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Carnegie Mellon University
Software Engineering Institute

Quarterly Update

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January–March 1992

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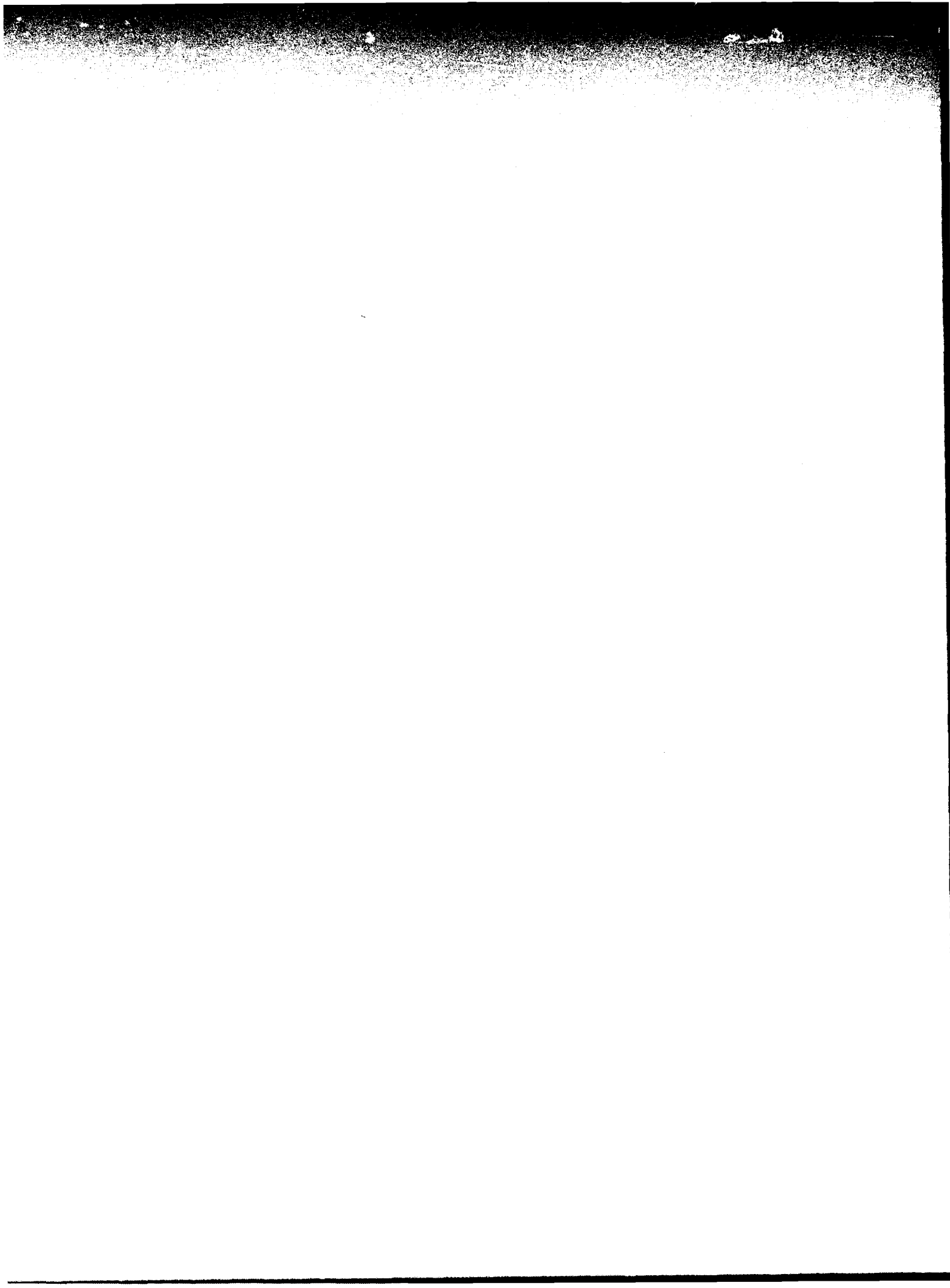
Summary of Accomplishments: 1Q92

A kick-off meeting for the **Software Process Measurement (SPM) Project's** Software Action Plan (SWAP) effort was held this quarter. Representatives from MITRE, the Institute for Defense Analyses, Corporate Information Management, Defense Information Systems Agency, U.S. Army Software Test and Evaluation Procedure Metrics Initiative, and Software Technology for Adaptable, Reliable Systems (STARS) attended. SPM project members briefed members of the SWAP Working Group on technical plans and status.

During this quarter, the **Software Process Definition Project** delivered an initial version of the level 2 process framework for review. This deliverable included a hierarchical map of the activities within each key process area, and a map of products, policy, procedure, training, and tools.

The **Software Process Definition Project** is providing support to the Defense Advanced Research Projects Agency (DARPA)/STARS effort as technical lead for the DARPA/STARS Process Asset Library. This is a joint effort between the SEI and STARS prime contractors. The effort is also supported by SEI resident affiliates from AT&T, GTE, and Texas Instruments.

Staff members from **Empirical Methods** completed initial data collection for a report and article resulting from the National Software Capacity Study on international software production. Information will be summarized about demographics, education, research and development concentrations, and product market share for 23 countries.

Along with other SEI staff, members of the **Rate Monotonic Analysis for Real-Time Systems (RMARTS) Project** continued working toward the long-range goal of producing a real-time systems engineering handbook. The handbook team completed a preliminary draft of the handbook and conducted user testing at two sites.

In support of the goal of promoting development of rate monotonic analysis (RMA) training and consulting services outside the SEI, the **RMARTS Project** began a pilot effort with two consulting firms. Representatives from each firm participated in SEI delivery of the two-day RMA training course to an SEI client.

The **Real-Time Simulator Project** was initiated in 1992. The goal of the project is to extend and transition software architectures for real-time simulators. This project is the merger of the Domain-Specific Software Architectures Project and the Virtual Reality Feasibility Study of 1991.

Staff members from **Transition Models** prepared a paper entitled "Defining the Process of Software Technology Transition," which was accepted for presentation at the International Federation of Information Processing '92 World Congress. An earlier version of the paper was published in the March 1992 issue of *American Programmer*, which was devoted to software technology transfer.

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This section provides a summary of accomplishments from January—March 1992

With the addition of a resident affiliate from the Air Force, the **Domain Analysis Project** has begun the transition of its methods and products outside its original Army customers. Project members are working together to establish a comprehensive framework for domain analysis, software architectures, and reuse.

The **Software Risk Management Program** has produced a preliminary design of a risk action planning mechanism, and internal testing has been completed. The action planning mechanism is being refined for introduction into the third quarter risk assessments.

Members of the **Computer Emergency Response Team Coordination Center** (CERT/CC), in collaboration with members of an Internet Engineering Task Force working group, completed the document Guidelines for the Secure Operation of the Internet. This document is now available as RFC 1281, a final Informational RFC (request for comments). (Final Informational RFCs have been reviewed and approved, and they are not open for further comment.) RFCs are available electronically (via anonymous FTP) from various Internet locations.

During this quarter, the **Software Process Assessment Project** provided authorized assessment coaching services to Army Materiel Command and Air Force Logistics Command, serving four sites with five assessments.

The **Continuing Education Project** released a new Technology Series videotape: *Applying Software Engineering Skills to Writing*. The video was introduced at a post-symposium workshop following the ACM Special Interest Group on Computer Science Education (SIGCSE) Technical Symposium. The workshop was one of three presented by SEI staff.

A task for the Air Force Institute of Technology (AFIT) was completed by the project with the delivery of a final report on the 1990 Course Development Workshop. During this workshop, the SEI assisted AFIT faculty in developing software engineering courses for the AFIT professional continuing education program.

