# Semiconductor Research Corporation: A Proven Means to Fund Relevant Research

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# What is SRC?

- World's leading consortium funding collaborative university research driven by industry needs.
- Adds to broad Federal investment in universities to fund industry-relevant research.
- Exists between "blue sky" basic research and industry product development.
- Invests in people and research; not bricks and mortar.

# Why was SRC established?

- Support U.S. industry competitiveness
- Jointly invest in basic, precompetitive research relevant to industry needs; explore new technologies
- Stimulate academic interest in manufacturing & design research
- Promote collaboration among researchers, departments/disciplines, and universities
- Generate a pool of experienced faculty and relevantly educated students

# How does SRC operate?

| | |
|---|---|
| Strategic Planning | Iterative process by advisory boards and SRC staff |
| Project Initiation | Solicitation, white papers, advisory board reviews |
| Progress Monitoring | Annual reviews by industry, gov't and academia. Industry mentors throughout project |
| Research Output | Rapid electronic distribution of results and student information |
| Member Satisfaction | Value metrics maintained for each company member |
| Government Partners | Sought for programs with shared interests |

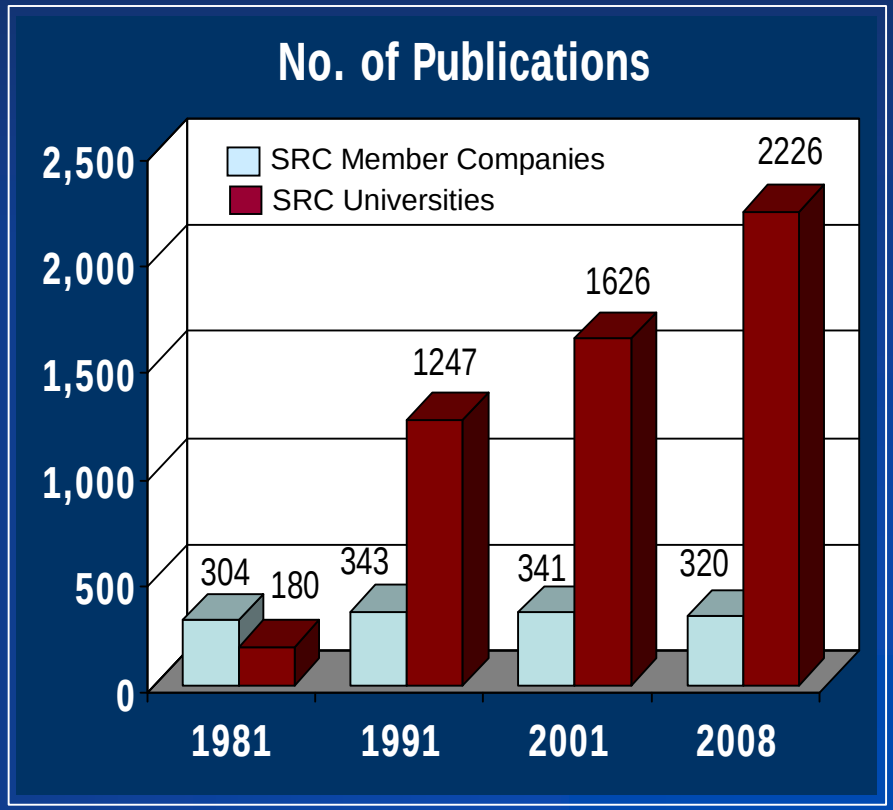
This process has been exercised by the SRC community ***thousands of times*** over the past 27 years.

# A Major SRC Accomplishment

Built the world's largest and most successful university research force to support the 10,000-fold advances of the semiconductor industry

- In 1982, fewer than 100 students and faculty conducted silicon research
- 27 years later, the SRC had built a force of 1,707 faculty and 7,455 **students!**

The SRC community publishes 20% of the world research on silicon.



# SRC Numbers

SRC Research Programs*

- Over $1.3B invested by SRC participants
- 2,906 contracts
- 7,455 students
- 1,707 faculty members
- 241 universities

Deliverables*

- 43,419 technical documents
  - 326 patents granted
  - 777 patent applications
  - 579 software tools
- 2,315 research tasks/themes

**** Approx. from inception through 2008***

# National Medal of Technology


CITATION

The National Medal of Technology was awarded to the Semiconductor Research Corporation…..

