SRC: Celebrating 30 Years

Working together we are formidable!

June 26, 2012

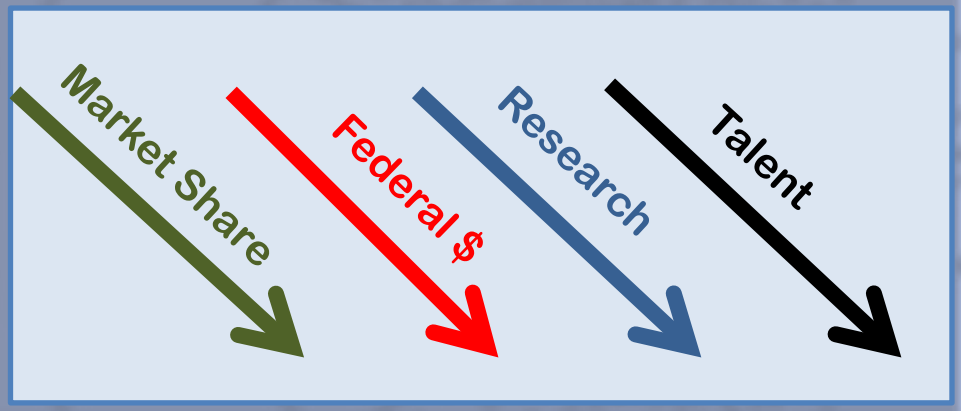
The Semiconductor Environment in 1982

U.S. semiconductor companies were rapidly losing market share and federal support for silicon research was decreasing.

Very little silicon-oriented research was being conducted in universities.

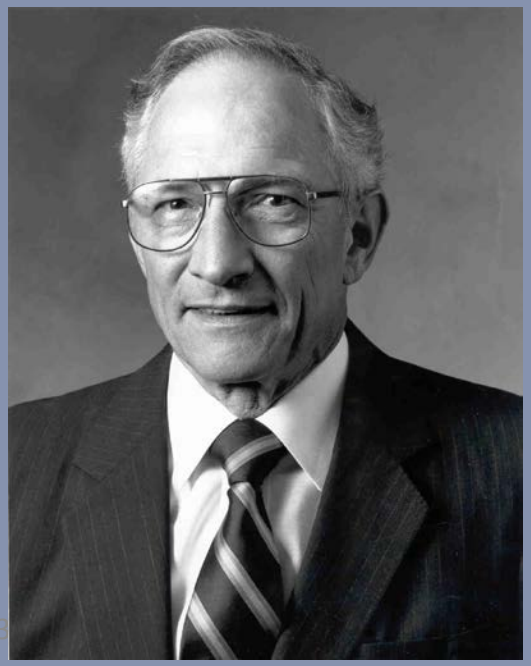
- Less than 100 students and faculty conducted silicon research

As a result, the pipeline of talent was drying up.



What happened?

- In 1982, the Semiconductor Industry Association formed the SRC to launch and manage relevant and collaborative university research programs



- Robert Noyce of Intel wrote a personal check to Larry Sumney, the SRC's founding President, to begin SRC operations

SRC's Charter (1982)

Objectives:

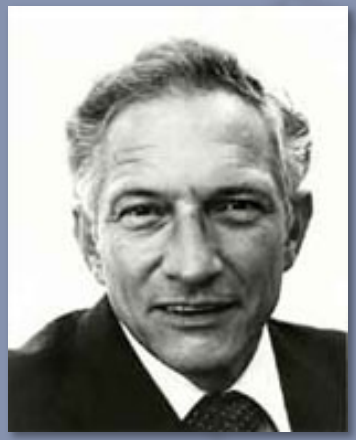
- Define relevant research directions
- Explore potentially important new technologies (and transfer results to industry)
- Generate a pool of experienced faculty & relevantly educated students