This quarter, three new **resident affiliates** joined the SEI from the following organizations: Defense Logistics Agency, IBM, and University of Catabria. As of 31 March 1992, 16 resident affiliates were working at the SEI: 8 affiliates from industry, 1 from academia, and 7 from the Services and government agencies.

Customer Relations began a subscription program in January. The program is open to any individual with a U.S. mailing address. Subscribers receive regular publications such as *Bridge*, invitations to selected SEI events (for example, the annual SEI Symposium), and first notification of SEI course offerings and new technical reports.

Planning began for the **SEI Software Engineering Symposium**, which will take place in Pittsburgh on 15-17 September.

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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.

The Software Process Measurement (SPM) Project advocates 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 (DoD) and industry acceptance, the project convenes a steering committee and two working groups, and has undertaken a best-practices study, all of which are devoted to encouraging organizations to use quantitative methods to improve their software processes.

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Software Process Measurement

Anita Carleton participated in the Army Software Test and Evaluation Procedure (STEP) Workshop on 4-5 February, in Denver, Colorado. Her purpose was to understand which software measures the Army was proposing and to see how this might have an impact the project's work for recommending and defining a core set of measures. The core set of measures will serve as a basis for collecting well-understood and consistent software measures throughout the DoD.

A kick-off meeting for the project's Software Action Plan (SWAP) effort was held this quarter. Representatives from MITRE, the Institute for Defense Analyses (IDA), the DoD Corporate Information Management, Defense Information Systems Agency (DISA), U.S. Army STEP Metrics Initiative, and Software Technology for Adaptable, Reliable Systems (STARS) attended. SPM project members briefed members of the SWAP Working Group on technical plans and status.

SPM project members convened a Software Metrics Panel Meeting. Representatives from government and industry met with SPM project members, holding internal brainstorming meetings to generate ideas for checklist-based methods that will be used in defining staff-hour measures and problem report measurement and tracking.

The project team reviewed MIL-HDBK-WBS.SW and prepared a response for Communications-Electronic Command (CECOM) on the proposed Work Breakdown Structure for Software.

Also this quarter, three site visits were conducted in support of the measurement work at Standard Systems Center (SSC), Gunter Air Force Base. Project members developed and reviewed the first draft of the SPM Project support plan for SSC. Work is underway to assemble a generic measurement process and template, which is one of the deliverables listed in the support plan.

A resolution was reached to continue support for Naval Air Warfare Center (NAWC) through fiscal year 1992. During this quarter, two site visits were conducted. The focus of the continued support will be to pilot test the measurement processes and definitions on selected NAWC projects.

John Baumert, resident affiliate from Computer Sciences Corporation, completed and distributed the level 2 and level 3 indicators for review. His work entails mapping measures to existing key process areas of the capability maturity model (CMM), making recommendations on the use of specific measures and providing guidance on the use of the recommended measures.

Patricia Van Verth, visiting scientist from Canisius College, conducted 28 interviews and completed a draft outline for the technical report in support of her study of national software engineering databases. This study consists of gathering and summarizing lessons learned by agencies that are collecting data. The report will include a list of needs for items and capabilities that are missing in current databases.

Carleton served as the track chair for the "Productivity, Metrics, and Quality Systems" session at the Fourth International Conference on Strategic Software Systems, which was held this quarter in Huntsville, Alabama.

Robert Park served as an invited speaker at the National Security Industrial Association (NSIA) Quality and Reliability Assurance Committee Workshop, which took place in Arlington, Virginia.

Van Verth was an invited participant at the Fourth Annual Oregon Workshop on Software Metrics, which was held in Portland, Oregon.

Project members met with representatives from Fleet Combat Direction System Support Activity, Dam Neck Naval Base, Naval Underwater Systems Center, and Naval Air Systems (NAVAIR) to discuss SPM project activities and opportunities for future collaboration.

External review comments were incorporated into the draft document *Software Measurement Concepts for Acquisition Program Managers*. The final edit is in process.

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Software Process Definition

The objectives of the Software Process Definition (SPD) Project are to establish standard software engineering practice for the management and development of software and to advance the capabilities required to define and automate the software process within an organization. The Software Process Definition Project supports process improvement through the development and maturation of methods and technology that support process definition.

The project is supporting process development efforts with SSC, Gunter Air Force Base, and Army Materiel Command (AMC). Project members are also exploring advanced applications of process through the STARS program.

This quarter, the project supported the replanning of the SSC process improvement effort, following the reorganization and staffing changes in the SSC software engineering process group (SEPG).

The project developed, reviewed, and approved a revised version of the Software Process Definition Project Support Plan for SSC. Due to changes in deliverables resulting from the replanning, the SSC technical objectives and plans (TO&P) was revised.

During this quarter, the project delivered an initial version of the level 2 process framework for review. This deliverable included a hierarchical map of the activities within each key process area, and a map of products, policy, procedure, training, and tools.

Also during this quarter, the project delivered examples of software process guide templates to SSC for review.

The project is providing support to the MICOM/LCSEC (Missile Command/Life Cycle Software Engineering Center) and AMCCOM/LCSEC (Armament Munitions and Chemical Command/Life Cycle Software Engineering Center). During this quarter, the project began to plan how to support SEPGs that are being formed at MICOM and AMCCOM.

The project developed and delivered a kickoff briefing for newly established SEPGs that provides background material for implementation planning.

Also during this quarter, the project supported a Managing Technological Change workshop and planning session at MICOM.

The project is providing support to the Defense Advanced Research Projects Agency (DARPA)/STARS effort as technical lead for the DARPA/STARS Process Asset Library. This is a joint effort between the SEI and STARS prime contractors. The effort is also supported by SEI resident affiliates from AT&T, GTE, and Texas Instruments.

During this quarter, the project completed the design and construction phases of the Process Asset Library for the first increment of a three increment product development plan. Process assets modeled during this increment include:

- Portions of the TRW Ada Process Model
- Sections of the Cleanroom Engineering Process
- IEEE STD 1074-1991 Quality Management/V&V Processes
- IEEE Configuration Management Process
- Quality Function Deployment (QFD) Process

The project developed a workshop on the Process Asset Library for the Process Definition Advisory Group meeting, which is being held in April. The project also developed a workshop on the Process Asset Library for the SEPG Workshop, which is also being held in April.

Project members participated in the development and review of the STARS Process Concepts document and an associated briefing for the April '92 Software Technology Support Center (STSC) conference.

Project members prepared and delivered a half-day Process Asset Library Technical Overview briefing for the STARS Technical Program Review. This briefing was also delivered to SIGAda in Los Angeles.

Project members developed a Process Asset Library overview paper for the DARPA Principal Investigators meeting in late April.

During this quarter, project members participated in a one-day technical interchange meeting with members of Boeing Aerospace, NAVAIR, Dual Systems (a potential STARS demonstration project), and the STARS demonstration project advisory group. Project members also participated in a one-day technical interchange meeting with IBM, Toronto.

Members from the SPD Project and Information Management group were trained in the application of the information mapping method. Also during this quarter, project members delivered a project briefing to Brigadier General Shulstad and the SEI Board of Visitors.

pability Maturity
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The Capability Maturity Model (CMM) Project maintains a model describing how organizations can improve their software process maturity. This model will be continuously updated with the state of the art as it evolves in software engineering, total quality management, and other relevant areas of improvement. It will elaborate on software development practices that provide clear strategies for capability maturity growth and improvement.

More than 800 change requests were received on CMM V1.0. Project members built a change request report with the project's proposed disposition of the change requests.