"For building the world's largest and most successful university research force to support the rapid growth and 10,000-fold advances of the semiconductor industry; for proving the concept of collaborative research as the first high-tech research consortium; and for creating the concept and methodology that evolved into the International Technology Roadmap for Semiconductors."

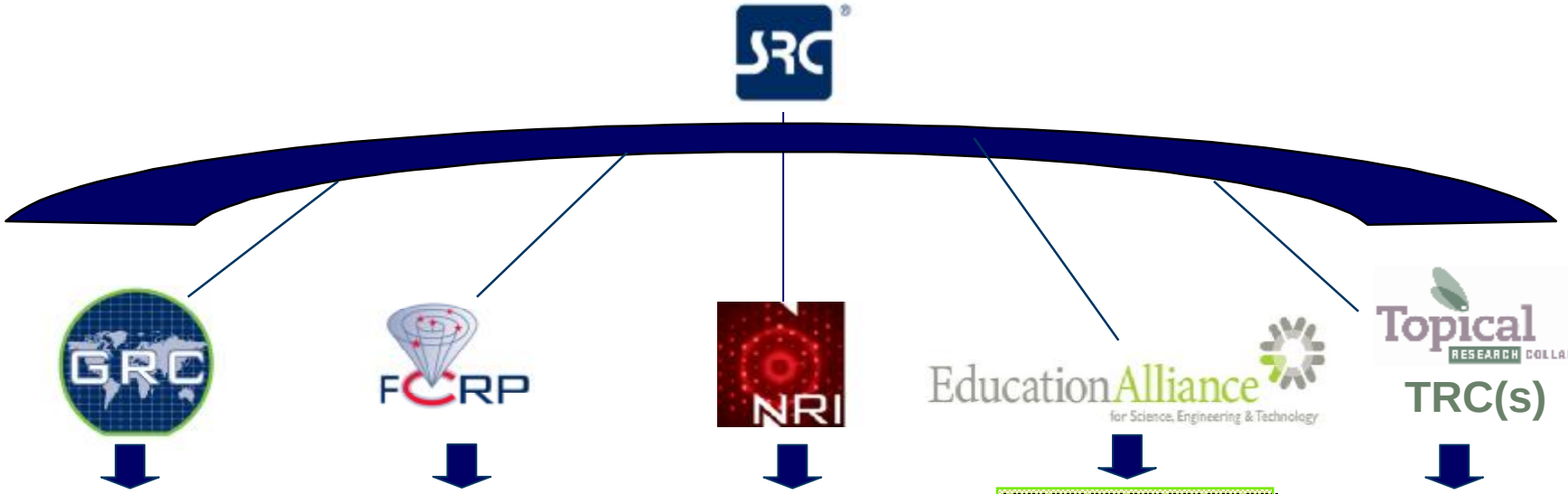
# The Secrets of SRC's Success

- Competitors agree to collaborate
- Commitment to Moore's Law
- The Roadmap
- Precompetitive → shared IP
- *The* industry technical experts in the loop
- World-class researchers (faculty and students)
- Nimble and adaptable
- Accountable; value-driven

# Roadmaps and Moore's Law

- For other industries, an observation such as Moore's law may not be apparent or possible; but identifying "research needs" to achieve certain capabilities *is* possible.
- Industry commitment is a must.
- SRC began the ITRS journey for the semiconductor industry this way

# Semiconductor Research Corporation
## A Family of Distinct, Related Program Entities




**Global Research Collaboration**

Ensuring vitality of current industry

AMD
Freescale
GLOBALFOUNDRIES
IBM
Intel
TI
AMAT
Axcelis
Cadence
Mentor
Novellus
Rohm & Haas
TEL

