SCIENCE, TECHNOLOGY AND THE GLOBAL ECONOMY

Science and Technology in the US from World War II to the 21st Century

Today's challenges in Science and Technology

Some thoughts on Science and Technology in support of "INTELLIGENT TAIWAN"

Post-WWII Science

Vannevar Bush and the Government-University Partnership

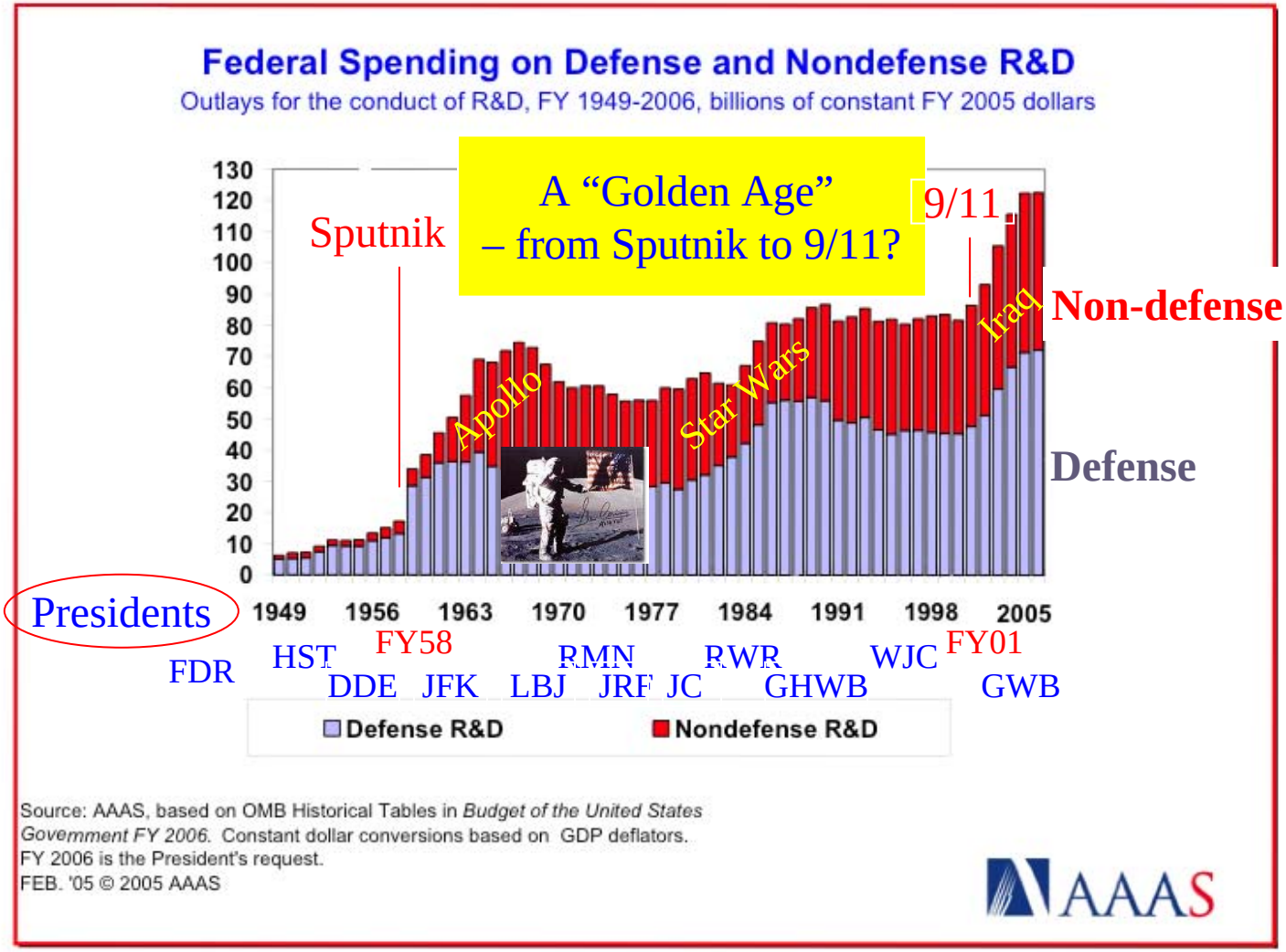
Vannevar Bush (1945)

Vannevar Bush's "Science: The Endless Frontier"

