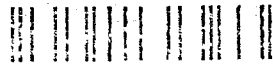


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Carnegie Mellon University
Software Engineering Institute

Quarterly Update

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July-September 1990

92-20043

Summary of SEI Accomplishments: 3Q90

The **Software Process Assessment Project** selected nine corporations to receive training to offer assessment services commercially.

NASA adopted the **rate monotonic scheduling analysis approach** for the Space Station Data Management System. The European Space Agency, On-Board Data Division, announced that the rate monotonic scheduling analysis approach will be the baseline methodology for its hard real-time operating system project.

The **User Interface Project** completed an **interim .9 release of Serpent**. Several organizations, including Telesoft, Digital, Sun, CECOM, and Air Force Electronic Systems Division/Computer Resources Management Technology, have expressed strong interest in the planned **Serpent Consortium**.

The **Risk Program** completed its feasibility study with a detailed plan in which members will evaluate existing methods of identifying, confronting, and resolving risk to develop new methods.

Fall courses began in the **Master of Software Engineering program** at Carnegie Mellon University. The dean of the School of Computer Science recently approved replacing the 24-month program with a 16-month curriculum.

Students who attended the **Software Development Studio** in the spring and summer sessions delivered their product, the Medusa software tool, to the Wichita Division of Boeing Defense Group—on time and within budget.

The **Continuing Education Project** is presenting the **fourth offering of Software Project Management for Instructors** this quarter and delivered an interim report for the **Course Development Workshop** to the Air Force Institute of Technology (AFIT).

Beta testing began for the intelligent hypermedia tutoring system developed by the **Advanced Learning Technologies Project**.

The **Software Architectures Engineering Project** and the **Information Sciences Technology Office (ISTO)** of the **Defense Advanced Research Projects Agency (DARPA)** held a **workshop on domain-specific architectures (DSSA)** in July as part of an initial step toward the development of a DARPA research program in DSSA.

A **prototype SAME Description Language (SAmDL) processor** based on the SQL/Ada binding was delivered by Intermetrics to the project manager of the **Army Tactical Command and Control System Common Hardware Software**.

Technology Applications created a new **electronic mailing list** intended to foster discussion among researchers and practitioners from academia, government, and industry who are working on **technology transition and innovation**.

Eleven new **industry affiliates**, one new **academic affiliate**, and five new **resident affiliates** joined the SEI this quarter.

The **fifth SEI Affiliates Symposium** was held in September and included more than 80 hours of presentations highlighting SEI programs, plans, and activities. The symposium was attended by 543 people from affiliate organizations.

The **Computer Emergency Response Team (CERT)** continued working with the **Internet Engineering Task Force** and produced the first draft of an **Internet Security Policy**.

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This section provides
a summary of
accomplishments from
July–September 1990

Table of Contents

Software Capability Evaluation	1	Software Engineering Process
Software Process Assessment	2	
Software Process Measurement	2	
Software Engineering Process Definition	3	
Software Development Environments	5	Software Engineering Methods
Software Architecture Design Principles	5	
Software Process Modeling	6	
Domain Analysis	6	
Application of Formal Methods	7	
Real-Time Embedded Systems Testbed	9	Software Systems
Rate Monotonic Analysis for Real-Time Systems	9	
User Interface	10	
Software for Heterogeneous Machines	11	
	13	RISK
Software Engineering Curriculum	15	Education
Continuing Education	16	
Advanced Learning Technologies	17	
Software Architectures Engineering	19	Ada & STARS Support
Binding of Ada and SQL	20	
Study and Analysis for Ada 9X	20	
Technology Applications	23	Technology Transition
Affiliate Relations	24	
Empirical Methods	25	
	27	CERT Coordination Center
	29	For More Information

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Software Engineering Process

The Software Engineering 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 Capability Evaluation (SCE) Project is responsible for refining a method for evaluating the software process capability of contractors. The project transitions this method to acquisition organizations wishing to reduce program risks and to improve their software suppliers' product quality and performance on cost and schedule.

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**Software Capability
Evaluation**

In July, evaluation teams from the Air Force's Electronic Systems Division, MITRE, and the Army's Communications and Electronics Command participated in a Software Capability Evaluation training program held at MITRE in Bedford, Massachusetts. Project members presented an overview of the SCE method and led the teams through simulated visits to two contractor sites.

In September, project members trained evaluation teams from the Joint STARS program, the Naval Air Development Center (NADC), and the Army Program Office for Training Devices. The training program was held at the SEI.

Project members visited NADC and Naval Weapons Center (NWC) in July and August to collect feedback on their use of the capability evaluation method over the past year. DoD experiences with the method are being incorporated in the usage guides that project members are developing.

The Questionnaire Advisory Board met with project members in July to review in detail the software management and engineering practices covered in the draft of the capability maturity model released in June. The board, which is composed of seven government and industry professionals, met again in September to continue the review. Project members will incorporate the board's comments in the next draft of the model.

Project members were actively involved in the Affiliates Symposium. A one-day tutorial on the capability maturity model was attended by more than 100 participants from industry and government. Other project members demonstrated a prototype version of AESOP (Assistant for Evaluating Software Practice), a software program designed to support assessment and evaluation teams. In another session, project members illustrated the essential features and capability of a Level 3 software company. After listening to a series of simulated interviews between the company and a government capability evaluation team, the audience had to identify the strengths and weaknesses of the company. Following this session, project members gave a presentation on the usage status of SCE in the DoD. David Rugg from NWC then discussed NWC's positive experience in using SCE in a recent source selection.

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**Software Process
Assessment**

The Software Process Assessment Project assists software organizations in launching effective process improvement programs, characterizes and reports on the software engineering capabilities of defense contractors, and defines priority needs for software process improvement in the defense community.

