Cooperative Research

A Decade of Service to the Semiconductor Industry

Semiconductor Research Corporation

1992 Annual Report

Mission

It is the mission of the
Semiconductor Research Corporation (SRC)
to enhance the competitiveness
of the North American semiconductor industry
through the support of generic,
pre-competitive research and educational initiatives
in areas relevant to industry needs,
and through the timely transfer
of research results to its participants.
In addition, the SRC will participate with industry
and government in coordination of R&D
and in the identification and analysis of,
and appropriate responses to,
key semiconductor R&D issues.

Excerpt from the October 1992 Letter Nominating the Semiconductor Research Corporation for The National Medal of Technology

Winners of the National Medal of Technology will be announced in 1993. The SRC is pleased to have been nominated by distinguished scientist and medal recipient Erich Bloch. We are honored to be considered for this prestigious award.

...The SRC is one of the nation s most respected university research consortia and consists of 70 companies and federal agencies who contribute to the semiconductor value-added chain. In the ten years since its inception, the SRC has evolved into a premier research management organization that has developed a systematic approach to transferring university-generated technology to its participants. As a result of this endeavor, the SRC has played a major role in enabling the semiconductor industry to regain its global competitiveness... .

...Today, because of the SRC, the following key accomplishments have been achieved.

- A semiconductor-research effort exists that is strategically planned, goal-oriented. cooperative. and non-redundant.
- University research efforts span the spectrum from devices and materials to design. manufacturing sciences and packaging.
- Silicon device research is being carried out in the U.S. university system.
- Computer-aided design for integrated circuits has progressed at a substantial rate in the past ten years.
- Semiconductor manufacturing science is an integral part of the academic research agenda and curricula.
- Packaging research on semiconductor devices has emerged and the electrical. thermal, materials and systems aspects are formed into a coherent. integrated research effort.

Without the SRC most. if not all, of these key accomplishments would not have occurred... .

...The SRC has proven the concept that research consortia can provide their participants with critical generic research and that these efforts can quickly be commercialized... . The SRC s successful performance is now providing the model for other pivotal industries to emulate... .

As a further benefit for the semiconductor industry, the SRC recognized the critical role our education system plays in U.S. industrial competitiveness. In 1988, the SRC participants created a non-profit foundation, the SRC Education Alliance, to focus attention to both K- 12 and university (undergraduate and graduate) science and math education... .

The SRC has redefined technology transfer to enable U.S. world-class universities to contribute to the improved competitiveness of the microelectronics industry. In the process of developing this cooperative approach between industry, academia and government, the SRC has also had a profound impact on guiding the U.S. education system in producing students educated to fulfill industry s needs or to become the next generation of faculty... .

It is my great pleasure to present the SRC as a nominee for the National Medal of Technology.

Erich Bloch
Distinguished Fellow
Council on Competitiveness

"...Become recognized as the best research management organization in the world." Owen P. Williams, 1992 SRC Chairman of the Board.

In 10 years, milestones include:

- $200 million in research contracts funded:
- Hundreds of faculty members supported;
- More than 1,000 graduate students hired by the industry;
- Over 950 interactive meetings and events held;
- 8,000 research reports published; and
- 41 patents issued, another 38 patents filed.

The Semiconductor Research Corporation is the U.S. semiconductor industry's first cooperative research consortium. The SRC plans and implements an integrated program of basic and applied pre-competitive generic research conducted by faculty and graduate students at leading U.S. and Canadian universities and research institutions.

Industry-led and predominantly industry-funded, the SRC has become one of the most successful research management institutions in the world. The consortium currently funds about $32 million in research contracts at 60 major universities each year. This funding represents about half of all support for silicon semiconductor research at U.S. universities and research institutions.

The semiconductor industry's participation in the SRC research program has resulted in:

- Nationally unified research goals for key science areas critical to the semiconductor industry;
- Graduate students educated in the anticipated needs of industry who are becoming leaders in the industry and at universities, and
- Timely transfer of research results to SRC participants for rapid commercialization.

The SRC model has strengthened global competitiveness for the American semiconductor industry, and improved relationships among industry, academia and government.

1992: SRC's Year of Review, Self-Assessment; Industry's Year of Cooperation, Competitiveness

"U.S. Again Leads in Computer Chips: American Firms Recapture Global Sales Share From Japanese."
— Headline, The Washington Post, Nov. 20, 1992

Larry W. Sumney

The SRC proudly shares in the competitive comeback of the North American semiconductor industry and looks forward to the continued competitiveness of SRC participants. Universities. government and industry have forged a unique cooperative relationship, initiated and pioneered by the SRC. The SRC's research and engineering education achievements have assisted the industry in regaining competitiveness, and SRC members are receiving a significant return on their investment.

The year 1992 was a special one for the SRC. The consortium marked its first decade of service to the semiconductor industry. We began the year by reviewing and quantifying our achievements of the last 10 years.

We also began a comprehensive self-assessment and examination of how we serve our members – our customers – with a comprehensive technology transfer program.

Our year of self-assessment led the SRC to:

- Implement a Total Quality program to ensure that the SRC continues to provide outstanding research management services to participating companies and government agencies;
- Form the SRC Technology Transfer and Quality (TT&Q) team, a unique linkage of the SRC's technology transfer and total quality management activities; and
- Create a Technology Insertion Project to move SRC research results to their logical next step — insertion into SRC-participating companies' design and manufacturing processes.

Owen P. Williams

The SRC has made significant contributions to North American semiconductor industry competitiveness during the last decade. The SRC's success in improving industry-wide generic pre-competitive research and SRC's leadership in scientific studies have resulted in national, unified goals accepted by the vast majority of the semiconductor industry. The SRC strategy provides academia and government with a clear picture of the industry's needs.

In 1992, the SRC played a major organizing and planning role for the Semiconductor Industry Association's Semiconductor Technology Workshop in Dallas to coordinate a long-term technology roadmap for the industry.

Among the SRC's proudest achievements was the initiation of the SRC Technical Excellence Awards to recognize research contributions with significant impact on the industry.