Tutorials and presentations on the CMM and software process management were presented at the following sites:

- Strategic Systems Conference (Huntsville, Alabama)
- The International Software Quality Exchange (San Francisco, California)
- NSIA (Washington, D.C.)
- The Canadian Information Processing Society (Calgary, Canada)

Also this quarter, Mark Paulk continued to participate in the International Standards Organization's JTC1/SC7/WG7 work on the process management study group and on the standard for "Software Life Cycle Processes."

npirical Methods

The Empirical Methods Project develops, evaluates, and validates products (e.g., questionnaires and tests, methods, and models) for use in baselining and measuring software process improvement.

Project members and colleagues from the CMM Project, Software Process Assessment (SPA) Project, and Information Management group at the SEI are designing the process maturity questionnaire and related questionnaire prototypes for use in pilot testing during the second quarter of 1992. Commitments from more than 60 industry and government organizations were received. These organizations will provide access to managers and technical staff in providing feedback on the clarity and usability of the updated process maturity questionnaire. These organizations will also provide support for tryouts of related materials as the SPA method is upgraded. (For more information about the SPA Project, see page 28.)

Empirical Methods staff completed initial data collection for a report and article resulting from the National Software Capacity Study on international software production. Information about demographics, education, research and development concentrations, and product market share for 23 countries will be summarized. The data suggest that significant amounts of software design and production are moving outside the U.S.

Real-Time Distributed Systems

The goal of the Real-Time Systems Program is to improve the development of real-time distributed systems by integrating software engineering with systems engineering and reducing the risk associated with new technology.

The Rate Monotonic Analysis for Real-Time Systems (RMARTS) Project aims to ensure that rate monotonic analysis (RMA) and scheduling algorithms become part of the standard practice for designing, building, troubleshooting, and maintaining real-time systems. RMA helps engineers to understand and predict the timing behavior of hard real-time systems to a degree not previously possible.

Rate Monotonic Analysis for Real-Time Systems

Project members are working with the Navy's Next Generation Computing Resources (NGCR) Program to encourage the development of a local area network (LAN) that adequately supports rate monotonic principles. The Ada binding to the SAFENET Lightweight Application Services is being revised, and project members continue to interact with NGCR personnel concerning scheduling issues.

Project members are working with the POSIX.12 group, which is developing a protocol-independent interface to a LAN. The goal is to have the resulting standard meet the needs of real-time applications. Project members have been asked to take the lead in developing real-time extensions to POSIX.12. An additional standard may also be developed that specifies information, to be provided by a vendor, relating to the performance of an implementation.

Project members continue to interact with members of the Carnegie Mellon University (CMU) Master of Software Engineering (MSE) program. A group of students is developing a real-time analysis tool that performs schedulability assessments for software designs. The students have completed the development plan and are in the process of developing an application-specification language that will be used to describe tasks. Another MSE student is taking an independent study course on RMA and, as part of the work, is assessing the Patriot Missile ground control software. To date, several interesting questions have been raised about the application of RMA to multiprocessors.

This quarter, project members continued working toward the long-range goal of producing a real-time systems engineering handbook. The goal of the handbook is to codify the principles of RMA in a manner that is easily accessible to real-time systems practitioners. Project members completed a preliminary draft of the handbook. The draft was a prototype whose purpose was to allow project members to assess usability at an early stage in the handbook's development so they could change its global structure if necessary.

The handbook team used a think-aloud protocol to test the handbook. A "think-aloud" protocol requires reviewers to talk about what is going through their minds while attempting to use a document in solving a set of prespecified problems. The team visited two sites: the Naval Air Weapons Station (NAWS) at China Lake, California, and Magnavox in Ft. Wayne, Indiana. During each visit, the team

conducted several tests and made observations and videotapes of the reviewers as they tried to use the handbook. This type of testing proved to be useful in exposing the weaknesses and strengths of the draft. Copies of the draft were also distributed externally for a conventional review. The handbook team is now in the process of reacting to this input.

This quarter, project members continued to work with the Advanced Real-Time Technology Project at CMU. They completed a paper that documents extensions to current analytical methods for assessing schedulability and submitted it to a special issue of *IEEE Transactions on Software Engineering of Real-Time Systems*.

RMART^c project members attended numerous meetings at General Electric (GE), Syracuse, to continue the RMA of the nuclear partition software under the BSY-2 effort. It was decided that a data sheet should be developed that will be used in extracting the processor utilization and memory requirements of each computer software configuration item in the nuclear partition. This is the first step in performing an RMA. It was further decided that a realistic worst-case scenario, covering a specified interval of time, be specified as the way of obtaining the most relevant information with the least amount of effort. The SEI developed the data sheets and specified the realistic worst-case scenario and duration, and Singer Librascope helped to refine the scenario. A video teleconference was held between representatives from Singer Librascope, GE, and the SEI to review the data sheet and the approach specified to obtain the processor utilization and memory requirements. After this, it was decided that the data sheet and scenario were appropriate. Now that the data sheets are completed, RMARTS and GE personnel will develop a schedulability analysis of the nuclear partition and present the results at the next available BSY-2 status meeting with the Navy.

In support of the goal of promoting development of RMA training and consulting services outside the SEI, the project began a pilot effort with two consulting firms. Representatives from each firm participated in SEI delivery of the two-day RMA training course to an SEI client. Each firm is now making plans to develop courseware and begin offering RMA courses. The project will continue to help the companies gather more knowledge and experience in the use of RMA. Through this pilot effort, project members intend to gain a more clear understanding of the level of SEI support required for a vendor to successfully offer RMA training and consulting services. The pilot effort will also help the SEI develop a package that can be offered to follow-on companies. After the pilot, the SEI will make the RMA package available to all interested vendors.

Personnel at the NAWS in China Lake, California, have also been offering training in RMA. They have presented one- and two-day in-house courses. Their first external offering of the course will be a full-day tutorial at the Washington Ada Symposium in July. Project members have been supporting efforts of China Lake personnel to improve the material and prepare themselves for this event.

Project members have been working on management guidelines for using RMA. They will offer a presentation on these guidelines at the Software Technology Support Center (STSC) Software Technology Conference in April. They will also offer a half-day tutorial at the Washington Ada Symposium.

The Distributed Systems Project is developing tools and a methodology for building distributed, large-grained, concurrent applications to run on networks of heterogeneous machines. The project has developed Durra, a language for describing distributed applications as a set of task descriptions and port connections. The Durra compiler generates Ada program units that link clusters of application tasks as executable programs. A library package provides application- and location-independent communication facilities to the application tasks.

Distributed Systems

Project members presented a paper to the International Workshop on Configurable Distributed Systems, organized by Imperial College, London, England, in March. In addition, Dennis Doubleday participated on an expert panel at the workshop.

Doubleday continued to serve as a technical reviewer with the IEEE POSIX 1003.5 Working Group (Ada binding to 1003.1, the POSIX System API).

The project received requests for information from PRISM (Programmable Reusable Integrated Software Modules) contractors; Hughes Aircraft, and Raytheon and from the Air Force Electronic Systems Division (ESD). Their proposal included the use of the Durra language and tools; and in the next couple of months project members will be discussing SEI support for Hughes and ESD.

The Real-Time Simulator Project was initiated early this year. This project is the merger of the Domain-Specific Software Architectures Project and the Virtual Reality Feasibility Study of 1991. The goal of the project is to extend and transition software architectures for real-time simulators.

Real-Time Simulators

This quarter, project members submitted a draft of a white paper to the Air Force Aeronautical Systems Division Program Office for Simulators and Trainers. The white paper describes structural modeling in general terms and a particular structural model appropriate for flight simulators.