Project members acted as observers for self-assessments conducted by Tinker Air Force Base in Oklahoma City, Oklahoma, and by IBM Federal Sector Division (FSD) in Manassas, Virginia. The project frequently provides one or two observers experienced in assessments to attend an organization's initial self-assessment.

Initial vendor response to the project's commercialization effort has been very positive. In July, 69 people from 54 organizations participated in a one-day vendor briefing held at the SEI. Twenty-six organizations then submitted Service Development Proposals for consideration to become a commercial vendor who will offer assessment services. After reviewing each proposal, the Vendor Selection Committee chose four organizations (Arthur D. Little, Inc.; Booz, Allen, and Hamilton Inc.; Software Productivity Consortium; and Technology Applications, Inc.) to attend the vendor training, which was held September 30 to October 5. An additional five organizations (American Management Systems, Inc.; Contel; Dayton Aerospace Associates, Inc.; Digital Equipment Corporation; and pragma Systems Corporation) were selected to attend the second vendor training class, which will be held in January 1991.

Version 2.0 of the assessment data analysis system (ADAS) was completed. The ADAS is a combination repository and analysis platform for assessment-related data and is used for (among other things) state-of-the-practice reporting.

Preparations are nearing completion for the on-site phase of the Japanese maturity study, which will take place in October. The objective of the study is to better understand Japanese software engineering capabilities from a process maturity perspective. Process Program members will visit leading Japanese software organizations. They expect to collect a large amount of data from responses to the maturity questionnaire.

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**Software Process
Measurement**

The Software Process Measurement Project (formerly the Software Process Development Project) advocates the use of measurement in the practice of software development and management. Toward that end, it coordinates a steering committee, two working groups, and a best-practices study, all devoted to encouraging organizations to use quantitative methods to improve their software processes.

The Software Metrics Definition Working Group met for three days in August. The quality subgroup of that working group circulated a draft of its portion of a definitions report to about 640 reviewers, composed of members of the Software Acquisition Metrics Working Group and subgroups, the metrics correspondence group, and SEI affiliates. More than 60 responses were received.

Leaders of the Software Acquisition Metrics Working Group met in Los Angeles to revise the outline of a planned report, to evaluate written contributions, and to begin to write to the revised outline. James Rozum, the working group co-chair from the SEI, established a document register and process to track comments on the working group's products.

To encourage organizations to adopt measurement, project members are collecting best practices and motivations, which will be published in an SEI technical report. To further the collection, project members visited several sites considered to be leaders in software measurement.

Project members made presentations to the Joint Logistics Commanders Computer Resources Management Committee, the IBM Software Technology Steering Committee, and Ellemtel (a Swedish company). They also presented at the Second Annual Software Quality Workshop and a Total Quality Management train-the-trainer course at the Defense Systems Management College.

Project leader Stan Rifkin completed the text of the *Software Engineering Process Group Guide* (CMU/SEI-90-TR-24), co-authored with Priscilla Fowler of SEI Technology Transition. This report is scheduled for release at the SEPG Workshop in November. He also visited the Naval Ocean System Center to help its process group revise its strategic action plan.

The Software Engineering Process Definition Project supports process improvement through the maturation of the methods and technology associated with software engineering process definition. The project is developing the capabilities required to support the definition and evolution of software processes within an organization.

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**Software Engineering
Process Definition**

The project is currently supporting process definition and development at Standard Systems Center (SSC) at Gunter Air Force Base. The project is also exploring advanced applications of process definitions through the Software Technology for Adaptable Reliable Systems (STARS) program.

Planning for the development and implementation of enhanced processes was initiated during this period. Project members collaborated with SSC working groups to develop tactical action plans for developing, piloting, and implementing new or enhanced processes. The action planning process is an essential part of a process improvement initiative. Action planning builds support for the improvement effort among those organizations that are impacted, documents the problem and approach to a solution as seen by experts within the organization, and identifies the activities required to pilot and implement the proposed solution.

Project members participated in problem identification and action plan development and review with SSC. They also conducted a structured technical review of the tactical plan of the SSC Project Management Working Group.

Project leader Jim Over assumed the role of deputy chair for the STARS Process Working Group (SPWG). The SPWG provides recommendations to the STARS Program Manager to achieve the goals of the program related to process and process metrics. The SPWG will review the programs of STARS primes related to process and process metrics, examine the programs for unnecessary overlap, examine the programs for uncovered areas of potential high leverage, facilitate and coordinate education and information interchange among the primes and other related activities, and make recommendations to the STARS Program Manager for modifications to the program. Over and other project members participated in planning activities associated with STARS.

Software Engineering Methods

The primary objective of the Methods Program is to improve the practice of software engineering by improving individual and team productivity through the identification and transition to practice of emerging software technology. Promoting the appropriate use of this technology supports the SEI effort to transform software development from an ad-hoc, labor-intensive activity to a technology-supported engineering discipline.

The Software Development Environments Project is assessing state-of-the-art commercial environment support for configuration management (CM) with the goal of moving toward a common CM model.

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**Software Development
Environments**

The project has reviewed a number of commercial systems and identified three major CM concepts in recent commercial systems. These findings have been presented in an all-day tutorial entitled "Software Configuration Management: Advances in Software Development Environments," which was presented at the SEI Affiliates Symposium and taped at the SEI Video Studio. The findings will be documented in four reports planned for 4th quarter, 1990.

This quarter, project members began to investigate the integration of CASE tools with CM systems. Tools use their own data management schemes and provide their own multi-user and versioning support. The purpose of the investigation is to assess integration issues between tools and CM systems, and to identify appropriate interfaces between them. Such interfaces are considered to be a stepping stone toward a common CM model.