Another key contribution is the ever-strengthening bond among industry, university and government. This synergistic relationship is the first working example in the U.S. of an industry-led endeavor resulting in a national technology-development plan that serves the needs of all participants and improves the competitive position of a vital technology.

Highlighting the year was Erich Bloch's nomination of the SRC for the prestigious National Medal of Technology for the consortium's technology transfer accomplishments and contributions toward a technologically trained workforce for the nation. Part of his nomination letter is included in this annual report because it so eloquently expresses the value of the SRC.

In 1993, we look forward to holding the TECHCON research conference in Atlanta, filing new patents and communicating their research benefits to our participating companies, expanding our electronic document delivery project and continuing our Technology Transfer and Quality efforts.

The SRC is working to make next decade even more productive and beneficial to SRC member companies and participating government agencies than the first decade has been.

Larry W. Sumney
President and CEO

Owen P. Williams
Chairman

SRC Members Leverage R&D Investments into Global Competitiveness

More than 70 companies and government agencies find the SRC's work.

The SRC's strength comes from its ability to bring industry relevance to university research and to transfer research results quickly from universities to industry.

Our corporate members and participating government agencies make these technological advances possible. More than 70 companies and government agencies fund the SRC's work, leveraging their own research and development dollars. The potential leverage of their investment is enormous.

New Participants in 1992

The SRC welcomed 18 new participants in 1992:

Member

Northern Telecom Ltd. — Northern Telecom is a leading supplier of fully digital telecommunications switching equipment. Based in Nepean, Ontario, Canada, Northern Telecom is both a major producer and major user of integrated circuits and optoelectronics at their production facilities in Canada, the United Kingdom and the United States.

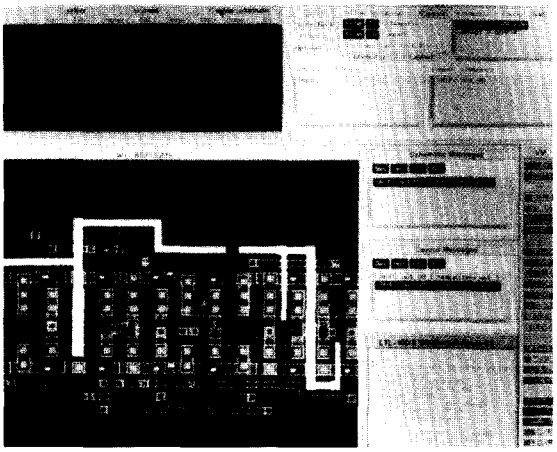
Northern Telecom fabricates custom integrated circuits for use in its advanced telecommunications systems, including digital switches, private branch exchanges, fiber optic transmission systems and terminals.

Associate Member

MITRE Corp. — MITRE is a federally funded research and development center, providing engineering consulting services to agencies of the U.S. Department of Defense and the Federal Aviation Administration. MITRE is based in Woburn, MA.

In addition, 16 companies became Affiliate Members of the SRC:

AG Associates, Sunnyvale, CA
Brantford Computer Haus, Ontario, Canada
CVC Holdings Inc., Rochester, NY
DTX Corp., Lancaster. PA
Excimer Laser Systems Inc., Wayland, MA
Famtec International, Chandler, AZ
Ibis Technology Corp., Danvers, MA
Integrated Electronics Innovations Inc., Charlotte, NC
PDF Solutions, Pittsburgh, PA
Phenix Semicron Corp.. Hurdle Mills, NC
Q-metrics Inc., Woburn, MA
Realtime Performance Inc., Sunnyvale, CA
Scientific Exchange, Ontario, Canada
Spire Corp., Bedford, MA
UTI Instruments Company, San Jose, CA
Verity Instruments Inc., Carrollton, TX



Integrated Silicon Systems (ISS) produces Vericheck IC Design Verification Software. This photograph shows the layout versus schematic compare module.

And we continued working with these members in 1992:

Members

AT&T
Advanced Micro Devices Inc.
Alcoa
Digital Equipment Corp.
E.I. du Pont de Nemours & Company
E-Systems Inc.
Eastman Kodak Company
Eaton Corp.
Etec Systems
General Motors Corp.
Harris Corp.
Hewlett-Packard Company
Honeywell Inc.
IBM Corp.
Intel Corp.
LSI Logic Corp.
M/A COM
Micron Technology Inc.
Motorola Inc.
National Semiconductor Corp.
Rockwell International Corp.
Texas Instruments Inc.
Union Carbide Corp.
Varian Associates Inc.
Westinghouse Electric Corp.
Xerox

Associate Members

Los Alamos National Laboratory
MCC
SEMATECH

U.S. Government Participants

Army Research Office (ARO)
Defense Nuclear Agency (DNA)
National Institute of Standards and Technology (NIST)
National Science Foundation (NSF)
National Security Agency (NSA)
Office of Naval Technology (ONT)
Wright Laboratory (USAF)

Affiliate Members

Analogy Inc.
Arizona Packaging Software Inc.
Dawn Technologies
Hestia Technologies Inc.
Integrated Silicon Systems Inc.
Meta-Software Inc.
Mission Research Corp.
nCHIP Inc.
Process Technology Ltd.
Prometrix
SILVACO Data Systems
Solid State Measurements Inc.
SRI International
Sunrise Test Systems
Technology Modeling Associates Inc.
Tyecin Systems Inc.
WYKO Corp.