Visionary Leadership for SRC

First SRC Board Chair

Erich Bloch

SIA Board

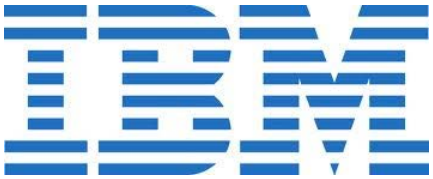


Robert Noyce

SRC IP Policy

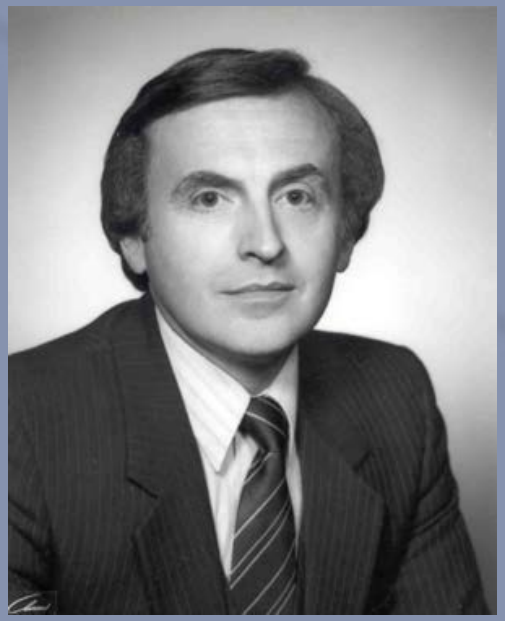
Jack Kilby

Founding SRC Companies



Current SRC Member Companies

SRC Senior Staff (Circa 1982)

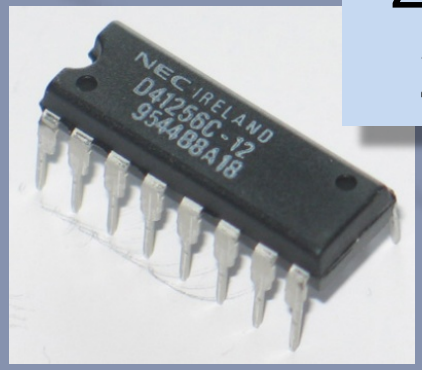


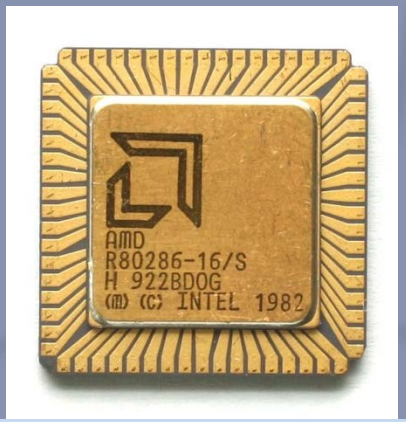
Larry Sumney

Robert Burger & Richard Alberts

Semiconductor Landscape in 1982

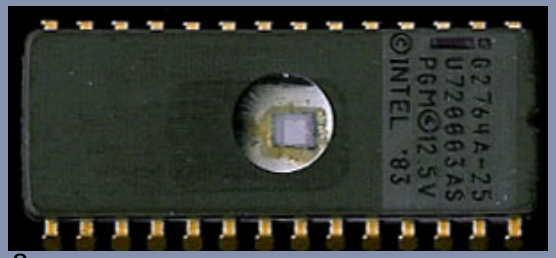
256 Kbit DRAM
2 μm features

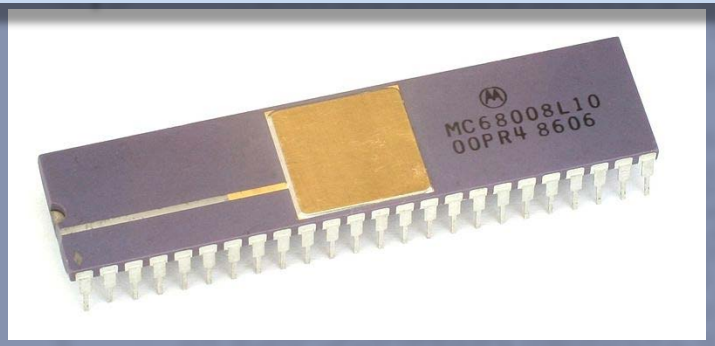




10^5 transistors/MPU
10 MHz
1.5 μm features

64 Kbit UV-EPROM
No flash memory as we know it today





What 30 Years of Progress Enabled

1976: Best available storage technology was the **IBM 3350**

Each unit:
- 635 MB
- $70,000

80Gb cost
$9,000,000 !!!
in 1976 dollars

126 IBM 3350's = storage in **1 iPod**

2006

iPod(5G)
80GB

80Gb cost
$350
in 2006 dollars

Example 10-year SRC Research Goals (1984)