Project members were involved with a number of external activities related to CM systems. They contributed to the review of the European Computer Manufacturing Association (ECMA) reference model draft as part of a National Institute of Standards and Technology (NIST) Integrated Software Engineering Environment Working Group. They participated in a STARS/User Workshop and planning activities of the STARS Program. In cooperation with the CASE Technology Project, they started a survey of environment integrators in preparation for the Navy Next Generation Computer Resources/Programming Support Environments (NGCR/PSE) Working Group effort. Project members also gave presentations at the Software Process Symposium and participated in the 2nd International Symposium on Future Software Environments.

To develop a fundamental understanding of structures for the software architecture level of design, this project is describing basic design elements used in the description, analysis, and development of software systems.

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**Software Architecture
Design Principles**

The project completed two technical reports this quarter. The first, *Informatics for A New Century: Computing Education for 1990s and Beyond* (CMU/SEI-90-TR-15), sketches the coming needs for information processing and analyzes the populations that will require informatics education.

The second report, *Prospects for An Engineering Discipline of Software* (CMU/SEI-90-TR-20), begins by examining the usual practice of engineering and the way it has evolved in other disciplines. This discussion provides an historical context for assessing the current practice of software production and setting an agenda for attaining an engineering practice.

Project leader Mary Shaw took part in the DARPA/ISAT (Defense Advanced Research Projects Agency/Information Science and Technology) summer study group. She also served as a member on the advisory Computer Science and Telecommunications Board. In addition, her participation in a meeting for Principal Investigators at the Office of Naval Research provided an opportunity to disseminate her view of the software architecture problem.

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**Software Process
Modeling**

The Software Process Modeling Project is investigating techniques for modeling software development and maintenance processes.

The project delivered a Statemate model of the *Military Handbook for Mission Critical Computer Resources Software Support* (MIL-HDBK-347). Since then it has concentrated on examining extensions to the modeling techniques developed previously.

To date, the process models have concentrated on showing the flow that a single software change request followed as it progressed through the software development process to be incorporated into a software release. These models showed all the possible paths that could be taken by such a change request.

The project has extended the modeling technique in two ways:

- By applying significant new capabilities of Statemate to the model of the MIL-HDBK-347 process (expected to be completed next quarter), and
- By examining how to upgrade the model to account for aggregate change requests (rather than individual change requests).

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Domain Analysis

This project is developing and testing methods for performing domain analysis to support software reuse. The primary objectives of the project are to define a process and set of products to support the systematic discovery and exploitation of commonality across related software systems and to apply the process to a domain within the Army Tactical Command and Control System (ATCCS).

During this quarter, the project drafted a report that defines the process and the products of a feature oriented domain analysis (FODA) and provides a sample domain analysis. This method of domain analysis will be used during the next phase to analyze the project movement control subsystems within the Army's Advanced Tactical Command and Control System (ATCCS).

During this phase, project members performed the initial scoping activities of the domain analysis of movement control software. This software manages and controls the movement of tactical battlefield resources. It supports three planning activities:

- 1) preparing movement requests
- 2) coordinating those requests with the appropriate force level headquarters
- 3) maintaining movement files

The project has prepared a *structure chart*, *context diagram*, and *domain terminology dictionary* as part of this analysis. (Note: these three products are all defined in our domain analysis method.)

During the quarter, project members participated in the following outside activities:

The project provided three presentations at the Affiliates Symposium: these included a full-day tutorial on Software Reuse Technology, a demonstration and discussion of the project at the Open House, and a one-hour briefing on the project as one of the regular Symposium tracks.

Project member Sholom Cohen is participating in planning for the next phase of the DoD Software Technology for Adaptable Reliable Systems (STARS).

The Application of Formal Methods Project is investigating various approaches by which DoD agencies and contractors may make use of formal software development methods.

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**Application of Formal
Methods**

This quarter, the project completed a survey of formal techniques appropriate for specification of MCCR systems and started work on a formal development method.

The survey has been concerned with formal techniques appropriate for the specification of MCCR systems. We have concentrated solely on specification and have left development methods for later work.

The project developed a number of criteria with which to judge the specification techniques. These criteria may also be used to match a system to the most appropriate specification technique for the system. Project members also created a sample generic avionics system specification using three specification techniques: Communicating Sequential Processes, Temporal Logic, and an extended Vienna Development Method.

The system development work currently under way uses the formal specification as part of the process for developing code. Generally, formal methods have been used to create a specification that has desirable properties, after which code is developed in an ad hoc manner. The project approach is to begin with the formal specification and, using a sequence of transformations, translate the specification into a notation specific to the programming language. Subsequent development adds code to this specification. The initial investigations are complete, and the project is now looking for more substantial examples to prove the approach.

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Informatics for a New Century: Computing Education for the 1990s and Beyond
(CMU/SEI-90-TR-15)

**Methods Program
Reports**

Prospects for an Engineering Discipline of Software
(CMU/SEI-90-TR-20)

July-September 1990

A Domain Analysis Bibliography
(SEI-90-SR-3)

For information on how to order modules and reports, see page 29.

Software Systems

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

The Real-Time Embedded Systems Testbed Project is collecting, classifying, generating, and disseminating information about software development for real-time embedded systems.

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**Real-Time Embedded
Systems Testbed**

The project has completed a series of tests using the Hartstone benchmarks, the results of which have been documented in a technical report, *The Hartstone Benchmark Results and Analysis Report* (CMU/SEI-90-TR-7). The Hartstone results were obtained for six of the eight Ada compilers that the project has in-house: DDC-I, DEC VAX/VMS, Rational, System Designers, TeleSoft, and Verdix.

A project member made a presentation based on project work on the Ada Compiler Evaluation Capability (ACEC) and Ada Evaluation System (AES) to the Ada Board on 29 June. (The ACEC was developed by Boeing under contract to the U.S. DoD and the AES by the U.K. MoD.) John Solomond, director of the Ada Joint Program Office (AJPO) indicated that the AJPO has decided to pursue, with the British, a merger of the two test suites.

The project has stayed in contact with the ACEC development. A project member attended the kickoff meeting of Version 3.0 in Dayton, Ohio on 2-3 July.