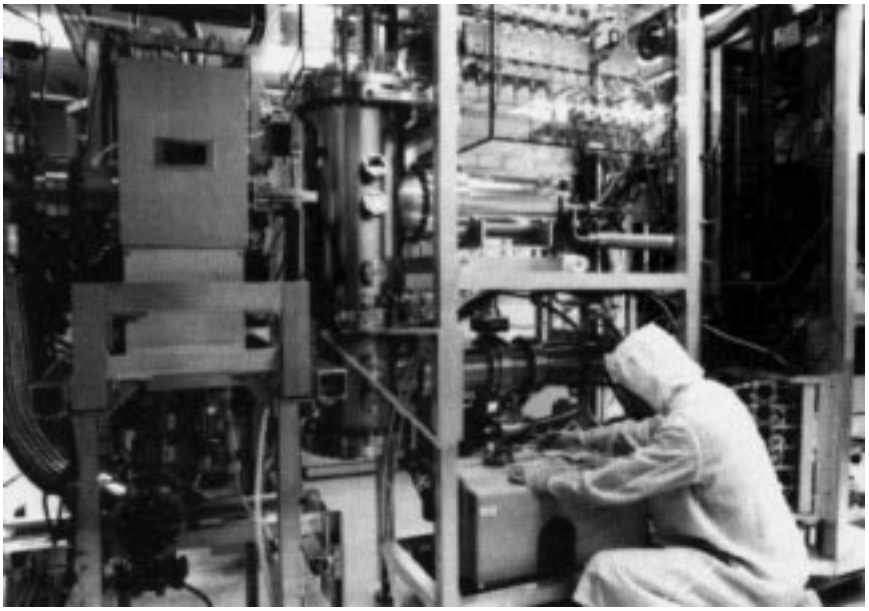
1992 Highlights Reflect SRC Imperative: Transfer, Insert and Commercialize Research Results

The SRC has developed a Concurrent Technology Transfer System that has re-defined technology transfer:

Progress for the North American semiconductor industry is often described in terms of a technology chain. Each link is an activity essential to the creation of new products. The chain begins with research and ends with production of competitive products.

The SRC has developed a Concurrent Technology Transfer System that has re-defined technology transfer as a multi-directional, concurrent process among industry, academia and government, throughout every stage from planning through commercialization.

Since its inception in 1982, the SRC has contributed many elements to the nation's overall technology base, including its novel approach to technology transfer. In doing so, the SRC has strengthened each link in the technology chain.



Pre-competitive research is a fundamental component of the SRC's mission.

Some of the technology transfer highlights of 1992 include:

Texas A&M-SRC Analysis and Planning Workstation Used at Systems Modeling Corp.

The development of a cost-benefit model for automated manufacturing systems is a high priority within the semiconductor industry. CHIPS (CoHerent and Integrated Planning System) is a cohesive, data-driven modeling system for predicting semiconductor integrated circuit manufacturing performance.

Dr. Don T. Phillips of Texas A&M and his research team developed a prototype of a software modeling tool for production systems and cost analysis. The tools were developed in close cooperation with Dr. John W. Fowler, Darren Dance and Neal G. Pierce of SEMATECH and Paul Stachura of Advanced Micro Devices.

Systems Modeling Corporation, Sewickley, PA, is in a joint development program with SEMATECH to commercialize CHIPS methodologies.

"A fundamental problem existed," said C. Dennis Pegden, president of Systems Modeling Corporation. "Our technology was not focused enough on the specific areas that SRC's members are faced with, and the software was not easy enough to use for an engineer who frequently employed simulation technology. Our approach to the problem was to develop a general modeling tool that could easily be customized to specific application areas... ."

Heavy Metals Project in Florida Transferred in One Year

Usually the SRC process takes approximately five years from the initial planning stage to technology insertion. The following project was of such interest to industry that it was researched and the results transferred to industry in only one year.

In 1991, a SEMATECH Center of Excellence, managed by the SRC, was established at the Florida Institute of Technology, University of Florida and University of South Florida. Two of its goals were to:

- Predict yield reduction caused by heavy metal contamination for a given technology; and
- Provide guidance concerning how much the heavy metal concentration must be reduced with further technology evolution.

In 1992, research results were already in use at AMD, Applied Materials, AT&T, Harris Semiconductor, Honeywell, IBM, Micron Semiconductor, SEMATECH, Texas Instruments. and TMA.

This is an example of an SRC Technology Insertion Project in which researchers and end-users collaborate closely for the duration of the project and the cycle time required for successful transfer is compressed.

1992 Highlights

" These projects enable industry to have much quicker access to usable, 'hard core' technologies coming out of the university research program."

University of California-Berkeley Computer-Aided Manufacturing System Installed at IBM, Lam Research and DEC

The University of California at Berkeley's "Computer-Aided Manufacturing System," called "B-CAM," has created a supervisory controller as an application module. B-CAM was demonstrated at the 1992 CIM-IC Workshop, sponsored by the SRC and DARPA (Defense Advanced Research Projects Agency), and has been implemented at Digital Equipment Corporation in Hudson. MA, for control of an AME 5000.

IBM, Lam Research Work with Professor Spanos to Improve Equipment Performance

SRC initiated collaboration among Professor Costos Spanos, IBM, Lam Research, SEMATECH and SRC to test a new set of software tools that will predict when a piece of manufacturing equipment is about to deviate from acceptable performance specifications.

This project was part of the Technology Insertion Program initiated by SRC and SEMATECH in 1992 to enhance university research efforts by providing support for early application of laboratory results.

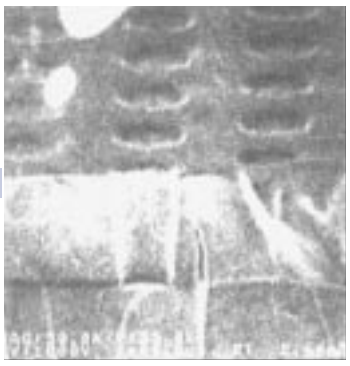
"These projects enable industry to have much quicker access to usable, 'hard core' technologies coming out of the university research program," said Dr. William C. Holton, SRC vice president of research operations.

The collective efforts of Professor Spanos and two students in UC-Berkeley's Computer-Aided Manufacturing Group, IBM's Semiconductor Group and Lam's etch process and software engineers centered on four primary areas:

- Real-time statistical process control to spot process trends:
- Automated malfunction diagnostics to provide real-time identification of internal condition variations that can affect process results;
- Statistical-based equipment models that can be used for automated recipe generation, as well as equipment control and diagnosis; and
- Run-by-run control that entails the development of standard test patterns and automated measurements to generate and download corrected recipes to the etch systems.