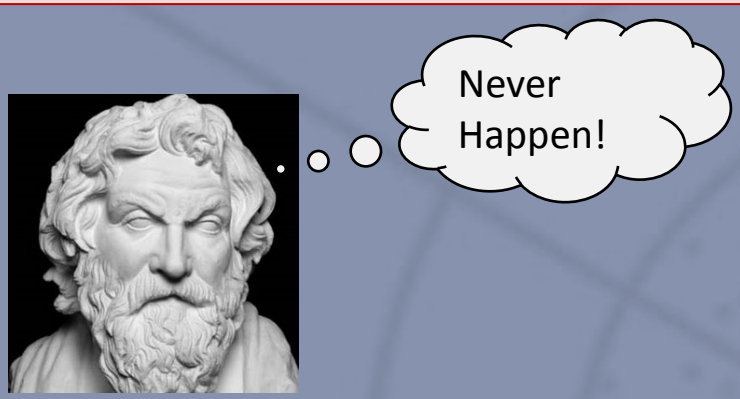
- ✓ **256Mb** DRAM with **0.25 micron** minimum feature size
- ✓ **50 ps** logic gate delay and switching energy of **5 fJ**
- ✓ **Six person-month** design time for error-free layout of chips with **10^8** transistors
- ✓ Tests that enable less than **1 in 10^6** defective devices
- ✓ **5X** increased manufacturing productivity

SRC Goals Were Sometimes Met With Disbelief

- **"0.25 micron minimum features – doesn't that violate the laws of physics?"**

  "It is doubtful that one can scale the device dimensions to ***below 0.1 μm*** *and gain any advantage in circuit performance because of several* ***basic limitations****"*

  Proc. IEEE (1983): *"A systems approach to 1 μm NMOS"*



- **Working together, we achieved the 1984 SRC goals!**

1982: SRC 'Springs into Action'