The project has also provided software architectural design support for the Special Operations Forces Aircrew Training System prime contractor, Loral, and several different subcontractors.

The Transition Models Project is developing a set of methods and supporting materials such as guidelines and checklists for planning, implementing, and assessing transition activities. These materials will be used by software technology producers and consumers both inside and outside the SEI. Transition Models staff members also provide other SEI staff, including management, with education and training on technology transition concepts and approaches. Additionally, project staff members provide limited consulting on software technology transition to members of the SEI constituencies, and maintain contact with researchers and others interested in technology transition from business and academic domains.

Transition Models

During this quarter, project members prepared a paper entitled "Defining the Process of Software Technology Transition," which was accepted for presentation at the International Federation of Information Processing '92 World Congress. Another paper, "Work in Progress: A Case Study of the Transition of Rate Monotonic

Analysis Technology," was prepared and will be presented at the DARPA Principal Investigators meeting in late April. An adaptation of the latter paper will also be presented at the Technology Transfer Society annual conference in June.

An earlier version of "Defining the Process of Software Technology Transition" was published in *American Programmer*, March 1992, an issue that was devoted to software technology transfer.

Project members have been working with members of the RMARTS Project to plan a transition of rate monotonic analysis for the purpose of alpha testing approaches to software technology transition developed by the Transition Models Project. This quarter, Linda Levine continued the transcription, editing, and synthesis of the project's interviews with Tom Ralya that trace his adoption of RMA while he was (primarily) at IBM.

Project members held a meeting with Dr. Walt Scacchi on 10-12 February to discuss the draft conceptual framework for technology transition that was recently developed by the project. Scacchi has consulted with Microelectronics & Computer Technology Corporation (MCC) and other major corporations on software technology transfer. His feedback largely corroborated the project's approach; he also made suggestions for alternative approaches in some areas.

The final version of the *Proceedings for the Technology Transfer Symposium* (November 1991) was proofed, corrected, and shipped to attendees in February. The symposium on technology transfer was organized by Priscilla Fowler, SEI, and William Smith, Electric Power Research Institute. This symposium was sponsored by the Council of CEOs (chief executive officers) of Consortia.

Arrangements were made for a meeting of the Technology Transfer Models committee that was established as a result of the symposium held in November 1991. Fowler is chair of the committee, which includes members from Bellcore, SPC, Industrial Technology Institute, SEMATECH, and Semiconductor Research Corporation. Claude Del Fosse, SPC, hosted the committee meeting at SPC in March. A committee charter and preliminary plan will be prepared and briefed at the next symposium, which will be held on 2 April at MCC in Austin. Some committee members have shared position statements in advance of the meeting; the project sent a copy of the paper "Toward a Defined Process of Software Technology Transition," which was recently published in *American Programmer*. This paper proposes a problem solving model and preliminary framework.

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Real-Time Distributed Systems Reports

January—March 1992

Durra: A Task-Level Description Language Reference Manual (Version 3) (CMU/SEI-91-TR-18)

A Description of Cluster Code Generated by the Durra Compiler (CMU/SEI-91-TR-19)

Design Specifications for Adaptive Real-Time Systems (CMU/SEI-91-TR-20)

Durra: An Integrated approach to Software Specification, Modeling, and Rapid Prototyping
(CMU/SEI-91-TR-21)

For information about ordering copies of SEI reports, see page 35.

Software Engineering Techniques

The goal of the Engineering Techniques Program is to increase precedented engineering for effective and efficient production of large software-intensive systems through a model-based engineering approach and engineered project support environments.

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Software Architectures Engineering

The Software Architectures Engineering (SAE) Project has been involved in the engineering of software in several critical DoD application areas for the last six years. The project's goal is to use sets of identified patterns together with engineering design goals in providing guidelines for building the basic elements of software structure (models). The project is currently focusing on three aspects of this technology: the generalization of software models by providing templated structural elements and connection rules that invest the implemented software with the desired product qualities; the naturalization of the models so that real-world components have corresponding software analogs; and the application of tools and notations to software development based on generalized structures.

The SAE Project provides DoD program offices with improvements to the practice of software engineering by assisting in the creation and adoption of model-based technology. Project members accomplish these improvements by helping clients to abstract the desirable software architecture characteristics for particular classes of applications and to use them in creating reusable patterns of software structures specific to an application. Project members refine and mature the new models by transferring them to other projects, which provides additional sources of feedback on their use.

Project members have recognized that most software-dependent systems have aspects of control systems in them. As a result, the project's current focus is in creating generalized models for control systems to take advantage of the high-level similarities of control across platforms, whether for defense or manufacturing systems.

The SAE Project has been working with the Air Force Electronic Combat Office and the Tri-Service CROSSBOW-S organization on the Joint Modeling And Simulation System (J-MASS). J-MASS currently relies on the SAE Project's model-based software development concepts and the Object-Connection Update (OCU) architectural model as the basis for simulation models used within the system. Project members are working with members of the J-MASS design team. During the first quarter, work concentrated on the design of new executives for the J-MASS system, which will allow either real-time or non-real-time operation in a distributed environment.

Project members are working with the DARPA Domain-Specific Software Architecture (DSSA) Program. DARPA is funding several industrial and academic teams to focus on software architecture development in DoD-critical domains. The SAE Project is participating in efforts to define software architectures for control in factory automation and manufacturing systems. The results will be generally applicable to all teams in the DSSA Program.

In conjunction with SEMATECH, the SAE Project is writing part of a proposal to participate in engineering modeling work for software-dependent control systems in the Corporate Integrated Manufacturing application area. SAE project members are currently writing a white paper describing future factory control systems at machine, cell, and factory floor levels. SAE project members attended the second Advanced Equipment Control workshop, sponsored by SEMATECH, held in Mesa, Arizona. The workshop was useful in verifying many of the factors included in the white paper.

SAE project members continue to work with the Coastal Systems Station (formerly Naval Coastal Systems Center) on the AN/SSQ-94 Combat System Integrated Training Equipment (CSITE) Program.

The SAE Project helped to form—and is a participating member of—the CSITE Architecture working group (AWG). SAE members provide expertise based on five years of experience in engineering software systems. The CSITE AWG is the vehicle for transitioning SAE modeling and model-based development expertise.

The charter for the CSITE AWG is to define and evolve the CSITE structural model, the CSITE application design, and the software development plan. Project members met with the CSITE AWG on several occasions to address these issues, as shown below:

- CSITE AWG meeting
- TO&P in-progress review (IPR) and CSITE AWG meeting
- Mine Neutralization System (MNS) Interface Controller (MIC) Preliminary Design Review (PDR)

The SAE Project hosted a TO&P IPR with Lyle Burnett, CSITE Program Manager, in February. Burnett expressed his satisfaction with the project's performance on the TO&P. He also expressed interest in the project's continued participation by adding to the existing TO&P. The details of tasking will be finalized in future meetings.

The MIC PDR included a CSITE structural model overview and an MIC preliminary design description. There was agreement that the approach taken was both unique and beneficial.

omain Analysis

The Domain Analysis Project is currently working with several Army projects to use the movement control domain analysis in the implementation of movement control applications. The analysis, completed in 1991, produced a domain model of Army movement control, establishing commonality among movement control applications and representations to support exploiting that commonality. The project used the Feature-Oriented Domain Analysis (FODA) method, developed by the project in 1990, in performing this analysis. The domain analysis provided a model of applications within the domain that has been used for understanding the design of those applications and to support the development of new movement control software.