University of North Carolina-Charlotte Works with Texas Instruments on Etch Resists

The University of North Carolina at Charlotte, working with Texas Instruments, has evaluated the properties of ionic modifiers in UCB-JSR 1X 500 EL and Shipley SPR511 i-line resists. Results show enhanced etch resistance to chlorine plasmas, while still removable in oxygen plasmas, with little adverse impact on the lithographic properties of these resists.



SRC-sponsored research in plasma etch resists at the University of North Carolina at Charlotte has resulted in two patents.

Then-US. Rep. Les Aspin (D-WI) discussed next-generation technology requirements for U.S. competitiveness during his tour of the X-Ray Lithography Center at the University of Wisconsin. Aspin was joined by Jim Rutledge (left) of SEMATECH and Howard Phillips of the SRC (right).

Wisconsin Center for X-ray Lithography Research Links with DARPA, IBM, Motorola and Silicon Valley Group Lithography

"You've done an amazing job," said then-Rep. Les Aspin (D-WI) and current U.S. Secretary of Defense, describing the cooperative research program forged by the SRC, SEMATECH, semiconductor companies and the federal government.

The Navy and DARPA announced their sponsorship of a research contract to develop X-ray lithography equipment in conjunction with IBM and Silicon Valley Group Lithography. The program will lead to evaluation of a new quarter-micron X-ray stepper by IBM and the installation of the stepper at the University of Wisconsin's Synchrotron Radiation Center. The equipment will be used for quarter-micron device research leading to more powerful silicon microchips for use in computers and telecommunications products.

Motorola also announced a research program with the University of Wisconsin to concentrate on quarter-micron microcircuit research and development, including the investigation of manufacturability issues which face industry.

Universities Receive Silicon Wafers from Micron Semiconductor

In an ideal example of cooperative research and technology exchange, Micron Semiconductor Inc. donated thousands of silicon wafers to a group of U.S. universities and research institutions. Distribution of the wafers was arranged by the SRC. The gift had a value of about $200,000.

The donation provides semiconductor researchers a unique opportunity to compare their research results.

"University research can be done more effectively if it is performed with the appropriate materials," said Steven R. Appleton, chairman and CEO of Micron Semiconductor Inc. "The use of silicon wafers in research on the production of semiconductors will be of greater benefit to those of us in the industry."

Institutions receiving wafers included the Massachusetts Institute of Technology, North Carolina State University, UCLA, University of Texas at Austin, Purdue, New Jersey Institute of Technology, University of Illinois, MCNC (formerly the Microelectronics Center of North Carolina) and Rensselaer Polytechnic Institute.

"Micron's gift of thousands of wafers will improve the technology exchange between universities and industry," said Professor Nino Masnari of N.C. State and chairman of the SRC's University Advisory Committee.

"SRC's goal is to match university and industry research and development more closely," said Larry W. Sumney, SRC president and CEO. "This is an excellent example of the kind of university-industry partnerships the SRC makes possible."

1992 Achievements in Intellectual Property Reflect Industry's Long-Term Goals

The SRC's patent portfolio is growing.

Long-term SRC-sponsored research is beginning to result in key generic patents and copyrighted Works of Authorship. The SRC has a worldwide, unrestricted, nonexclusive license to use the results of the SRC's funded research, as well as the ability to sub-license such rights to SRC participants. In 1992, two such patents issuing from SRC-sponsored research were:

UCLA Transistor

Technology developed by Professors Kang L. Wang and Jason C.S. Woo of UCLA resulted in a patent for complementary field effect transistors having strained superlattice structure.

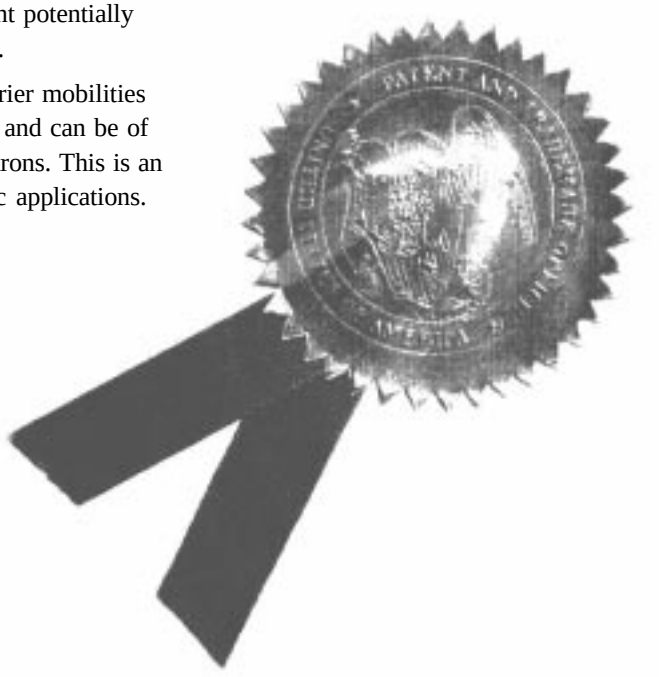
Using this device technology, it is possible to have equal and symmetrical rise/fall times on logic signals using matched-geometry CMOS interfaces to digital data bus circuits. Because most computers use data bus architecture, this patent potentially has broad commercial applications.

For CMOS transistors. the carrier mobilities of holes are increased significantly and can be of about the same magnitude for electrons. This is an advantage for complementary logic applications.

N.C. State Fabrication Technology

Professor F. Yates Sorrell, Jimmie J. Wortman and John R. Hauser of NC. State developed a technology for controlling rapid thermal processing (RTP) systems. This method produces a constant temperature at the wafer surface.

This approach solves the problem of large temperature excursions which limited the usefulness of previous RTP equipment designs.



SRC Produces a Technically Competent Workforce

A comprehensive and focused university research program in semiconductor technology exists.

Ten years ago, very little university research was directed to the needs of the semiconductor industry. When a new university graduate was hired by a semiconductor company, a lengthy training program was required before the new employee was able to contribute to the company's product development efforts.

A decade later, because of the SRC, a comprehensive and focused university research program in semiconductor technology exists. More than 1,000 SRC-funded graduates have now entered the workforce with the ability to immediately transfer their advanced knowledge into industry for the development of new processes and products.