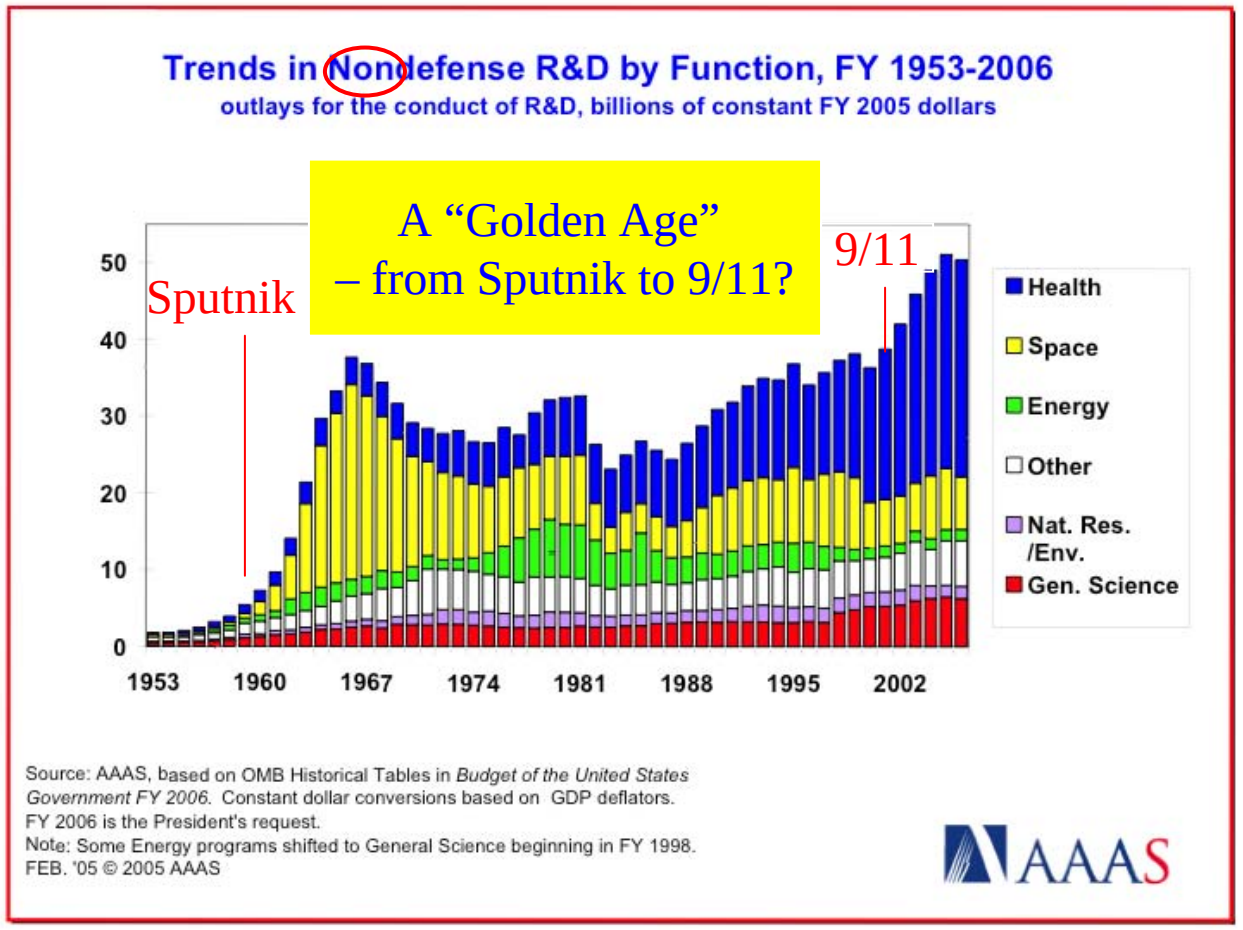
"The Government should accept new responsibilities for promoting the flow of new scientific knowledge and the development of scientific talent in our youth. These responsibilities are the proper concern of the Government, for they vitally affect our health, our jobs and our national security."