This quarter, two project members presented a briefing to Major General Harmon, Program Executive Officer (PEO), Command and Control Systems, on the results of the plans for 1992. Major Harmon plans to use the domain model results for movement control as a starting point for identifying commonality across other application areas within Army command and control systems. The movement control

model will become a part of systems in the Army Tactical Command and Control System (ATCCS). Project members have begun discussions with the project manager for the Army Field Artillery Tactical Data System on use of the model.

During this quarter, project members met with developers from Ft. Lee, the Army logistics center, to discuss the application of the project's domain model to their software development efforts. The project's Army working partners in this effort are:

- **Combined Arms Support Command (CASCOM).** The combat developer for Army logistics support software. CASCOM and its contractors are establishing requirements for subsystems of the Department of Army Movement Management System – Redesign (DAMMS-R).

- **Program Manager, DAMMS-R.** The representatives of the Army PEO for Standard Army management information systems.

- **Software Development Center, Ft. Lee.** The material developer from the Army Information Systems Engineering Command (ISEC) responsible for developing DAMMS-R software.

Two applications from the DAMMS-R system are under development:

1. **Operational Movement Program.** This application accepts movement requirements from throughout a theater of operations, generating a movement program that defines shipment mode (road, rail, air, water), sources, destinations, and volume for a two-week period.

2. **Highway Operations.** This application maintains the traffic circulation plan (main supply routes), plans and schedules convoys, and solves conflicts in road use.

During the first quarter, project members have concentrated efforts on applying the domain model in establishing the architecture for the Highway Operations subsystem and developing packages to support both DAMMS-R and other PMs with similar subsystem requirements. In accomplishing this task, the following issues have been studied:

1. **System requirements.** The key Army organizations that participate in movement control and that will use DAMMS-R software have been identified. Project members also identified the features of software that each organization will have and their interactions with other systems.

2. **System architecture.** A matrix listing system-level software, options, and tradeoffs for developing the Highway Operations systems of DAMMS-R has been prepared. System software will include man-machine interface, database, communications, geographic information system, and movement control.

3. **Software systems definition.** The requirements for Highway Operations to plan convoys and regulate highway use were refined (using the domain model). Agreement was obtained from the combat developer on software requirements for personnel using DAMMS-R

4. **Domain analysis method.** A full-day tutorial on methods for and results obtained from domain analysis was provided. The day also included a comprehensive exercise to demonstrate the application of the method.

5. **Software architecture.** An overview of the OCU structural model was presented by an SAE project member. Domain Analysis project members worked out a plan for applying OCU to the identification and design of Highway Operations subsystems.

6. **Shared software.** The use of Common ATCCS Support Software, STARS foundation area software, and other possible sources for development of DAMMS-R was discussed. Project members also reviewed design-for-reuse concepts based on the Common Ada Missile Package model.

Project members have agreed to co-develop a portion of the system to demonstrate use of the domain model for establishing requirements and OCU for design. One project member is currently working on the design of the convoy object for building a convoy structure from a set of vehicles. This object will interface with subsystems under development by ISEC and may also be used with other movement control systems. The object will be a reusable Ada package (or collection of packages) and is the project's first attempt at combining common features identified during the domain analysis with Ada packaging for reuse. In addition, this will be one of the objects forming the convoy builder subsystem, one of the subsystems identified during the OCU discussions with CASCOM and ISEC. This slice is scheduled to be complete by early April. At that time, CASCOM and ISEC will schedule a preliminary design review for the program manager.

A project member has begun to make significant progress in using the 001 tool from Hamilton Technologies for prototyping a movement control system. The project now has the ability to select vehicles and to configure a convoy, and are starting to implement the routing feature. The importance of this effort is a demonstration of the ability of working from a domain model to an operating system, where all entities, features, and the operational prototype are integrated in a single tool.

With the addition of a resident affiliate from the Air Force, the project has begun the transition of its methods and products outside its original Army customers. Project members are working together to establish a comprehensive framework for domain analysis, software architectures, and reuse. These efforts are focussed on three aspects of that framework:

- Modeling techniques for domain analysis, architecture, and implementation.
- Model building.
- Model use to support implementation of new applications.

The results of this effort were presented at a program off-site meeting in February. Project members are preparing an overview paper that will describe a concept of operations for model-based engineering. This paper discusses the roles of domain modeling, requirements engineering, and the software architectural modeling to support software development. This view of modeling to support development will form the basis of the project's transition activities with ESD and other customers.

Project members have also installed a domain modeling and repository tool named CARDS (Central Archive for Reusable Defense Software) on the project system. As the first task, parts of the Army models on CARDS to evaluate the effectiveness of the tool were rehosted. The rehosting demonstrated the approach to documenting a domain model using the reusability library framework. Currently, the tool is used to represent the functional and architectural aspects of the ATCCS domain developed at the SEI and the generic command center architecture developed at ESD. Aspects of the window manager domain have been incorporated into the command center model. A draft report describing use of the tool to document a FODA model has been prepared.

To develop a fundamental understanding of structures for the software architecture level of design, the Software Architecture Design Principles Project is describing basic design elements used in the description, analysis, and development of software systems.

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Software
Architecture
Design Principles

This quarter, project members continued the design and implementation of a low-level architectural connection language. A prototype is now running for pipeline connections.

Project leader Mary Shaw and Wilhelm Schaefer published "Design Methods and Software Processes," in the *Proceedings of the Sixth International Workshop on Software Specification and Design*. Project members also published "We Can Improve the Way We Teach CS Students," which appeared in *Computing Research News*.

The project leader accepted an invitation to organize an International Conference on Computer Languages (ICCL) panel. The paper, entitled "Tyrannical Languages Still Preempt System Design," will appear in the ICCL proceedings.

A project member gave a talk entitled "The Evolution of Computer Drawing Languages and Other Dimensionally Reductive Languages" at the CMU Information Technology Center in January. He also attended the San Francisco USENIX conference in January, where he chaired the tutorial program and assisted in the planning of the summer tutorial program. He also attended a meeting of the USENIX board of directors and a board meeting on "Computing Systems." Also at this conference, the project member submitted an extended abstract on the core language to the summer USENIX conference.

This quarter, a project member spoke on password security at the Sun Users' Group meeting in Chicago, Illinois. While there, he taught a class in device drivers.

The project leader started the MSE and undergraduate software architecture course, which is in part a transition vehicle for this project. Students are reporting that the point of view they learn in this course is useful in other courses. A project member also conducted one of the lectures for this class.

The project leader also attended meetings of the DARPA/Information Science Technology Office (ISTO)/Information Science and Technology Study Group (ISAT) and the Computer Science and Telecommunications Board. She accepted appointment to the executive committee of the DARPA/ISTO/ISAT and began planning for the 1992 summer study.

The Requirements Engineering Project is investigating the methods, tools, and processes necessary for the capture, analysis, and validation of requirements for software-intensive systems. Based on the recommendations from the Requirements Engineering and Analysis Workshop, which was hosted by the SEI in the preceding quarter, the project has developed a detailed plan that is currently under review for approval.

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Requirements
Engineering

Project members have been conducting a survey of requirements engineering techniques that address problems at the front end of the life cycle, where operational and user requirements are defined. The purpose of the survey is to provide a broad

understanding of issues and current techniques for user requirements elicitation, and validation and analysis, and to identify promising technologies that deserve further investigation in each of these areas.

The requirements elicitation task has investigated problems that occur at the beginning of systems development, when user requirements are elicited. Included in this investigation are the problems of communicating with multidisciplinary parties, identifying and resolving requirements conflicts, and rationalizing and prioritizing requirements. Techniques, including controlled requirements expression and joint application development, have been studied and a high-level elicitation process model that addresses the identified problems has been developed. This process model will be integrated with process models from other task areas. It will also be used as a basis for the development of elicitation guidelines during the remainder of this year.