The Graduate Fellowship Program administered by the SRC Education Alliance is a separate educational effort created by the SRC. There were 36 fellows participating in the program in 1992. Students in the Graduate Fellowship Program are U.S. citizens pursuing Ph.D. degrees and working on research tasks associated with SRC-funded projects. Currently, of these three SRC Fellows (one at the University of Michigan; two at N.C. State) are key contributors to six new U.S. patents, issued and/or applied for.

A portion of the SRC student funding is provided to the Fellow in the form of a loan which is converted to a gift if the student completes graduation and is employed with a participating company, North American university or government laboratory. In 1992, all 11 graduating SRC Fellows joined the ranks of SRC participating companies or the faculty of U.S. universities.

In addition, more than 800 students were enrolled in SRC-funded university research programs in 24 industry-identified research areas in 1992.

More than 800 students were enrolled in SRC-funded university research programs in 1992.

1992 Industrial Mentors Bring Industry Perspective to the University Research Laboratory

The program has grown to more than 450 mentors who represent a broad spectrum of SRC-participant research and manufacturing expertise.

Student and faculty researchers receive the benefit of direct contact with industry engineers through the SRC Industrial Mentor program. Ten years ago, there were 50 mentors assisting university researchers with collaborative technical guidance and a variety of industrial resources.

In 1992, there were 479 individual industrial mentors serving 571 specific task assignments. Some participating companies have more than 50 employees assigned to the Mentor Program. Three graduated SRC Fellows (and many more students who worked on SRC-funded projects) are now themselves Industrial Mentors to SRC university research teams (at the University of Michigan, University of Texas and Carnegie Mellon University).

Each year, the SRC names recipients of the SRC Outstanding Industrial Mentor Award. In 1992, the winners were:

Don Sharfetter of Intel Corp., Santa Clara, CA, who mentors an SRC Microstructure Sciences contract at the University of Texas at Austin;

Sury Maturi of National Semiconductor Corp., Santa Clara, CA, who mentors an SRC Design Sciences contract at Yale University;

Jack Linn of Harris Semiconductor, Melbourne, FL, who mentors a Manufacturing Processes Sciences contract at the University of New Mexico; and

George Katopis of IBM Corp., Hopewell Junction, NY, who is one of the mentors of the Packaging Sciences contract at the University of Arizona.

Technical Excellence Awards Honor Research Contributions Benefiting Industry

The SRC Technical Excellence Awards are based on scientific merit, relevance to the industry's technical objectives, utility and technology transfer potential.

In 1992, the SRC Technical Excellence Awards were first presented to recognize research contributions having significant impact on the productivity of the North American semiconductor industry. Awards are made to key contributors to programs judged on the basis of scientific merit, relevance to the technical objectives of the semiconductor industry, utility and technology transfer potential. The awards are competively selected from nominations by industry engineers and scientists.

In June 1992, four research teams were honored at the first awards dinner in Research Triangle Park recognizing contributions made through 1991. The winners were congratulated by Jack Kilby, co-inventor of the integrated circuit.

Jack Kilby, to-inventor of the integrated circuit, presents a Technical Excellence Award to Asad M. Haider.

- **University of Texas at Austin:** "MOSFET Structure for Deep Submicron ULSI Processes" — Key contributors: Professor Al F. Tasch, Jr., Professor Christine M. Maziar, Dr. Hyungsoon Shin. Industry impact: These researchers have generated new structures and models to design and evaluate hot carrier supressed MOSFETs, in which devices the dopant profile reduces the voltage drops across the more highly doped region of the drain, thereby reducing the electronic field. The resulting submicron devices have better long-term reliability.

- **Carnegie Mellon University:** "Asymptotic Waveform Estimator (AWE)" — Key contributors: Professor Ronald A. Rohrer, Professor Lawrence Pillage. Industry impact: This research resulted in a new simulator for the evaluation of transient waveforms at the chip level for large linear circuits. The impact is expected to be a reduction of risk in designing complex VLSI chips through accurate simulation analysis.

- **University of Arizona (Arizona SEMATECH Center of Excellence):** "Contamination Control in Gases and Liquids" — Key contributors: Professor Farhang Shadman, Mr. Robert A. Governal, Mr. Asad M. Haider, Ms. Alison L. Bonner. Industry impact: This research team developed novel methods for removal and control of organic impurities in DI water systems and for purification of gases. They also developed a new technique for determining the impurity levels in gas distribution systems and inside tools. These point-of-use techniques will make it possible to reduce particle and impurity levels in a cost-effective manner.