The Real-Time Scheduling in Ada Project has changed its name to Rate Monotonic Analysis for Real-Time Systems to reflect its focus on the scheduling theory by that name.

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**Rate Monotonic Analysis
for Real-Time Systems**

Work is continuing on applying rate monotonic theory to the BSY-2 to identify and help solve potential performance problems. The BSY-2 program has become extremely interested in RMS as a result of transition work by the project.

Project members are continuing to support Next Generation Computer Resources (NGCR). Two project members are working with other NGCR task group members to prepare an issue paper for handling end-to-end priorities from a systems viewpoint.

NASA has adopted the rate monotonic scheduling (RMS) theory for the Space Station Data Management System (DMS). Project members are providing input for amendments to the DMS requirements document to reflect the adoption of RMS by NASA, the result of significant project effort to transition RMS into practice.

The European Space Agency, On-Board Data Division, has announced that the Rate Monotonic Scheduling Theory will be the baseline methodology for its hard real-time operating system project. The selection criteria include: guarantee that tasks with hard timing constraints will always meet their deadlines; attain a high degree of processor utilization; provide fast average response time for tasks with soft deadlines; account for inter-task communication; and other criteria, such as existence of tools/kernels, performance, maturity, etc.

An ongoing effort of the project concerns the creation of a collection of instructional materials on principles of rate monotonic scheduling theory. These materials were enhanced and extended for use in a tutorial that will be offered at Tri-Ada 90. These materials are also being transitioned to the Research Institute for Computing and Information Systems (RICIS), which will provide courses to NASA and NASA contractors.

Project members are investigating issues involving real-time extensions to POSIX.

The first draft of the real-time system chapter of the *IEEE Futurebus+ System Design Manual* was submitted to the Futurebus+ committee by Lui Sha of the SEI and Rangunathan Rajkumar of IBM Research. In addition, project members have been working actively with the Operating System Standard Working Group (OSSWG) and POSIX.4 communities to help ensure that the real-time computing needs will be properly supported in POSIX.4. Currently, a proposal on multi-processor task allocation was submitted by Douglass Locke of the Federal Sector Division of IBM and Lui Sha of the SEI. The rate monotonic interface is currently under development.

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User Interface

The User Interface Project is developing Serpent, a user interface management system. Serpent separates the concerns of the user interface from those of the application, which allows integration of input/output technologies without modifying the functional portion of the application.

An interim .9 release of Serpent has been completed and made available to the Serpent user community. The interim release includes the full Motif widget set and a usable snapshot of the editor. It also includes a generalized integration mechanism for Xt widgets. Substantial performance enhancements have been made to the Slang compiler. The project is now working on the 1.0 release, which will include visualization capability for all widgets within the editor, a totally revised set of documentation, and performance enhancements to the runtime system.

Several organizations have expressed strong interest in the planned Serpent Consortium. Among these organizations are Telesoft, Digital, Sun, Communication and Electronics Command (CECOM), and Electronic Systems Division/Computer Resources Management Technology. Once feedback on a draft of the consortium agreement has been obtained from these organizations, a decision about whether or not to form the consortium will be made.

The Affiliates Symposium was a success for the User Interface Project. Prior to the Symposium, project members sponsored a day of user interface development tools presentations, which brought together producers of the leading user interface tools (including TAE+, Serpent, Teleuse, DV Tools, and WinterP). In addition, a two day meeting was held with developers to generate a framework for the next generation of tools.

Project members attended the P1201 standards meeting at Danvers, MA, this quarter. There were previously two different efforts ongoing within the standards group. The 1201.1 group was working on standardizing toolkits and the 1201.3

group, under a UI project member's leadership, was working on standardizing UIMSs. The 1201.1 group is broadening its scope to include some UIMS issues. As a result, the 1201.1 and 1201.3 efforts might be merged. It is not clear when the issues will be resolved. Serpent, however, was presented as a standards candidate to the 1201.1 group.

Mike Parsons, a West Point cadet who spent three weeks at the SEI, has completed the field artillery battery control demonstration on Serpent. He designed and implemented this complicated user interface using Serpent in about a week and a half. This demonstration will be installed in the standard Serpent demo suite.

The Software for Heterogeneous Machines Project is developing tools and a methodology for building distributed, large-grained, concurrent applications running on heterogeneous machine networks. The project has developed Durra, a language for describing distributed applications as a set of task descriptions and type declarations that prescribe a way to manage the resources of the network.

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Software for Heterogeneous Machines

The project completed an implementation of the Durra communications task. This task allows dynamic routing of typed messages between Durra application programs. Testing has been completed and the communications task has become a built-in task in Durra and runs as part of the runtime executive.

Project members are customizing the EDGE graphics editor as a front-end tool for developing Durra applications. EDGE was developed at the University of Karlsruhe by Frances Newbery.

The Durra demonstration during the Affiliates Symposium was well attended and generated a number of inquiries for further information about Durra and Durra licensing agreements. The project had upgraded the network simulation demonstration to allow the use of Serpent to build operator displays. This was one of the featured demonstrations. As a result of interest expressed at the Symposium, the project will explore ways to tape the standard demonstration.

The project is exploring an activity to be done jointly by Hughes Aircraft, CECOM Center for Software Engineering, and the SEI. Project members are gathering additional information about the application (modeling and prototyping real-time applications) and will send a representative to the October CECOM Real-Time Technical Interchange Meeting.

Hartstone Benchmark Results and Analysis
(CMU/SEI-90-TR-7)

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Systems Program Reports

An Analysis of Input/Output Paradigms for Real-Time Systems
(CMU/SEI-90-TR-19)

July-September 1990

For information on how to order reports, see page 29.

