customer needs by being the voice of the customer to the Software Engineering Institute (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, distribution partners, and events such as the annual SEI Software Engineering Symposium and Visitor's Days. 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.

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 *Key Practices of the Capability Maturity Model, Version 1.1* and the *Capability Maturity Model for Software, Version 1.1.*

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. Questions about SEI work or the subscriber program should be directed to Customer Relations (see page 35 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 preregister; walk-ins will not be accommodated. Registration forms are available from Customer Relations (see page 35 for more information).

The SEI hosted its annual Software Engineering Symposium on 22-25 August 1994 in Pittsburgh. Since this is the ten-year anniversary of the existence of the SEI, the theme for the symposium was "10 Years of Improving the State of the Practice." This year's keynote speakers looked back on the past 10 years and forward to the next 5-10 years and discussed relevant issues in terms of the state of software engineering practice. As in the past two years of the Symposium, there were dozens of exhibition booths, including ones from organizations who are commercializing technology developed at the SEI.

Invited speakers at the Symposium included:

- William F. (Hank) Hayes, Executive Vice President of Texas Instruments
- John Major, Senior Vice President of Motorola
- Robert Mehrabian, President of Carnegie Mellon
- Emmett Paige, Assistant Secretary of Department of Defense
- William Valentine, Xerox

Frank McGarry spoke on behalf of his team at the NASA Software Engineering Laboratory, which was selected as the first recipient of the IEEE/SEI Award for Software Process Achievement.

An article about the Symposium will be published in the October 1994 edition of *Carnegie Mellon News*.

As of 30 September 1994, the organizations listed in Table 1 have active technical collaboration agreements 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.

The SEI has signed strategic collaboration agreements with 4 strategic partners as of 30 September. 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.

The organizations in Tables 3-4 sponsored resident affiliates during the third 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 a SPIN in a new geographic location. The locations listed in Tables 5-6 have active SPIN organizations.

As of 30 September, the organizations listed in Table 7 have active Technical Objectives and Plans (TO&P) agreements with the SEI. These customers provide the SEI with funding to support specific technical activities that facilitate the transition of promising software engineering technology into practice.

Table 1
Organizations with current Technical Collaboration Agreements

Applied Software Engineering Centre, Canada	Science Applications International Corp.
Bell Northern Research	SETA Corp.
Computer Sciences Corporation	Siemens Corporate Research
Federal Express	Software Productivity Consortium
Ford	Texas Instruments
Harris Corporation	Universidad Politecnica de Madrid (Spain)
Hewlett-Packard Corporation	University of Southern California Center for Software Engineering
Hughes	USWest Technologies, Inc.
Loral Federal Systems	Westinghouse
Master Systems, Inc.	Xerox
Motorola	

Table 2
Strategic Partners

Hewlett Packard	Loral Federal Systems
Hughes Aircraft	Texas Instruments

Table 3
Industry Affiliates

Bell Northern Research	SEMATECH
Computer Sciences Corporation	Texas Instruments
GTE Government Systems	Unisys CARDS
Hughes Aircraft Company	Wilcox Electric

Table 4
Government Affiliates

Defense Logistics Agency	Nuclear Regulatory Commission
Electronic Systems Center, USAF	United States Military Academy
National Security Agency	

Table 5
Domestic locations that have active SPIN organizations

Huntsville, Alabama	St. Louis, Missouri
Phoenix, Arizona	Omaha, Nebraska
Tucson, Arizona	Northern New Jersey
Bay Area (Northern California)	Albuquerque, New Mexico
Los Angeles, California	Cleveland, Ohio
Silicon Valley, California	Pittsburgh, Pennsylvania
Southern California	Austin, Texas
Colorado (Front Range area)	Dallas/Fort Worth, Texas
Washington, D.C.	Hampton Roads, Virginia
Boston, Massachusetts	Seattle, Washington
Chicago, Illinois	Southeast Wisconsin

Table 6
International locations that have active SPIN organizations

Victoria, Australia	The Netherlands
Montreal, Canada	Bizkaiaa, Spain
France	Madrid, Spain
Bangalore, India	United Kingdom

Table 7
Organizations with TO&P agreements with the SEI

Air Force	Air Force Communications Command (AFCC)
	Air Force Materiel Command (AFMC)
	Air Force Space Command (AFSPACECOM)
	Air Staff Automation Support
	Electronic Systems Center (ESC)
Navy	Marine Corps Tactical Systems Support Agency (MCTSSA)
	Navy Supply Systems Command (NAVSUP)
	Naval Surface Warfare Center (NSWC)
	Naval Oceanic Office (NAVOCEANO)
	Office of Naval Research (ONR)
	Program manager (Aircraft) (PMA) 264
	Program Manager (Aircraft) (PMA) 271
	Program Executive Officers (A) (PEO (A))
	Space and Naval Warfare Systems Command (SPAWAR)
Army	Army Materiel Command (AMC)
	Corps of Engineers
	Stimulation, Training, and Instrumentation Command (STRICOM)
Joint Agencies	Ada Joint Program Office (AJPO)
	Advanced Projects Research Agency (ARPA)
	Ballistic Missile Defense Organization (BMDO)
	Defense Financial Accounting Systems (DFAS)
	Defense Information Systems Agency (DISA)
	Defense Mapping Agency (DMA)
	National Security Agency (NSA)
	Office of the Secretary of Defense (OSD)
Federal Agencies	Federal Aviation Administration (FAA)
	Financial Management Service (FMS)
	National Institute of Standards and Technology (NIST)
	National Oceanographic and Atmospheric Sciences Agency (NOAA)
	U.S. Coast Guard
Federal Laboratories	Sandia National Lab

ADDITIONAL INFORMATION

■ HOW TO OBTAIN HARDCOPIES OF SEI DOCUMENTS

For information about purchasing hardcopies of Software Engineering Institute (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
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