**Focus Center Research Program**

Breaking down barriers to extend CMOS to its limits

The Mitre Corp

State of Arizona
State of Georgia
State of Texas
State of NY
UK Eng & Phy Sci

NIST
NSF

SEMATECH

AMD
AMAT
Cadence
Freescale
GLOBALFOUNDRIES
IBM
Intel
MICRON
Novellus
TI
Xilinx

DARPA

**Nanoelectronics Research Initiative**

Beyond CMOS – identifying next information element

AMD
IBM
Intel
MICRON
TI

State of CA
State of Indiana
State of NY
State of Texas

NIST
NSF

Oregon NanoScience & Microtech Institute

South Bend, Indiana

**Attracting and educating the next generation of innovators and technology leaders**

**Topical Research Collaborations**

Topic(s) chosen by participants

TERC
NINE

AMAT
First Solar

Interested:
GE
IBM
BP Solar
Suntech
Air Products
Q-Cells

Goodyear
Exxon Mobil
Intel

Interested:
IBM
Lockheed Martin
Corning

# Our Four Major Research Programs

| | 1<br>**G**lobal **R**esearch **C**ollaboration | 2<br>**F**ocus **C**enter **R**esearch **P**rogram | 3<br>**N**anoelectronics **R**esearch Initiative | 4<br>**Topical Research Collaboration** |
|---|---|---|---|---|
| Time Frame | 7 - 14 yrs | 14 - 20 yrs | > 20 yrs | Variable |
| Technology | Traditional CMOS | Limit of Traditional CMOS | Beyond CMOS | Selected Topics |
| Purpose | Narrowing options | New options | Revolutionary discoveries | Topic Specific |
| Industry Participation | **ü ü ü** | **ü ü** | **ü** | **ü ü ü** |
| Government Participation | **ü** | **ü ü** | **ü ü ü** | **ü ü ü** |

# Topical Research Collaborations (TRCs): A New SRC Research Vehicle

- Apply the collaborative model to new technical areas
- Leverage the successful SRC roadmapping and industry-engagement model with new companies and additional government agencies
- Supply opportunities for new product directions for current members

# Topical Research Collaborations (TRCs) in Development

1. National Institute for Nano-engineering (NINE)
   - § Nano-materials and Nano-engineering
   - § Joint program with Sandia National Laboratories

2. The Energy Research Corporation (TERC)
   - § Designed to help enable the realization of reliable, low cost, energy efficient systems
   - § Initially focus on modeling and simulation of PV technologies and leverage NSF Network for Computational Nanotechnology (NCN) capability at Purdue

**Industry members involved are:**

**AMAT Corning Exxon Mobil First Solar GE Goodyear IBM Intel Lockheed Martin**

# Applicability of Collaborative Model to PV Manufacturing Research

- PV and semiconductor manufacturing share:
  - ***Common materials*** – silicon ingots/wafers
  - ***Common equipment*** – etching, sputtering, chemical vapor deposition, metrology tools, defect inspection, test and assembly, etc.
  - ***Common processes*** – wafer handling, deposition of materials and coatings on substrates.
- Many potential technology overlaps (e.g., thin films, flexible substrates and novel semiconductor materials).
- PV and semiconductor manufacturing research both focus on ***increasing efficiencies*** and ***reducing costs***.

# Possible Collaborative Model for PV Manufacturing Research

- Bring together industry, universities and government, e.g. DOE Laboratories, NIST, etc.
- Develop roadmap and technology assessment to identify gaps and common challenges.
- Focus on precompetitive research and on developing underlying technology for manufacturing improvement.
- Make research results broadly available to all participants.
  - Participants receive IP on a non-exclusive, royalty-free basis.
  - Results generally would be published.

# Possible Collaborative Model for PV Manufacturing Research (cont.)

- Coordinate to minimize overlap, leverage efforts, and promote commercialization of results.
- Center in a university or a Federal laboratory.
- Not a demonstration or prototype facility, but could interact with a demonstration facility or other proprietary projects.

# Summary

- Collaborative research will spur innovation
- Need industry to commit/lead by jointly identifying areas of R&D needs where non-exclusivity is acceptable.
- Government can incentivize by providing significant co-funding for implementation of research plan.
- Given the diversity of technologies, distributed—but coordinated—university and/or Federal laboratory centers seems preferable to building a pilot facility.
  - DOE Energy Frontier Research Centers (funded by BES) are a good start, but are not sufficiently connected to industry.
  - DOE could use flexibility offered by ARPA-E to coordinate a portion of its PV manufacturing research with a (SRC like) consortium that is guided and funded by industry.

# PV Manufacturing Research "Ecosystem"