Risk

The Risk Program is focusing on improving the management of risk in DoD programs involving software-dependent systems. In this context, risk management is the identification, confrontation, and resolution of software-related risks. The program objectives are to establish a foundation for addressing software related risk and to strengthen the ability of organizations in the software community to evaluate and manage software-related risk.

The Risk Program completed its feasibility study with a detailed plan for four phases in which members will evaluate existing methods of identifying, confronting, and resolving risk in order to develop new methods. The first phase culminated with an internal review of the program's early concepts and planning and with a decision to proceed to the second phase, risk assessments. During this phase, the program is developing mechanisms for systematically identifying software technical risk.

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The program has continued its interaction with the software acquisition and development communities through awareness briefings and in-depth interviews. These interviews follow a structured format and questionnaire to extract information concerning risk management practice and problems, as well as issues that managers and practitioners face on specific projects. During this quarter, the program conducted interviews with three companies and five projects.

Education

The primary objective of the SEI Education Program is to increase the number of highly qualified software engineers by rapidly improving software engineering education throughout the education communities of academia, government, and industry. To accomplish this, the projects of the Education Program focus on accelerating the development of software engineering programs in academia and on enhancing opportunities for the continuing education of practitioners.

A combined Educator Development/Continuing Education Workshop was held September 10 in Pittsburgh. The 86 attendees represented academia, government, industry, and the SEI. SEI staff members presented a curriculum module on understanding program dependencies and an education materials package on reading computer programs (see page 17 for titles). Other sessions included panels on industry needs and on academic and industry cooperation, and a description of one university's cooperative effort with industry and the SEI.

Fall courses began in the Master of Software Engineering program at Carnegie Mellon University. The core of the MSE program is based on the SEI Academic Series and a software development studio modeled on architectural studios. The dean of the School of Computer Science recently approved replacing the 24-month program with a 16-month curriculum.

Students who attended the Software Development Studio in the spring and summer sessions delivered their product, the Medusa software tool, to the Wichita Division of Boeing Defense Group, Military Airplanes. Medusa provides window system capabilities to users of DEC VT-220 and VT-320 terminals. Medusa runs under the DEC VMS operating system and enables users to perform multiple computer tasks simultaneously from a single terminal. Medusa thus enhances end-user productivity without requiring additional capital investment for new workstations. In June, the students assisted Boeing systems managers in installing the tool and gave training to a group of approximately a dozen engineers. The product was delivered on time and under budget. Initial reaction to the tool was highly positive.

The Software Engineering Curriculum Project is developing model curricula, promoting the growth of graduate software engineering programs in the academic community, investigating the feasibility of undergraduate programs, and working to increase the amount of software engineering content in both undergraduate and graduate computer science programs. The project produces educational materials, including the Academic Series (formerly part of the Video Dissemination Project), a set of videotaped graduate-level courses available to universities who agree to offer them for academic credit.

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Software Engineering Curriculum

During the fall semester, five *Academic Series* courses are being offered at the institutions listed:

Software Project Management – Regis College and University of Houston at Clear Lake

Software Specification – Regis College, Eastern Michigan University, and East Tennessee State University

Systems Design – Florida Atlantic University (six sites), Rose-Hulman Institute of Technology, and East Tennessee State University

Software Verification and Validation – Florida Institute of Technology

Software Creation and Maintenance – East Tennessee State University

Project member Gary Ford participated in a workshop on “how computing education can help solve the software crisis” as part of the National Educational Computing Conference [NECC] held in Nashville, Tennessee, on June 25–27. Ford presented a special session at NECC, titled “Teaching a Software Engineering Project Course.”

A call for papers has been released for the Fifth SEI Conference on Software Engineering Education, which will be held in cooperation with ACM and the IEEE Computer Society on October 7–8, 1991. The conference brings together college and university educators, industry educators and trainers, and other professionals concerned with the preparation of new software engineers and the continuing professional development of current practitioners. The conference invites submission of papers and panel proposals on any aspect of software engineering education or training at any level. Topics of special interest include design, formal methods, graduate software engineering education, and industry software engineering education and training. The deadline for papers is February 4, 1991.

An Educator Development Workshop has been scheduled for October 9, 1991, following the Conference on Software Engineering Education.

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Continuing Education

The Continuing Education Project (formerly Video Dissemination Project) interacts with industry and government to increase the availability of high-quality educational opportunities in software engineering topics for software practitioners. The project produces two video-based series: the Continuing Education Series, whose courses are designed for clients' in-house education; and the Technology Series, which provides stand-alone presentations that promote awareness of emerging issues and leading-edge technologies.

The fourth offering of Software Project Management for Instructors is being presented this quarter. Nine individuals are participating; they represent the Defense Logistics Agency, Ford Aerospace, Fordham University, Israeli Aircraft, Lockheed, MITRE, and Standard Systems Center. Three of the attendees are SEI resident affiliates. The group will complete the course in October and receive 5.4 continuing education units. This session qualifies them to serve as learning facilitators for the course at their respective organizations. The SEI provides guidance in tailoring the course to meet the educational requirements of their organizations.

The project delivered an interim report for the Course Development Workshop to the Air Force Institute of Technology (AFIT). During the six-month workshop at the SEI, participants from AFIT, General Dynamics, and the University of Scranton developed five courses: Software Generation and Maintenance, Principles and Application of Software Design, Specification of Software Systems, Software Verification and Validation, and Software Engineering Concepts. The interim report discusses accomplishments, lessons learned, and recommendations for undertaking such an effort in the future. A final report will be released in the spring as an SEI technical report.

Project member Nancy Mead visited AFIT to attend dry-run presentations of the Software Engineering Concepts course, which will be offered in October.

The Advanced Learning Technologies (ALT) Project is using hardware and software technologies to teach software code inspections. Interactive, technology-intensive training can be distributed economically to a broad audience and can provide an effective learning experience.