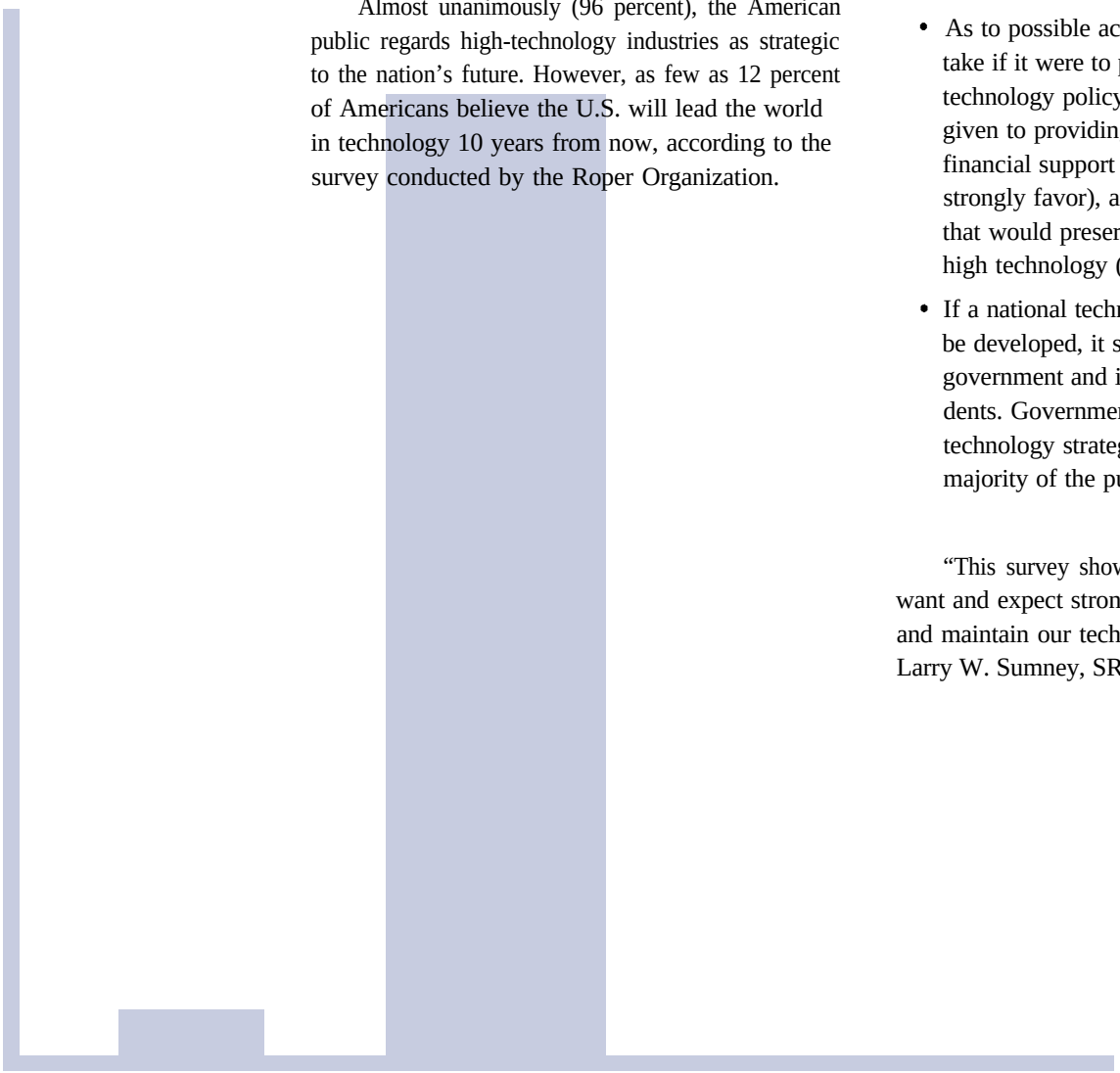
- **University of California at Berkeley:** "Berkeley Reliability Tool (BERT)" — Key contributors: Professor Chenming Hu, Professor Ping K. Ko, Dr. Peter M. Lee, Mr. Boon-Khim Liew, Ms. Elyse Rosenbaum, Dr. J. David Burnett. Industry impact: This research contributed a design tool that simulates IC reliability during the circuit design stage which addresses gate oxide lifetime electromigration and hot carrier lifetime. A bipolar reliability module is being added to enhance this important tool. Industry is provided a means to build reliability into chip design.

1992 Survey Proves Americans Support Technology Industries

The American public regards high-technology industries as strategic to the nation's future.

In February 1992, the SRC and Semiconductor Industry Association (SIA) commissioned a public opinion survey that found broad support among Americans for the concept that high-technology industries are critical to the nation's productivity, economic health and military security.

Almost unanimously (96 percent), the American public regards high-technology industries as strategic to the nation's future. However, as few as 12 percent of Americans believe the U.S. will lead the world in technology 10 years from now, according to the survey conducted by the Roper Organization.



An analysis of the survey results showed:

- A majority of the public from both major political parties believe government should take a more active role to assist American high-tech competitiveness in the world market.
- As to possible actions the government might take if it were to play a more active role in technology policy, the strongest support was given to providing higher education with more financial support for research (58 percent strongly favor), and pursuing a trade policy that would preserve American interests in high technology (54 percent strongly support).
- If a national technology strategy were to be developed, it should be led jointly by government and industry, said the respondents. Government leadership of a national technology strategy was rejected by a large majority of the public.

"This survey shows that the American people want and expect strong efforts to strengthen and maintain our technology base," said Larry W. Sumney, SRC president and CEO.

Washington Hears Semiconductor Research Message at 10th Annual Conference

The SRC completed 18 national technical research roadmaps for use in the cooperative tripartite process (universities-industry-government) for the advancement of semiconductor technology.

Global forces. Expansion in the consortium's membership base. Total quality management. Research expansion. These are trends seen by SRC President Larry W. Sumney as the SRC enters its second decade.

Sumney discussed these trends at the plenary session held during the annual joint meeting of the SRC and Semiconductor Industry Association in Washington in March 1992.

In his remarks, Mr. Sumney noted, the SRC has completed 18 national technical research roadmaps for use in the cooperative tripartite process (universities-industry-government) for the advancement of semiconductor technology. The U.S. Air Force has provided funds to develop a research plan and roadmap for semiconductor packaging, providing an example to follow in other areas of microelectronics.

In addition, Mr. Sumney noted that number of organizations funding the work of the SRC continues to grow. Additional membership classifications are being created to encourage the participation of a broad range of organizations. Membership in the SRC is open to Canadian companies and preparations are being made to fund research at Canadian universities. With the North American Free Trade Agreement with Canada and Mexico, the potential is developing for the SRC to evolve into a North American consortium. In addition, Mr. Sumney mentioned the possibilities of joint research alliances with foreign universities and research institutes, particularly in Europe.

Rep. Tim Valentine (D-NC), chairman of the Congressional Subcommittee on Technology, Environment and Aviation, spoke at the 1992 joint meeting of the SIA and the SRC.

Other speakers and topics included:

Ian Ross, president emeritus of Bell Laboratories and chairman of the National Advisory Committee on Semiconductors (NACS), spoke on a national strategy for semiconductors and reviewed the NACS recommendations.

Rep. Tim Valentine (D-NC), chairman of the Congressional Subcommittee on Technology, Environment and Aviation, and sponsor of the legislation that created NACS, emphasized that the federal government can play a role through its support of a national technology strategy.

