



Collaborative Research in Semiconductors

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Perspectives

- **Markets are the downstream result of new technologies**
 - Semiconductor research enables new markets, which cannot be foreseen

- **Technical leadership is crucial for US economy**
 - A decline in the knowledge base is a potential threat to US competitiveness
 - Is global research collaboration a partial solution to the reverse braindrain?



Thesis: Fundamental University research Creates Market Opportunities

Basic Research

Impact on the Society

Precise Control of Atoms in Semiconductor Materials (Stanford)



Microchips with hundreds of millions and billions transistors

Single-crystals of SiC and GaN (NCSU)

Cell-phone displays



Bright & energy efficient traffic lights

Laser crystallization of amorphous silicon (Cornell-MIT-CalTech-Columbia)

Flat panel displays



Hot-electron injection in thin films of insulators (Berkeley)



digital cameras

pocket memory sticks



iPod nano



Today's iPod market couldn't be created in 1976 because the enabling technology was unavailable

2006

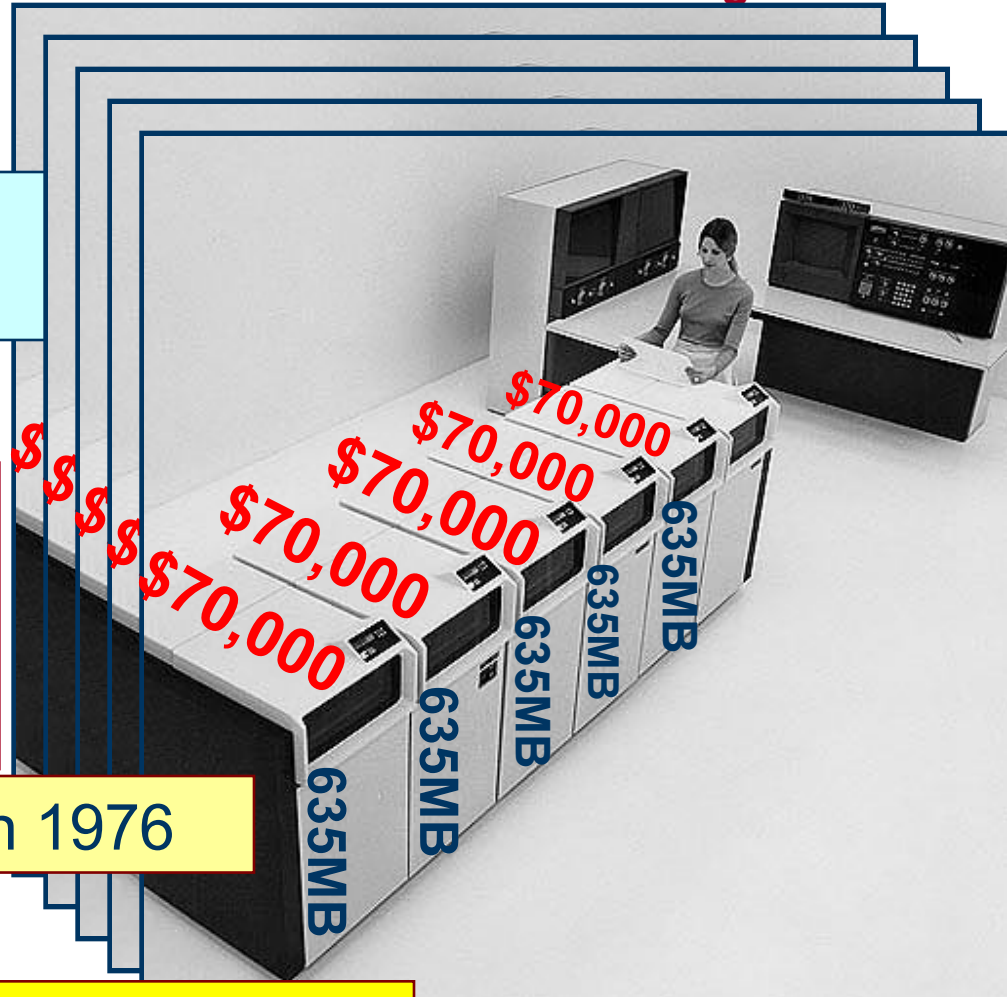


iPod(5G)
80GB

126 IBM 3350
units needed!

\$9,000,000 !!!
(1976 USD)
(storage only)

Available technology in 1976:
IBM 3350 direct access storage



iPod concept was unthinkable in 1976

New technology creates new markets



The are two roads to success in the market

- Low cost **A competitive challenge for US**

- **Technical Leadership**

Can't afford to lose!

US innovation in semiconductor technologies has been one of the key enablers of competitiveness

Potential Threats to US Competitiveness

Erosion of Semiconductor Manufacturing Base

Not replenishing the Knowledge Base

Can Integrated International Research Networks mitigate to some extent the reversal of the *Brain Drain*?



Why Collaborative Research?

The Semiconductor Research Corporation (SRC) was established in 1982 as a consortium of semiconductor companies to manage high priority university research

- Pooling of funds
- Definition of relevant research directions
- Provide foundation for new technologies and subsequent products
- Generate skilled human resources
- Vehicle for global collaboration

SRC's "Founding Fathers"



Erich Bloch, IBM vice president
Director of the National Science Foundation,
Recipient of the National Medal of Technology



Robert Noyce, "the Mayor of Silicon Valley", co-founder of Intel and co-inventor of the integrated circuit.