The requirements validation task has concentrated on the application of prototyping techniques as a means of validating requirements. There are many techniques for prototyping, and it is often difficult to understand the purposes and the goals of these techniques. Because of this, project members have been producing a taxonomy, classifications, and an annotated bibliography of prototyping techniques. Also, "concept prototyping" for the support of rapid requirements validation has been explored, and a high-level process model has been produced. This process model will be refined as further exploration of concept prototyping techniques (e.g., the Naval Air Development Center's Storyboard Prototyping, Rome Laboratory's Proto+) are made. This task has acquired Proto+, a prototyping tool from Rome Laboratory, and also intends to explore several other off-the-shelf tools and methods that are supportive of the proposed high-level process.

Critical requirements need special care because errors in the specification can produce disastrous results. The requirements analysis task has been investigating techniques for analyzing safety requirements. A summary of safety issues, standards, and techniques will be produced from this task. Guidelines for structuring and analyzing safety requirements are planned for the fourth quarter of 1992.

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ɔftware
evelopment
nvironments

The Software Development Environments (SDE) Project focuses on environment support for software configuration management (SCM) and on environment architectures in support of integration.

The project has identified the state of commercial technology regarding SCM support. This has been captured through a spectrum of concepts and four observed paradigms. Configuration management (CM) capabilities can be found in SCM tools, computer-aided software engineering (CASE) tools, and environment frameworks, each implementing its own variant of some of the concepts. This variety leads to the need to integrate tools with different SCM capabilities into a software development environment, and the desire for a unified SCM model that can be adapted to different processes. The result is project activity in issues of consolidation of SCM concepts, integration of SCM and CASE tools, and SCM support for the CM process and its relationship to the CMM.

The need for integration of SCM and CASE and a number of emerging environment technologies has led to increased project activity on environment architectures in support of integration. A number of government and industry efforts are focused on

environment reference models and interface standardization. New insights are gained into the problem of environment integration, taking into consideration environment framework mechanisms, engineering service concepts and information models, and engineering processes.

In the SCM area, the goal is communicating findings through articles, presentations, and tutorials. In particular, papers describing aspects of project work on understanding the state of the art in SCM have been accepted for the International Federation of Information Processing World Congress. The paper "The Past, Present and Future of SCM" will be presented at the conference, which will be held this September in Madrid.

Another paper, "Parallels in CAD Framework and SDE Efforts," was presented at the Electronic Computer-Aided Design conference in Germany in March. A tutorial on "The State of the Art in Environment Support for Configuration Management" will be presented at the International Conference on Software Engineering in Melbourne, Australia, in May.

The project has provided consulting and advice on automated SCM to several different organizations, including Siemens/ROLM, Intel, and the National Security Agency (NSA). The last of a series of presentations on SCM and CASE environments entitled "Strategies for CM in a CASE Environment" was given at NSA.

The project has continued its development of a conceptual framework for helping to understand, compare, and analyze environment integration. This work is performed in the context of providing technical leadership in the Navy's NGCR work within their Project Support Environment Standards Working Group as well as participation in the National Institute for Standards and Technology Integrated Software Engineering Environments forum. In addition to direct contributions to these efforts, the conceptual framework and its application are described in detail in two SEI technical reports. These reports are: *The Conceptual Basis for a Project Support Environment Services Reference Model* (CMU/SEI-TR-92-2) and *An Analysis Technique for Examining Integration in a Project Support Environment* (CMU/SEI-TR-92-3). Aspects of this work have been summarized in two papers. "Understanding Integration in a Software Development Environment" (also published as CMU/SEI-TR-91-31) will be presented at the International Conference on Systems Integration, which will be held in Morristown, New Jersey, in June. "Past and Future Models of CASE Integration" will be presented at the CASE '92 conference in Montreal, Canada, in July. Project members also provided working group leadership at the Software Engineering Tools for Ada conference on the topics of environment integration and process support through user interfaces.

In a joint effort with the CASE Technology Project, an investigation into lessons learned from previous government efforts on software engineering environments has been performed in the context of the Air Force SSC Integrated CASE (I-CASE) effort. Initial results have been presented at a workshop with the sponsor. The findings will also be made available in an SEI technical report.

The CASE Technology Project focuses on improving the ability of SEI sponsors and affiliates to make informed decisions about tool adoption and improving their practice in the use of CASE tools. It also provides information to tool vendors on current tool usage and gaps in current technology.

The CASE and Project Support Environment Project completed the initial interviews to obtain "lessons learned" from previous government-sponsored efforts at building or acquiring environments or tools. A two-day workshop was conducted for the SSC at Gunter Air Force Base to understand how the lessons from the past can be applied to future government efforts, including the I-CASE effort. In addition, input was provided to assist in understanding some of the issues with which this effort is dealing.

Project members are beginning a new effort to understand the connection between the CMM and tool usage. This effort will examine how organizations at different levels of process maturity use tools differently.

A Context Analysis of the Movement Control Domain for the Army Tactical Command and Control System (ATCCS)
(CMU/SEI-91-SR-3)

Case Studies in Environment Integration
(CMU/SEI-91-TR-13)

Requirements Engineering and Analysis Workshop Proceedings
(CMU/SEI-91-TR-30)

Understanding Integration in a Software Development Environment
(CMU/SEI-91-TR-31)

For information about ordering copies of SEI reports, see page 35.

Special Projects

The Process Research study will investigate factors that limit software development performance by conducting research on how software process principles are applied to individuals and small teams. This research, in turn, will provide further insight into the processes, tools, and methods that will be the most useful to software professionals.

Process Research

Watts Humphrey completed the statistical defect projection studies and wrote a technical paper on the method.

The Binding of Ada and SQL Project, initiated at the request of the Ada Joint Program Office, has investigated the problem of binding the Ada programming language with the Structured Query Language (SQL) database language. The solution to this problem was the specification of the SQL Ada Module Extension (SAME), an interface that permits an application program written in Ada to access and manipulate data that is controlled by a database management system (DBMS) using SQL.

Binding of Ada and SQL

The SQL Ada Module Description Language (SAMeDL) allows for the partial automation of Ada SQL programs having the SAME architecture. The SAMeDL is under commercial development. It has been specified in the ATCCS, and it is in the process of being standardized by the International Standards Organization (ISO).

This quarter, the project leader attended the American National Standards Institute database standard subcommittee meeting (ANSI X3H2). Also, dissemination of SAMeDL information through workshops, conferences, panel sessions, and working groups continued this quarter.

Software Risk Management

The Risk Program is exploring existing techniques and developing methods for managing risk, assessing practice, preparing organizations to manage risk, and conducting prototype risk assessment methods. To achieve its goal and objectives, the Risk Program must not only provide the mechanisms for managing risks, but must also provide a process that can be implemented within a project and organization and that can facilitate the communication of risk issues. Communicating risk underlies the strategy of addressing risk throughout the acquisition process, with specific attention to developing risk-driven acquisition strategies and systematic risk reviews.

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**Technical
Development**

The Technical Development Area provides mechanisms, methods, and tools for risk management. Project members have developed a risk paradigm as an approach to risk management and are exploring both existing technology and new methods to identify, analyze, plan, track, control, and communicate risk to improve risk management within the defense community.

Work in the Technical Development Area has focused on risk analysis and risk action planning. In the risk analysis arena, project members have completed two internal concept papers: one on the role of risk analysis and one on the consolidation of risk information. As a result of this work, the Analytic Hierarchy Process and the Comparison Risk Ranking (CRR) was chosen for further development as risk analysis methods. Work on the CRR approach has led to a working paper on using the method for ranking program risks. An internal test of the CRR method to verify that the concept is workable has been conducted. The test results led project members to believe that the concept and approach are sound.