Erich Bloch, former director of the National Science Foundation and now a distinguished fellow at the Council on Competitiveness, addressed the issue of workforce preparedness. He spoke of the need to attract students to engineering, retain them, and modernize curricula.

Dr. Gerhard H. Parker of Intel and chairman of the SRC Board of Directors enumerated the SRC's accomplishments during its initial decade.

SEMATECH, Other Consortia Provide Benchmarks for 1992

The SRC has strengthened its relationship with SEMATECH to develop advanced technology transfer programs.

Five years ago, SRC was instrumental in developing the model and generating support for the concept of SEMATECH, the semiconductor industry's consortium to focus on improving the semiconductor industry's manufacturing equipment and processing technology. The manufacturing sciences research begun by the SRC laid the groundwork for expanded research efforts in this vital area now managed by the SRC and funded by SEMATECH.

Today, the SRC has strengthened its relationship with SEMATECH to develop advanced technology transfer programs to promote timely acquisition of new developments by semiconductor equipment manufacturers and to share best-demonstrated practices.

In 1992, SRC worked with SEMATECH to manage six new Technology Insertion Programs. These programs provided financial support for early industrial application of university research. They involved activity by professors and students at an industry manufacturing site and included a Technology Demonstration Workshop at the conclusion of each project.

SEMATECH'S mission is to solve the tethnical challenges required to keep the U.S. number one in the global semiconductor industry.

SRC continued to manage the SEMATECH Center of Excellence (SCOE) research program in 1992. The SCOE program was established in July 1988 to address manufacturing technologies required for U.S. leadership in IC manufacturing in the 1990s and beyond. The program is conducted in U.S. universities under SEMATECH's contract with the SRC and is fully integrated with the entire SRC-sponsored university research program.

Significant research results have been and continue to be achieved. In particular, advances have been made in contamination control, plasma etching, metrology and the development of response surface methodologies, including sensor technology, which have immediate application for invasive manufacturing tool control. Opportunities exist for the initiation of substantial technology exchange activities.

In 1992, the SRC also continued to work cooperatively with the Council of Consortia CEOs, chaired by SRC President Larry W. Sumney. The Council addresses issues of common concern, seeks solutions to shared problems, encourages industry, government and academic support for the use of consortia to address shared problems, and works to assure that the results of consortia activities are widespread, equitable and beneficial to members and the economic community.

The Council includes representatives of the Electric Power Research Institute, Gas Research Institute, MCC, Software Engineering Institute, Great Lakes Composites Consortium, BELLCORE, Software Productivity Consortium, MCNC, National Center for Manufacturing Sciences, SEMATECH, Ohio Aerospace Institute, Strategic Microelectronics Consortium (Canada), and USCAR.

The SRC Takes a Long-Term View

SRC strategically plans, prioritizes and implements a research program in support of industry consortia, universities, national laboratories and government agencies.

Packaging

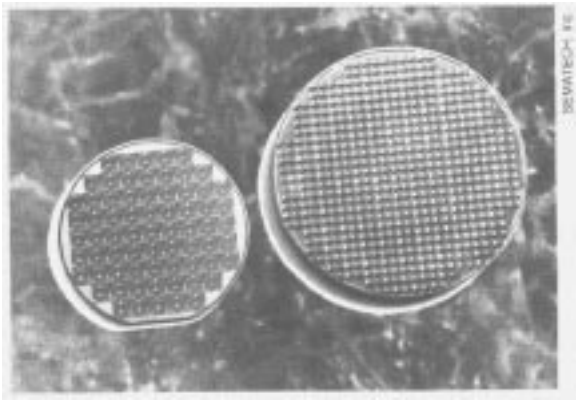
In January 1992, top U.S. semiconductor and electronics packaging technologists met in Research Triangle Park to begin development of a national strategic research and development program for semiconductor and electronics packaging. Packaging includes an IC chip's protective enclosure and interconnection of subassemblies into the completed equipment.

Participants of the three-day workshop agreed that there was a tremendous shortfall in real research into technologies for the products of the year 2005.

New packaging technologies hold greater promise for future electronics systems than miniaturization or increases in the number of circuits per chip. The largest volume of an electronic product, and the greatest cost, is devoted to packaging components.

The SRC coordinated the development of the packaging research plan, which has identified and prioritized research needed to be done by industry, consortia, universities, national laboratories and government. Work on the plan was guided by a steering committee composed of members from SRC, MCNC, DARPA, MCC, the U.S. Air Force Wright Laboratories, Sandia National Laboratories, SEMATECH, industry and academia.

The key packaging technologies included in the strategic plan included: signal transmission and interconnect, environmental protection of integrated circuits (ICs), IC to multiple-module Design-for-Test and test methods, power/thermal technologies, and analysis, design and simulation of packages and assemblies.



Packaging technologies hold greater promise for future electronics systems than miniaturization or increases in the number of circuits per chip.

The SRC has contracted more than $11 million for packaging research since its packaging program was initiated in 1983. In 1992, the SRC increased its annual funding of microelectronics packaging research by 30 percent to $2.2 million.

The SRC is currently managing and funding IC packaging research at six universities: Arizona, Cornell, Lehigh, Ohio State, Purdue and Stanford.