166 proposals received → 80 proposals funded

↓

Three research centers were formed

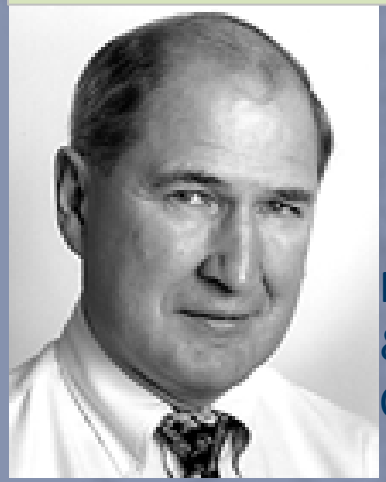
SRC-CMU Center of Excellence for CAD

Steve Director, CMU

SRC-UC/Berkeley Center of Excellence for CAD

Don Pederson, UC-Berkeley

SRC-Cornell Center of Excellence for Microscience & Technology



Noel MacDonald & Jeffrey Frey, Cornell

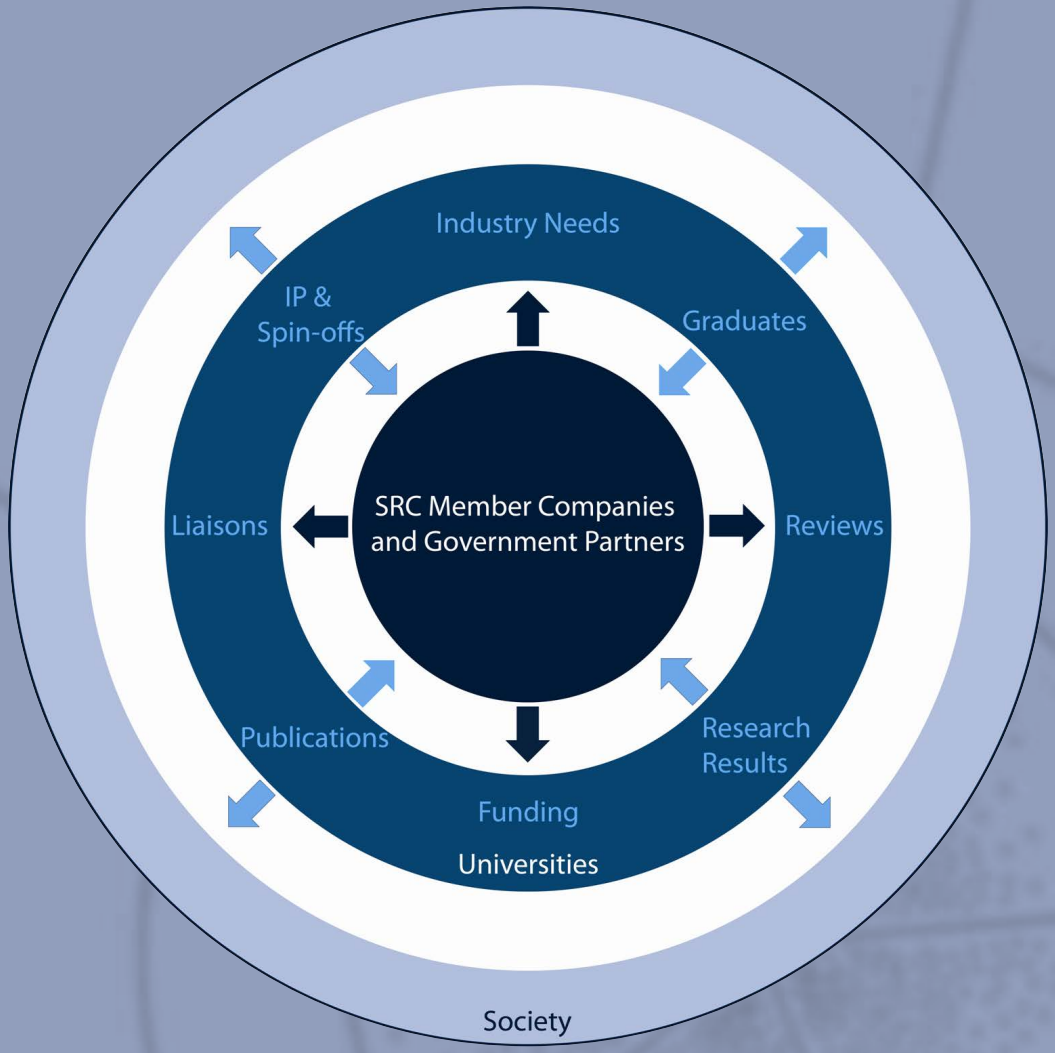
Knowledge creation for information technologies