In risk action planning, a preliminary design of a mechanism has been produced, and internal testing has been completed. The action planning mechanism is being refined for introduction into the third quarter risk assessments.

Project members have begun an effort to analyze the risk interview and risk assessment data collected thus far. The objectives for this work are to:

- Glean insights that cut across various companies and industries.
- Learn better ways to elicit risk information.
- Verify the effectiveness of our risk management methods.

The data analysis work is drawing on expertise available from other CMU departments, namely the Center for Computational Linguistics, which has developed an approach to analyzing textual data.

Work is continuing on the design of the Software Risk Management course.

In risk identification, a training version of the matrix mechanism report was completed, as was the document design for the risk paradigm report.

The draft Risk Program white paper has completed review by the program and Information Management and was submitted to the JPO for approval.

The project continued support of the Profit through Process Improvement course by presenting the Risk Management module.

A project member presented the Risk Program strategy briefing at the 30th American Institute of Aeronautics and Astronautics conference, and also completed a paper about the project's use of methods that are similar to the Quality Function Deployment (QFD) method for risk identification. This paper will be presented at a QFD conference in June.

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Operations

The Operations Area provides the primary interface to the customers and conducts interviews and risk assessments as test vehicles for developing risk management methods. It provides the development and conduct of interviews, risk assessments, risk assessment training, and risk profiles. Risk management methods are improved through active field work with government and industry defense programs. The Operations Area will develop methods to facilitate and strengthen risk communication through a rational, visible structure for identifying and analyzing risk. This area is concerned with creating viable methods for communicating risks internally within projects and externally to higher levels of management.

During this quarter, project members continued to test the risk management methods with industry customers via risk assessments. Specifically, project members:

- Conducted the probe for risk assessment number 2. The areas probed were system performance and user interface.

- Delivered the final report for risk assessment number 2.

- Conducted pre-training and team training for risk assessment number 3.

- Conducted the Quick Look for risk assessment number 3.

- Negotiated client commitments for risk assessments numbers 4 and 5 in the second quarter of 1992.

In addition to the assessment activity, project members concentrated on government interviews and conducted the project's third Navy PEO(A) risk interview and a risk interview with the Army.

A key part of the project's government focus is the use of risk management principles in the acquisition process. Project members are continuing the work on risk-driven acquisition strategies for government program managers.

During this quarter, a draft of the strategic plan for the TO&P program executive officer was developed and delivered.

The program manager presented the Risk Program at the Air Force Systems Command Product Division Commanders' seminar. An important result of this seminar is that from the Commanders' viewpoint, the highest leverage for risk is in the front end of the acquisition life cycle, primarily in the concept exploration and demonstration and validation phases.

Planning for the next Software Risk Management Conference, to be held in March 1993, has begun. A program committee has been selected and will meet for the first time next quarter. Planning for the COCOMO users group meeting has also begun. It will be held at the SEI in November.

A project member served as an invited speaker at the 4th Annual Strategic Software Systems Conference, which took place on 10-11 March in Huntsville, Alabama. He presented some observations the Risk Program has made as a result of its work and the mechanisms it is testing to identify risks in programs.

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, 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.

The Computer Emergency Response Team Coordination Center (CERT/CC) supplements existing mechanisms by which informally organized experts deal with and prevent computer emergencies. The CERT/CC supports two different communities: Internet users, and developers of technology that is available on the network, such as UNIX and networking software. The CERT/CC provides a dependable 24-hour point of contact for security issues and allows rapid communication during emergencies. It also raises constituents' awareness of security issues and assists individual organizations in improving the security of their systems. Finally, the CERT/CC maintains a highly secure repository of information for team members and cultivates close ties with researchers in the area of trusted systems to improve the security of existing systems.

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CERT Coordination Center

Since its inception in 1988, the CERT/CC has responded to a continuous stream of reported security incidents. These include reports of intrusions, worms, and viruses as well as reports of vulnerabilities and suggested fixes for problems. In handling these problems, the CERT/CC issues advisories to the Internet community to warn them of problems and inform them of preventive techniques. In cases where vulnerabilities exist, the CERT/CC works with software vendors and the technical community in analyzing and resolving the problems.

The CERT/CC continues to work with the Internet Engineering Task Force in several areas related to security:

- The Common Authentication Technology Working Group is developing a generic interface that can be used by a number of protocols for authentication. Currently there are only two authentication mechanisms available: Kerberos and SPX.

- The Privacy Enhanced Mail Working Group is developing implementation standards to provide secure, authenticated electronic mail on the Internet.

- The Internet Anonymous FTP (file transfer protocol) Archive Working Group is creating guidelines for the configuration, maintenance, and use of anonymous FTP archives.

- The Security Policy Working Group completed the document *Guidelines for the Secure Operation of the Internet.* This document is now available as RFC 1281, a final Informational RFC (request for comments). (Final Informational RFCs have been reviewed and approved, and they are not open for further comment.) RFCs are available electronically (via anonymous FTP) from various Internet locations.

The CERT/CC continued in its leadership role within the Forum of Incident Response and Security Teams system. The CERT/CC is sponsoring the Fourth Computer Security Incident Handling Workshop on 3-7 August, in Denver, Colorado. This workshop brings together members of the community of incident response teams, law enforcement agencies, system administrators, managers, academicians, and vendors. The workshop consists of tutorial sessions, technical presentations, panel discussions, invited speakers, and birds-of-a-feather sessions.

During this quarter, the CERT/CC added two new staff members: one to head the Security Research area, and the other to assist with incident responses.

The CERT/CC implemented a domain name change this quarter. The new net address is CERT.ORG. In addition to the name change, the CERT/CC will be establishing Internet connectivity through a second network service provider to improve the availability and reliability of the CERT/CC computer system.

In January, members of the CERT/CC attended the inaugural meeting of SAFE (Security Alliance For Enterprise) Computing, hosted by UNIX International. The objective of SAFE Computing is to promote UNIX as a secure environment for client/server applications. This objective fits nicely with existing initiatives within the CERT/CC to improve the security of commercial products.

Software Process Assessment

The Software Process Assessment (SPA) Project helps organizations improve their software development process by providing a structured method for assessing their current practice. The objectives of an assessment are to identify key areas for improvement utilizing the SEI process maturity model as a framework and to help the organization initiate those improvements.

During this quarter, the SPA Project provided authorized assessment coaching services to AMC and Air Force Logistics Command (AFLC), serving four sites with five assessments.

In addition, authorized SEI/SPA personnel observed vendor-assisted assessments conducted by two of the licensed SPA Associates, Digital Equipment Corporation and Dayton Aerospace Associates. SPA project members also prepared materials for and delivered training to additional staff members from the existing licensed organizations and staff from the DoD Center for Information Management and the Air Force Technology Integration Center.

In the product development area, SPA project members began to update the SPA method for inclusion of the revised CMM in its process, thereby reducing the subjectivity of an assessment. SPA project members participated in an SEI-wide integrated product planning effort for all CMM-related products.

SEI Products

With the goal of helping end-users help themselves, SEI Products works with other groups in the SEI to develop an integrated set of products and services for managers, practitioners, and educators. SEI 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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Undergraduate Curriculum

The Undergraduate Curriculum Project focuses on the long-term development of a highly qualified work force by addressing the needs of the majority of undergraduate computing students who do not pursue an advanced degree. The project promotes and accelerates the development of software engineering as an academic discipline and promotes the establishment of undergraduate software engineering degree programs.