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**Advanced Learning
Technologies**

The beta test version of the CD-ROM disk was sent to the beta sites. Further review of the beta test and final production will be handled by the SEI Technology Transition Program (see page 23 for further information).

Reading Computer Programs: Instructor's Guide and Exercises
(CMU/SEI-90-EM-3)

Understanding Program Dependencies
(SEI-CM-26)

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**Education Program
Reports**
July-September 1990

For information on how to order modules and reports, see page 29.

Ada & STARS Support

As Ada use becomes more common in software-dependent systems, users will be faced with the benefits and problems of adopting more disciplined approaches to software engineering. The goals of the Ada and STARS (Software Technology for Adaptable, Reliable Systems) Support Effort are to remove technical and managerial impediments to the adoption of Ada, to support the DoD STARS Program in technology development and transition efforts, and to explore the advantages and disadvantages of new software engineering approaches and paradigms made possible by Ada language features.

The Software Architectures Engineering (SAE) Project provides to DoD program offices improvements to the practice of software engineering by assisting in the development and insertion of new architectural and practice models where old models have proved inadequate. The project accomplishes this by assisting in the development of a new set of engineering optimizations (goals) in the application area and setting the requirements for models tunable to the new optimizations. The new models are packaged so that they can be adopted by practitioners in the area by extending the architectures to address possibilities precluded by the current model set. Project members are refining and maturing the new model sets by transitioning them to other projects and providing additional sources of reflection on their use.

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**Software Architectures
Engineering**

The SAE Project and the Information Sciences Technology Office (ISTO) of the Defense Advanced Research Projects Agency (DARPA) held a workshop on domain-specific software architectures (DSSA) in July to delineate the issues relevant to the creation and use of architectural-based software development approaches. The workshop was attended by 47 technical participants from industry, government, and academic institutions, and 7 observers from DARPA/ISTO and the SEI. The workshop was an initial step toward the development of a DARPA research program in DSSA.

Since the workshop, SAE members have been involved in the production of the workshop proceedings for distribution to potential bidders in the program, a workshop committee report for DARPA, and a bidders' conference to be held October 1, 1990. The workshop proceedings will be used by DARPA to solicit research proposals to address DSSA in various application areas.

The SAE Project explored the definition of a command, control, communications, and intelligence (C3I) model set with several organizations this quarter. Discussions were held with the Command Center Evaluation System (CCES) Project at Electronic Systems Division (ESD), a Strategic Air Command (SAC) group at Offutt Air Force Base, and a group at ESD that is investigating the definition of a generic Command Center architecture.

During this quarter, SAE project members reflected on past and present project efforts, relating those efforts to the writings and practices of other engineering disciplines. The results of this effort provided the basis for the SAE Project SEI Affiliates Symposium presentation and Open House discussion group. These results will be presented in a conference paper/presentation or SEI technical report.

As part of the SAE Project's continuing involvement with the Air Force Electronic Combat Office (AFECO), SAE project members are working with the Tri-Service Crossbow's Digital Simulation Steering Group Architectures Working Group. This effort will result in an architecture and model set for the simulation of radar and electronic combat systems.

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**Binding of Ada
and SQL**

The Binding of Ada and SQL Project, initiated at the request of the Ada Joint Program Office (AJPO), 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 Extensions (SAME), an interface that permits an application program written in Ada to access and manipulate data controlled by a database management system (DBMS) using SQL.

Work is continuing on the definition, implementation, and standardization of the SAME Description Language (SAMEDL). A meeting of the organizations implementing the SAMEDL was held at the SEI in July.

A prototype SAMEDL processor was delivered by Intermetrics to the project manager of the Army Tactical Command and Control System (ATCCS) Common Hardware Software (CHS). In support of ATCCS CHS, the Center for Software Engineering (CSE) at the Communication and Electronics Command (CECOM) has examined that processor and will be making recommendations to the CHS project manager.

The first complete draft of the SAMEDL reference manual will be ready for an October release. It will be mailed to members of the International Standards Organization Working Group on Ada, ISO/JTC1/SC22/WG9, and to members of the American National Standards Institute Database Committee X3H2. An informational brief will be given to X3H2 at their October meeting in California.

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**Study and Analysis
for Ada 9X**

The Ada Joint Program Office (AJPO) has decided that a revision to the Ada language standard is required to maintain it as a standard (ANSI/MIL-STD-1815A). This revision process is commonly referred to as Ada 9X. The purpose of this project is to identify and evaluate potential areas for revising the Ada standard based on the experiences of software developers and compiler implementors. This project is providing an organizational framework to help guide revision activities.

The SEI requirements team prepared a new version of the Ada 9X requirements document and distributed it to the Ada Distinguished Reviewers. A meeting of the Distinguished Reviewers in Washington in July provided feedback concerning

that version, and revision was done. The revised requirements were presented to the general public at a national SIGAda meeting in August, and comments were solicited from the general public. Feedback at the meeting indicated that most felt that the requirements were about "on track": about 10% thought them to be too conservative, about 10% thought them too extreme, and the rest thought them about right.

Since then, a draft document has been prepared to track revision requests to show how (or if) they have been incorporated in the requirements process.

The SEI recently hosted the STARS/USERS workshop in September. The workshop was geared toward increasing communication between the STARS program and those who specify, buy, and use environments to build and maintain large-scale, software-dependent systems. At the workshop, users provided input to the STARS program plans and target organizations reviewed STARS program goals, objectives, and progress. In addition, the STARS program sought to validate its goals, objectives, and plans. The workshop featured an overview of the current direction of the STARS program, a discussion of key issues affecting the program, and the technical thrust of the contractor efforts to date. Eleven groups discussed and provided input to STARS regarding various aspects of reuse, process, interface standards, technology transition mechanisms, and plans for STARS evaluation.

Several SEI staff members are participating in the Tier-2 planning process, which is the next step after the September workshop.