The SRC Enhances Communications, Electronic Document Delivery

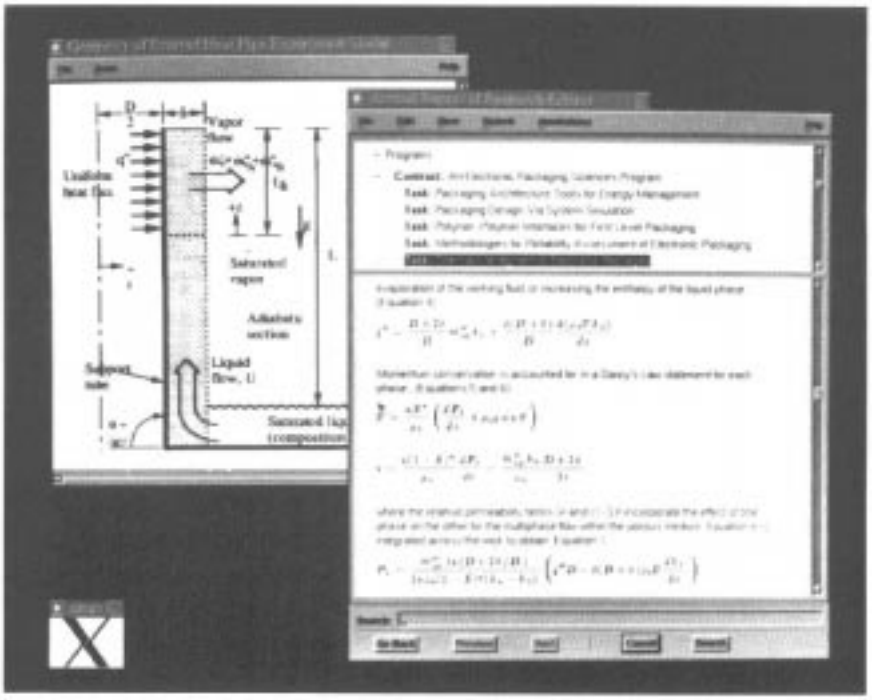
Satellite videoconferences were held on such topics as TCAD Model integration for VLSI Manufacturing, Silicon-on-Insulator Technology in VLSI Processing and Multi-Level Interconnect Technology.

Videoconferencing

A June 1992 conference on TCAD Model Integration for VLSI Manufacturing took advantage of satellite videoconferencing as an effective tool for widespread, immediate distribution of research information. The broadcast originated from N.C. State University in Raleigh and was distributed around the country. People at 11 locations participated in the videoconference.

Other 1992 satellite videoconferences included one on the topic of Silicon-on-Insulator Technology in VLSI Processing, carried at 20 sites, and a broadcast on Multi-Level Interconnect Technology, seen at 20 sites around the country.

Now, the SRC is evaluating videoconferences as an effective means for reducing costs and cycle time associated with interactive technology exchange. The SRC has acquired a PictureTel System 4000, Model 400 station to utilize videoconferencing as an alternative to face-to-face meetings.



The SRC Electronic Document Delivery Project integrates text, graphics, tables and mathematics supplied from many sources and in many formats.

Electronic Document Delivery Project

The SRC Electronic Document Delivery (EDD) Project made significant progress in 1992. The project's goal is to migrate the SRC's entire library of publications, now distributed on paper, to a common electronic format that could be viewed on an engineering workstation or a desktop computer. The electronic library would be updated regularly and distributed via CD-ROM, and could be accessed either directly, or from a network file service to which it is downloaded.

Specific application and distribution issues have been addressed. However, the project team recognized that its most significant challenge was to integrate text, graphics, tables and mathematics supplied from many sources and in many formats. The team sought advice from its advisory board and reviewed the related efforts by IEEE, ACM and AMS (among others) before selecting the international standards of SGML for modelling of text, TIFF and CGM for storing graphics, and TeX for representation of mathematics.

The project team prepared and presented a proof-of-concept prototype application to the SRC Advisory Board Executive Committee and to the SRC Board of Directors. Pilot universities were chosen to begin submitting documents to the SRC electronically, and all universities began submitting their abstracts via Internet e-mail.

The EDD project team prepared a four-year roadmap that outlines long-term goals of the project, and suggests a timeline for integration into the SRC's information delivery strategy.

SIA Technology Roadmap

SRC worked with SIA to help the industry devise a common technology roadmap for the next 15 years.

Dr. Gordon Moore, chairman of the board of Intel Corp., convened the SIA Semiconductor Technology Workshop to help the industry devise a common technology roadmap for the next 15 years.

SRC's Dr. Robert Burger provided co-leadership with Dr. William Howard, a SEMATECH consultant, for the planning and implementation of the SIA Semiconductor Technology Workshop in Dallas in November 1992. Dr. Gordon Moore, chairman of the board of Intel Corp., convened the working session to help the industry devise a common technology roadmap for the next 15 years. More than 170 of the country's leading IC technologists formed breakout groups to devise the plan which used as a starting point the National Advisory Committee on Semiconductors's reports. Committee members included representatives of industry, academia, SEMATECH, DARPA, NIST (National Institute of Standards and Technology) and the national laboratories.

The summary report was released in March 1993 and is being used by the Clinton Administration, universities, government agencies and the industry.

Moore told *Electronics* magazine: "The industry does short-term, tactical research very well, but we recognize that we're not doing some of the long-term things that we need to do."

He told the magazine that the industry can look to the SRC working with universities, and with government agencies, such as the national laboratories, to meet the industry's long-term goals.

Excerpt from *SIA Semiconductor Technology – Workshop Conclusions:*

"These efforts put forth by and on behalf of the U.S. semiconductor industry are bearing fruit. Worldwide market share of the U.S. industry climbed in 1991 for the first year in decades, and the semiconductor manufacturing equipment industry regained worldwide market share leadership. Preliminary estimates for 1992 show continuous U.S. strength with U.S. semiconductor market share nearly equal to that of Japan. While these results are extremely encouraging, they must be viewed in the light that the Japanese market is extremely depressed.

The semiconductor industry has proved that it can advance more rapidly by cooperating in pre-competitive areas. It has demonstrated the ability to recover competitiveness in the world market by means of focused programs addressing its shortcomings. I believe that it is likely that other industries could benefit by emulating the model that the semiconductor industry has pioneered. Of course, many improvements to the model are still possible. and alternatives should be considered depending on the specific situation... .

Both SRC and SEMATECH will use these roadmaps to plan their programs, and we hope that others supporting research and advanced technology, including individual companies, universities, and government funding agencies, will also use them to advantage."

Dr. Gordon Moore
Chair
Technology Committee of the SIA

The Annual Report of the Semiconductor Research, Corporation is published each June to summarize the directions and results of the SRC Research Program, present the formal financial report, and provide information on activities and events of the SRC industry/government/university community for the previous calendar year.

This report is available to my interested person by requesting SRC Publication Number S93011

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