SRC Pathways for Collaboration

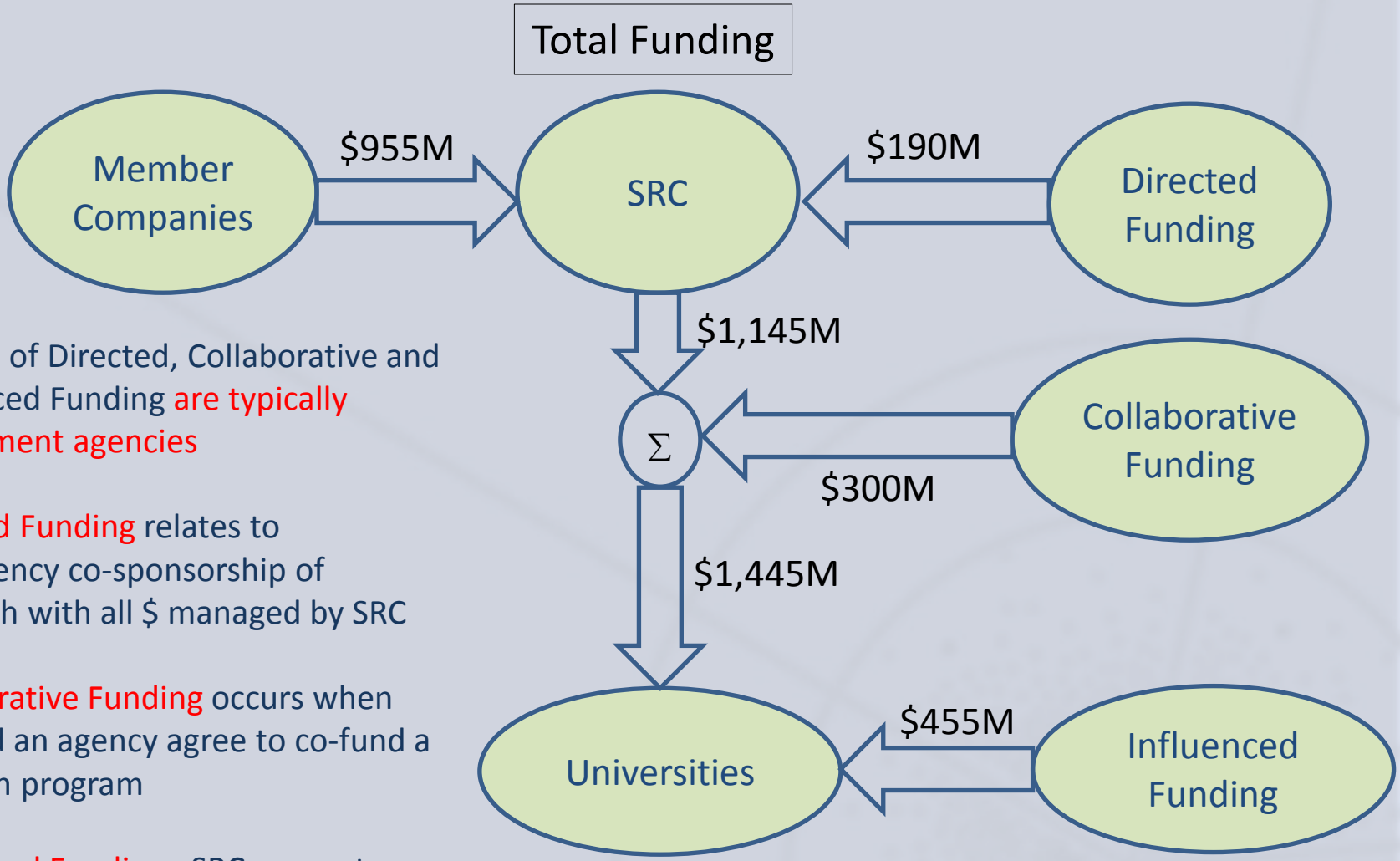
This chart represents how SRC impacts, and is impacted by, its member companies. **SRC Member Companies and Government Partners** determine **Industry Needs**, provide **Funding** to **Universities,** monitor the research through regular **Reviews** and establish partnerships through Industrial **Liaisons**.

SRC Member Companies receive **Research Results**, relevantly educated and experienced **Graduates**, access to **Publications, Intellectual Property and Spin-offs**.

These outputs benefit the semiconductor industry, and **Society**, as a whole.



SRC Funding Pathways – Actual $



- Sources of Directed, Collaborative and Influenced Funding are typically government agencies
- Directed Funding relates to SRC/Agency co-sponsorship of Research with all $ managed by SRC
- Collaborative Funding occurs when SRC and an agency agree to co-fund a research program
- Influenced Funding : SRC supports research needs development, proposal evaluations, and links funded projects to members

Overall: $1.9B

SRC Technical Advisory Boards

- Currently there are **1133** members of **Technical Advisory Boards** (TABs) who define research needs/review projects
- There have been **1704** distinct TAB members across **52** different TABs throughout the SRC history