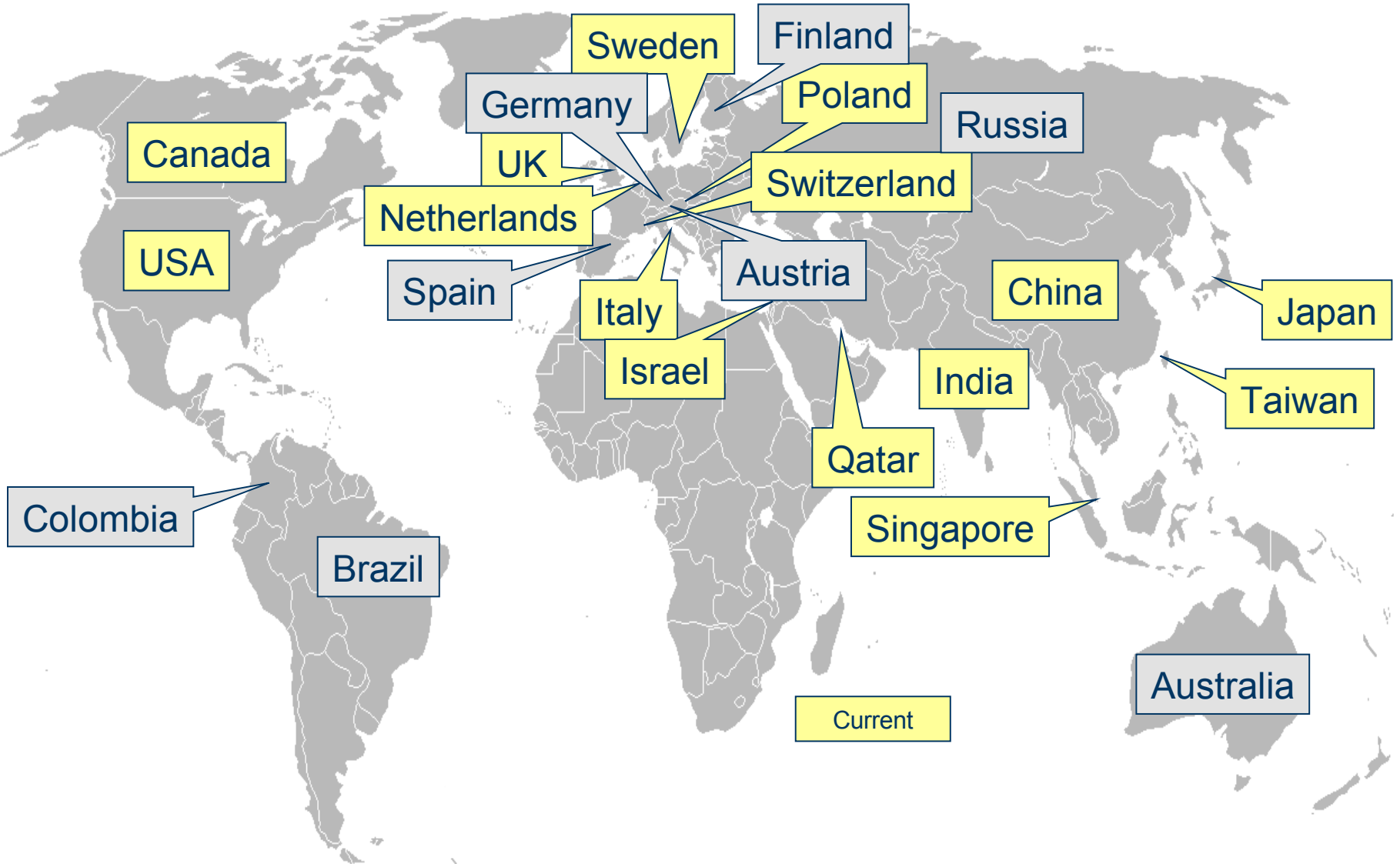


Jack Kilby, Nobel Prize Laureate for the invention of the integrated circuit



SRC-GRC Research Worldwide

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Lessons from SRC International Research Contracts

- IP is rarely a major issue with foreign universities
- The research quality quickly approaches that of US universities
- Export Control regulations greatly impede our ability to freely engage brightest minds, wherever they may emerge, to contribute to our research agenda
- Since SRC performs the research project integration function, its members obtain a collective view of the research - hence a competitive advantage

In the 21st century, cooperative research can provide the technological infrastructure for commercial success

- Semiconductor industry set the first precedent
- University research must be strongly supported in a “pre-competitive” environment
 - Promoting international university centers
- Global research consortia (SRC model has proved to be successful) insures that industry can get the best and brightest and can provide;
 - Easy, facilitated access to research centers of excellence around the world



Summary Continued

- **There is great value in pooled industry involvement in support of university research**
 - Leveraging of funds both across the industry and through other agencies and governments provides incentive for companies to participate and an approach for governments to maintain relevancy
 - Access to pooled industrial expertise during the course of the research maintains university research and provides continuous access to students
- **Funding directions can and must respond quickly to industry changes in direction and business models**
 - Agility of funding will decrease the time to market for new innovations
 - Global market changes can be accommodated