Technology Transition

The Technology Transition Program is the focal point for SEI transition efforts. The program works with other SEI programs to match problems and solutions in the DoD software community.

Technology Applications provides a link between DoD mission-critical application domains and ongoing SEI activities in technology evaluation, development, and transition. Technology Applications staff perform this role by working in collaboration with SEI programs to bring about the maturation, adoption, and institutionalization of SEI supported technologies and to reduce the time it takes for software engineering improvements to transition from research into practice. These efforts to mature and transfer technology are applied to DoD transition sites that are principally chosen for their ability to influence the further adoption of a technology throughout a larger community. The transition experiences are then used to enhance transition models, processes, methods, and tools that will benefit both the transition of SEI technology and the ability of MCCR organizations to absorb new technologies.

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**Technology
Applications**

The beta test began in this quarter for the intelligent hypermedia tutoring system developed by the Advanced Learning Technologies (ALT) Project. Technology Applications has been providing transition engineering support to this project for the last 18 months and will manage the beta test. Test sites include the Air Force Standard Systems Center at Gunter Air Force Base, the Jet Propulsion Laboratory, and Virginia Polytechnic Institute and State University. The test will last for two months, and the sites will provide feedback on system form and function using data collection instruments developed by Technology Applications. When the test is complete, the ALT project team will use the results to modify the system prior to its public release, scheduled for the first quarter of 1991.

In this quarter, Technology Applications created a new electronic mailing list intended to foster discussion among researchers and practitioners from academia, government, and industry who are working on technology transfer and innovation. The technology-transfer-list was created in collaboration with the Computer Resource Management Technology (CRMT) program of the U.S. Air Force.

Technology Applications began providing the project management and supporting transition infrastructure for SEI support of an Air Force Logistics Command (AFLC) activity that will plan and implement an extensive process-oriented software improvement effort. This project will involve Headquarters AFLC, five Air Logistics Centers, and the Aerospace Guidance and Metrology Center. The goal is to provide technical support to AFLC activities that will define common software processes, establish measuring and monitoring for the processes, establish technology transition processes, and identify organizational and training or educational needs. At this time the project is in the initial planning stages.

SEI assessment of current and future avionics software issues within government and industry for the Air Force PAVE PACE Program was concluded and an SEI

special report was written for the Air Force Wright Research Development Center. This assessment included an evaluation of several current or planned avionics software activities of DoD program offices and the contractors involved. Common concerns and issues were identified and recommendations made for improvements. A development road map was defined that would develop solutions to address the issues identified. These issues and solutions will be addressed through the PAVE PACE program, which attempts to improve the capability and ability of industry and government to develop avionics software in the future.

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Affiliate Relations

The Affiliate Relations Function establishes and maintains SEI relationships with industry and government organizations. Affiliate Relations also negotiates and places, with the cooperation of the SEI Joint Program Office, government and industry resident affiliates at the SEI. The SEI Education Program manages academic affiliates and visiting scientists from academia.

Eleven new industry affiliates signed information exchange agreements during this quarter: Amherst Systems Inc.; Arinc Research Corporation; Arthur D. Little Program Systems; Ashton-Tate; CASElab, Inc.; Rockwell International, Collins Commercial Avionics Engineering; Science and Technology Associates; Strictly Business Computer Systems; Sumaria Systems, Inc.; The Analysis Group; and Xontech, Inc.

Five new resident affiliates from the following organizations joined the SEI this quarter: two from Hughes Aircraft Company and one each from Defense Logistics Agency, Telesoft AB, and Universidad de Cantabria. Six resident affiliates concluded their work at the SEI during this quarter. As of September 30, 1990, thirteen resident affiliates were working at the SEI: eight from industry, one from academia, and four from the services and government agencies.

Affiliate Relations conducted SEI Visitors Day on August 23. This event is held quarterly to accommodate the increasing requests for visits to the SEI. Eighteen representatives from industry, two from academia, and one from government attended. The next Visitors Day is scheduled for November 15, 1990. Visitors must register for Visitors Day; walk-ins are not accepted.

The fifth SEI Affiliates Symposium was held in September in Pittsburgh. The annual symposium is a key forum for exchanging information among software professionals from industry, government, and academia. The symposium included more than 80 hours of presentation material that highlighted SEI programs, plans, and activities. Two keynote addresses were delivered: "DARPA Perspectives on Software Engineering," by Dr. Barry Boehm, Director of Information Systems Technology Office, DARPA; and "Experiences Supporting Space Shuttle Software," by Tony Macina, Manager, Onboard Space Systems, IBM. The symposium was attended by 543 people from affiliate organizations: 391 from industry, 129 from government, and 23 from academia. A day of tutorials and workshops was followed by two days of briefings and conference sessions.

The Empirical Methods Function supports transition management of SEI technology projects by providing market research methods and materials, by conducting surveys and special studies, and by evaluating events or validating products of SEI projects.

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Empirical Methods

During this quarter, Empirical Methods staff and colleagues from Carnegie Mellon's School of Urban and Public Affairs initiated three large-scale data collection efforts to further the National Software Capacity Study. First, data were obtained to estimate the labor supply and career patterns of scientists and engineers involved in software production in the U.S. Civil Service. Second, data collection began to estimate labor requirements to do post deployment software support (PDSS) and to analyze who is doing PDSS work for the Air Force and the Army. Third, data is being collected to update and improve the accuracy of the initial estimates of demand for Ada software production found in *National Software Capacity: Near-Term Study* (CMU/SEI-90-TR-12). All the material resulting from data collection and analysis will be incorporated in future capacity study briefings and reports.