Research Reviews

- SRC Members take the responsibility of research monitoring very seriously and review every SRC research program every year

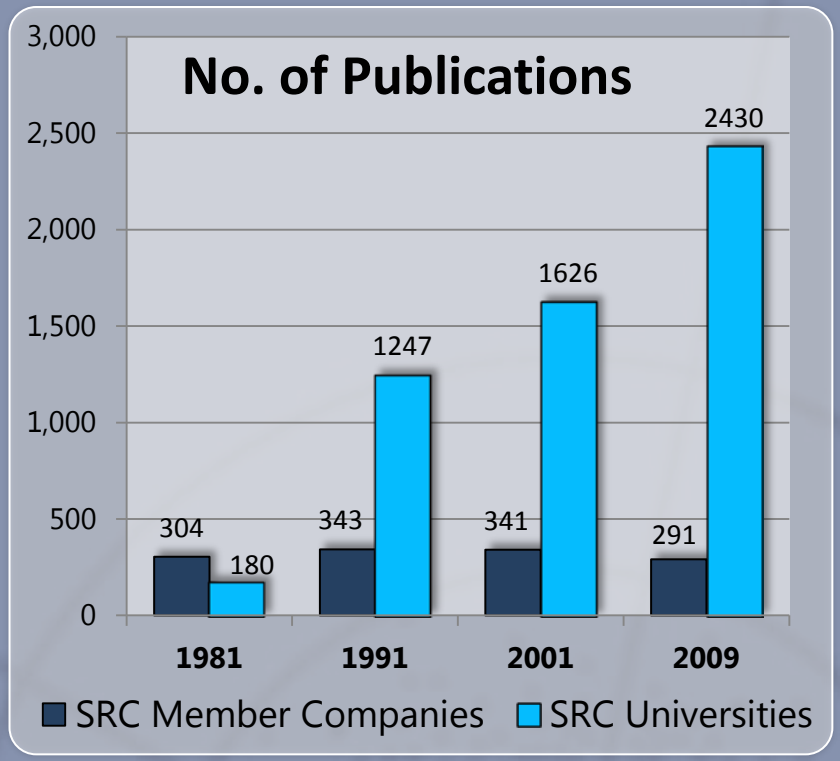
- ~ **850** reviews since inception to strengthen research and the industry-university partnership

Graduates

- Since 1982, over **9400** students have worked on SRC sponsored projects.
- At any given time, there are between **1200** and **1500** students involved in SRC research
- The vast majority of our alumni obtained graduate degrees, mostly the Ph.D.

Major Accomplishments

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



- In 1982, less than 100 students and faculty conducted silicon research.
- In 2011, that number is **500 faculty** and **1,500 students**!

The SRC community publishes 20% of the world's research on silicon; seven times more than AMD, GLOBALFOUNDRIES, IBM, Intel, Freescale, and TI ***combined.***

SRC Influential Publications

- Currently, 210 SRC- supported papers have received over 100 citations.

- Almost 2/3 of SRC's Influential Publications have received at least 15% industry citations

Celebrating Accomplishments

A few examples of research contributing to our members' technologies

- **The Copper Revolution**
- **The high-K Breakthrough**
- **'Green' Flip-Chip Packages**
- **The Birth of CAD Industry**

Where Are We Going?

- Some technology projections from current research
  - **Sub-16 nm patterning**
  - **III-V channel FET**
  - **Optical Interconnects**
  - **3D-IC**
  - **Integrated Sensors**
  - **Terahertz Electronics**