This quarter, the project leader presented issues in undergraduate software engineering education at the 10th Annual National Conference on Ada Technology in Arlington, Virginia. The presentation included a curriculum for educating the next generation of software engineers. It was part of the panel session, "Preparing Students for Industry," attended primarily by college professors.

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Graduate Curriculum

The Graduate Curriculum Project is developing model curricula, promoting the growth of graduate software engineering programs, and working to increase the amount of software engineering content in graduate computer science programs. The project produces educational materials that support the teaching of software engineering in universities.

Project staff handled arrangements for a full day of SEI workshops following the annual ACM Special Interest Group on Computer Science Education (SIGCSE) Technical Symposium, which was held in Kansas City in March. Two workshops were based on work of the MSE Project:

- Techniques and Resources for Teaching Software Engineering Project Courses. This workshop presented materials and methods for teaching undergraduate software engineering project courses.

- Helping Your Students Build Their Communication Skills. This workshop provided an overview of writing fundamentals and teaching tips.

In a third workshop, "Presentation Techniques for Instructors," an instructional designer from the Continuing Education Project discussed adult learning and classroom techniques.

The Continuing Education Project interacts with industry and government to increase the availability of high-quality educational opportunities for software practitioners and executives. The project produces the Continuing Education Series and the Technology Series. The Continuing Education Series provides video-based courses designed for clients' in-house education, and executive offerings designed for decision makers involved in improvement efforts. The Technology Series provides stand-alone presentations that promote awareness of emerging issues and leading-edge technologies.

This quarter, the project presented Software: Profit through Process Improvement, an executive seminar from the Continuing Education Series. Eleven people attended, representing Bell Atlantic, CECOM Center for Software Engineering at Ft. Sill, Century Technologies, Digital Equipment Corporation, EG&G Idaho, Idaho National Energy Laboratory, and the U.S. Air Force at Offutt Air Force Base. The seminar provided an overview of process improvement issues, which are examined in more detail in other SEI executive courses.

From the practitioner curriculum, the project conducted an instructor training session for the Continuing Education Series course, Software Project Management. The class included a member of the SEI Joint Program Office, four participants from the Army, three from the Air Force, two from Telos Systems Group, and one each from IBM France and Science Applications International Corporation. Two of the Air Force instructors attended through the Air Force Computer Resource Management Technology Program.

Project members completed two new courses in the Continuing Education Series. Software Productivity Improvement, a seminar for executives, will be offered on 13-15 April. Software Requirements Engineering, a course for practitioners, will be presented for the first time on 11-20 May. As with all practitioner courses, Software Requirements Engineering includes instructor training.

The project released a new Technology Series videotape: *Applying Software Engineering Skills to Writing*. The video was introduced at a post-symposium workshop following the ACM SIGCSE Technical Symposium. The workshop was one of three presented by SEI staff (see Graduate Curriculum Project, page 29).

A task for the Air Force Institute of Technology (AFIT) was completed with the delivery of a final report on the 1990 Course Development Workshop. During this workshop, the SEI assisted AFIT faculty in developing software engineering courses for the AFIT professional continuing education program.

As part of work defined by the Air Force Computer Resource Management Technology Program, project staff previously developed a prototype instrument called the Software Engineering Training Needs Analysis Survey. This quarter, the project completed the final report and other deliverables associated with this task.

The Software Capability Evaluation (SCE) Project helps DoD acquisition organizations evaluate the capability of contractors to develop and maintain software competently. The project is improving and implementing an evaluation method that examines the software process of contractors for use in software-intensive acquisitions.

The SCE team training course was conducted at the SEI on 7-10 January and 25-28 February.

Paul Byrnes supported SEI presentations delivered to Brigadier General Shulstad of ESD. As a result of General Shulstad's visit, a task force consisting of a joint SEI/government team was formed to investigate issues relating to SCE and SPA site visit results. The group conducted extensive interviews and data analysis and presented preliminary findings to the SEI executive management in March.

SCE project members supported an effort by the IDA, as tasked by Barry Boehm, to collect data about the use of SCE, SPA, and the CMM. SCE project members continued to support efforts of members of the SWAP in their task to develop DoD policies on SCE use. Project members have also been supporting similar efforts for the USAF and with AMC and ESD policy planning groups.

A staff member presented SCE overview briefings at the annual Navy Open Systems and Computer Architectures conference in Washington, D.C. in February, and at the annual Strategic Software Conference in Huntsville, Alabama in March.

Project members conducted a one-day SCE overview seminar at the Government Accounting Office (GAO) headquarters in Washington, D.C. in March. This is a new SCE product offering. GAO has many requests for future delivery of this seminar.

In response to industry's growing demand for skilled software developers, CMU offers a 16-month master's degree program in software engineering. The program is a joint effort of the Carnegie Mellon School of Computer Science and the SEI. The core of the program is based on the SEI curriculum recommendations for MSE programs. The MSE Project also produces the Academic Series, a set of videotaped graduate-level courses on software engineering.

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Master of Software Engineering

This semester, the project is videotaping a revised version of the Academic Series course, Software Design, Creation, and Maintenance. Using a "candid classroom" format, the SEI video studio tapes Robert Firth as he teaches the course to students in the CMU MSE program. The new version will be available to universities in June.

In the Software Analysis course for CMU MSE students, the instructor is prototyping classroom materials that will be released later as SEI educational materials packages.

Customer Relations

Customer Relations accelerates the transition of new 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.

Customer Relations began a subscription program in January. The program is open to any individual with a U.S. mailing address. Subscribers receive regular publications such as *Bridge*, invitations to selected SEI events (e.g., the annual SEI Symposium), and first notification of SEI course offerings and new technical reports. The fee for subscription is $100 per individual for each calendar year. The program applies only to industry and academia; government individuals receive the same benefits at no cost through controlled distribution. For more information, see page 35.

Planning began for the SEI Software Engineering Symposium, which will be hosted by the SEI and will take place in Pittsburgh on 15-17 September. The symposium will bring together software practitioners, managers, and educators to examine the state of software engineering technology and practice in light of SEI projects and plans. SEI products and services, as well as technical focus areas, will be highlighted this year. Participation is open to U.S. industry, government, and academia. Registration forms are now available; a preliminary program has been prepared and will be distributed in May.

Customer Relations held SEI Visitor's Day on 13 February for representatives from industry, government, and academic organizations. The next visitor's day is scheduled for 27 May. Visitors must pre-register with Customer Relations; walk-ins will not be accepted.

This quarter, three new resident affiliates joined the SEI from the following organizations: Defense Logistics Agency, IBM, and University of Catabria. As of 31 March 1992, 16 resident affiliates were working at the SEI. Customer Relations hosted 8 affiliates from industry, 1 from academia, and 7 from the Services and government agencies.

The following organizations sponsored resident affiliates in the first quarter of 1992.

Industry	AT&T Bell Labs
	Computer Sciences Corporation
	GTE Government Systems
	Hughes Aircraft Company
	IBM
	Paramax
	Texas Instruments

Government	Air Force:	Electronic Systems Division
	Navy:	Coastal Systems Station
		Naval Ocean Systems Command
	Army:	Communications-Electronics Command
	Other DoD:	Defense Logistics Agency
		National Security Agency
Academia	University of Catabria	

For More Information

SEI publications are available for purchase. For information, contact one of the following organizations:

RAI   Research Access Inc.
3400 Forbes Avenue, Suite 302
Pittsburgh, PA 15213
Telephone: (412) 682-6510 (or toll-free 1-800-685-6510)
FAX: (412) 682-6530
Internet: abu@cs.cmu.edu

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

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**How to Get
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List of Acronyms