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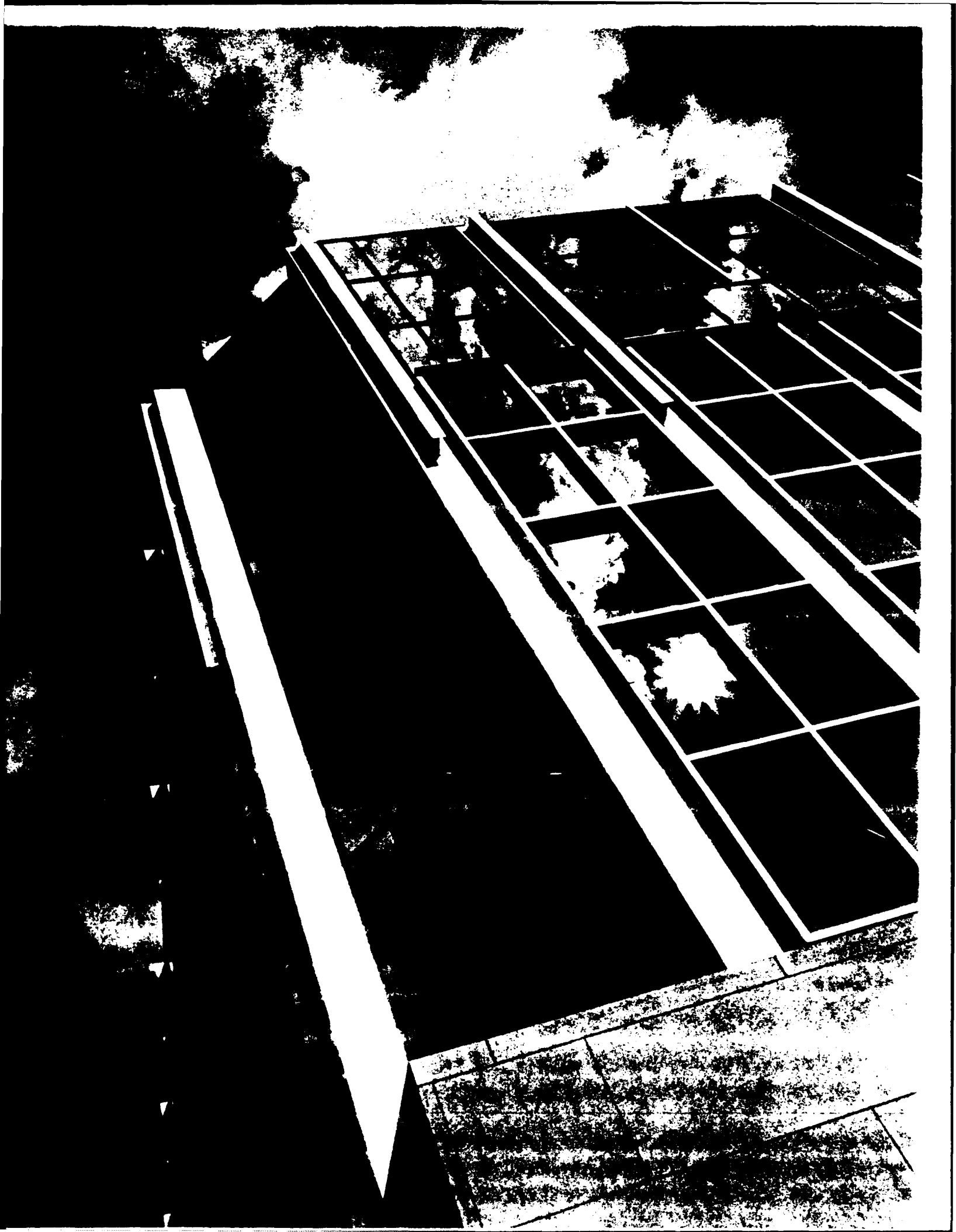
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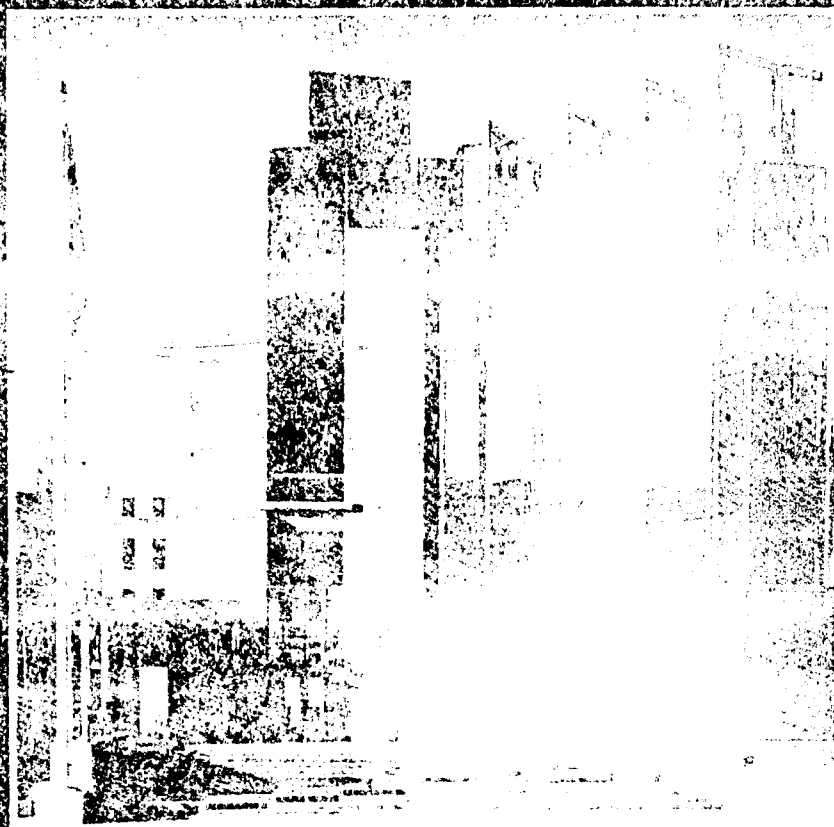


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