Many Challenges and Opportunities Stand Before Us

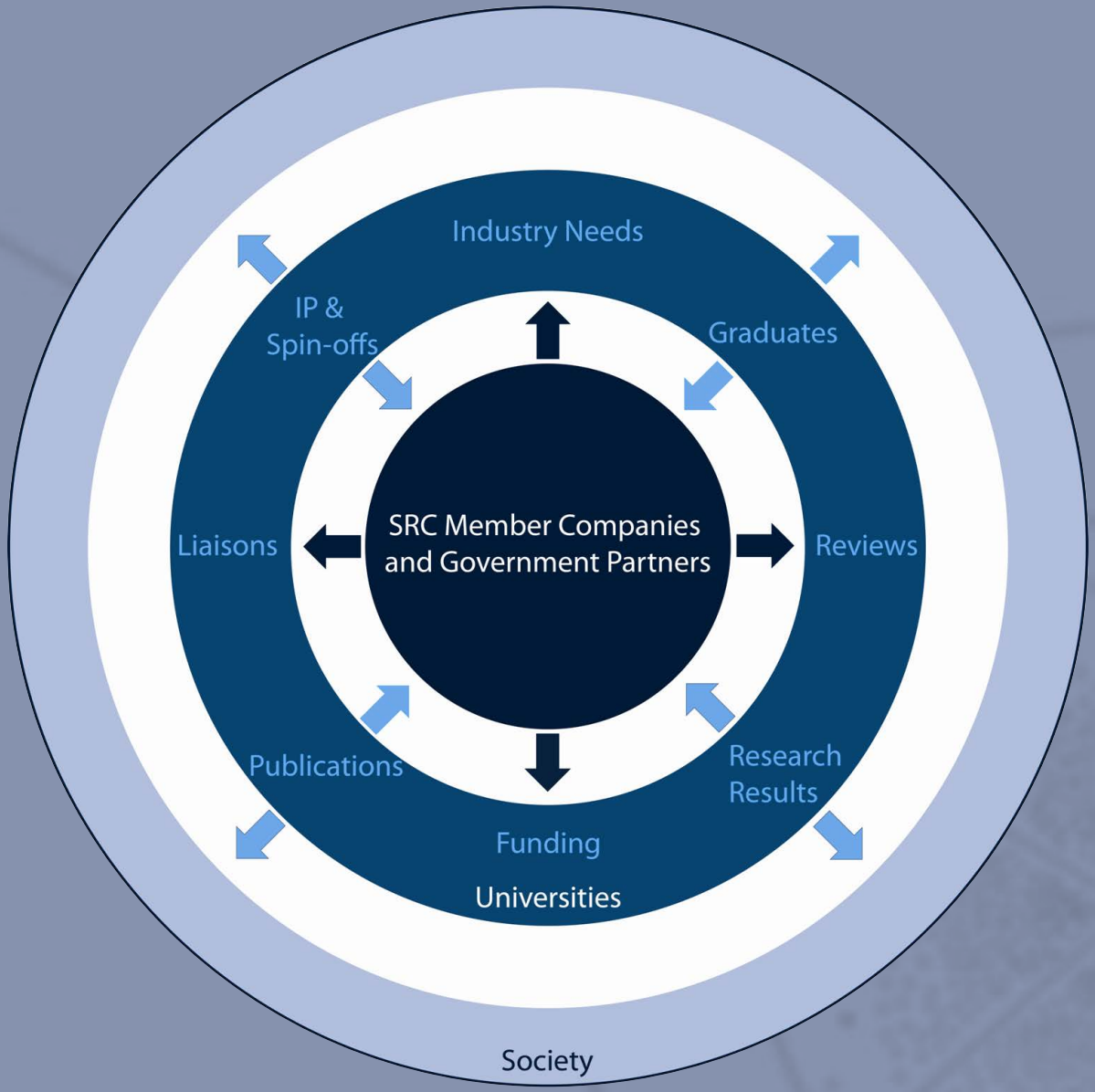
- Continue to drive-down integrated circuit fabrication costs
  - Even as features sizes approach atomic dimensions
- Expand the space of integrated circuit applications
- Dramatically reduce energy consumption of integrated circuits
  - May need to invent new devices & interconnect technologies
- Expand the sensory domain of integrated circuits
  - And learn to utilize the vast amount of data that results
- Develop new ways of processing information
  - Is it possible to develop machines that reason and discover?

Working Together We Can Accomplish Wonders!

"Never doubt that a small group of thoughtful, committed people can change the world. Indeed, it is the only thing that ever has."

– Margaret Mead

Let’s Keep Rolling!



SRC Pathways for Collaboration