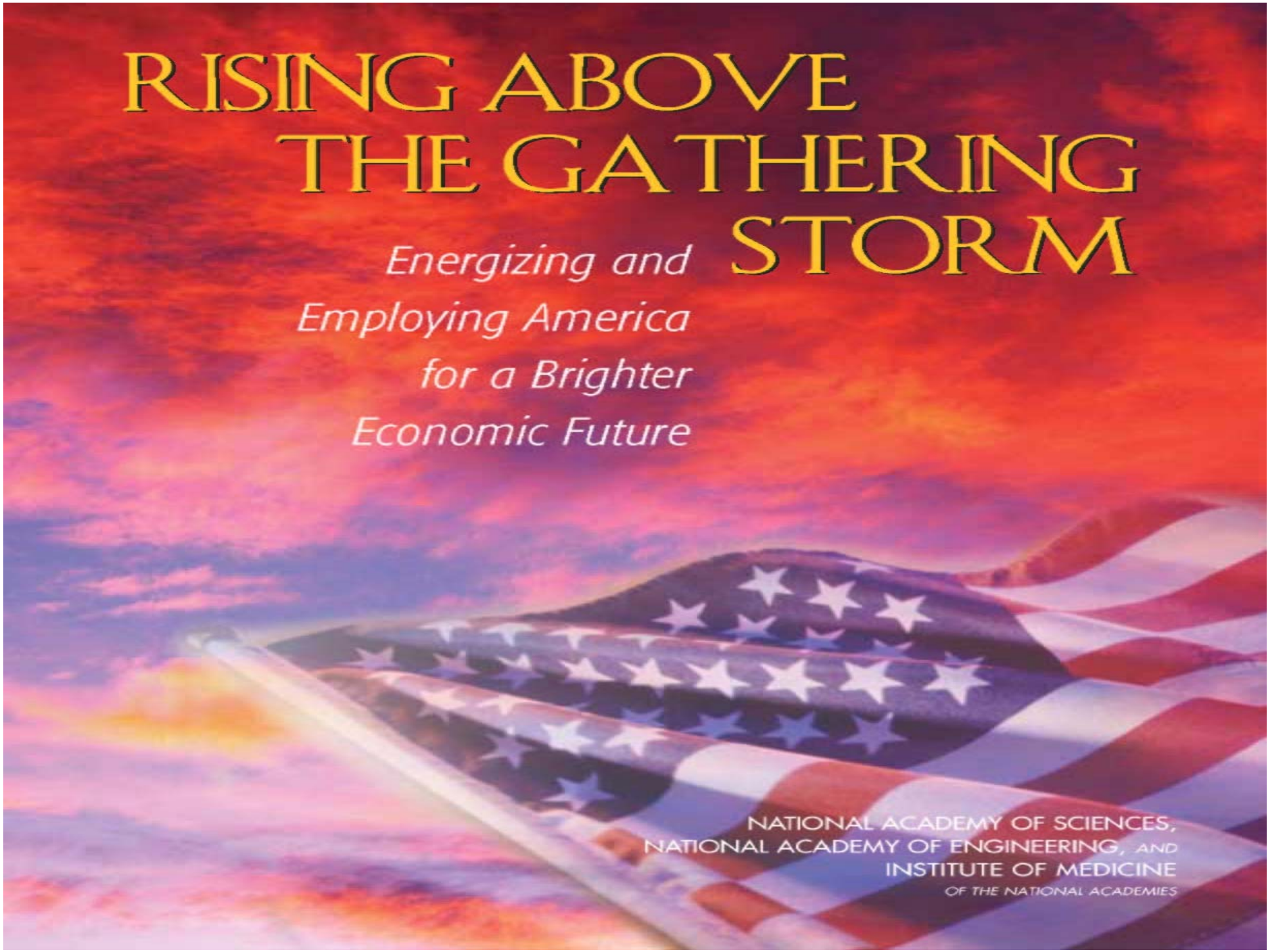
NSF established in 1950

A "Golden Age" of Federal R&D Funding



But what kind of "Golden Age" for science? – from space to medicine – leaving costly gaps.




RISING ABOVE THE GATHERING STORM
Energizing and Employing America for a Brighter Economic Future
NATIONAL ACADEMY OF SCIENCES,
NATIONAL ACADEMY OF ENGINEERING, AND
INSTITUTE OF MEDICINE
OF THE NATIONAL ACADEMIES

Some Competitiveness Indicators

- The United States is today a net importer of *high-technology* products. Its trade balance in high-technology manufactured goods shifted from *plus* $54 billion in 1990 to *negative* $50 billion in 2001.
- Chemical companies closed 70 facilities in the United States in 2004 and tagged 40 more for shutdown. Of 120 chemical plants being built around the world with price tags of $1 billion or more, one is in the United States and 50 are in China.
- In 2005, only four American companies ranked among the top 10 corporate recipients of patents granted by the *United States* Patent and Trademark Office.

More Competitiveness Indicators

- Fewer than one-third of US 4th grade and 8th grade students performed at or above a level called “proficient” in mathematics; “proficiency” was considered the ability to exhibit competence with challenging subject matter. Alarmingly, about one-third of the 4th graders and one-fifth of the 8th graders lacked the competence to perform even basic mathematical computations.
- US 15-year-olds ranked 24th out of 40 countries that participated in a 2003 administration of the Program for International Student Assessment (PISA) examination, which assessed students’ ability to apply mathematical concepts to real-world problems.
- In 1995 (the most recent data available), US 12th graders performed below the international average for 21 countries on a test of general knowledge in mathematics and science.

Yet More Competitiveness Indicators

- In South Korea, 38% of all undergraduates receive their degrees in natural science or engineering. In France, the figure is 47%, in China, 50%, and in Singapore 67%. In the United States, the corresponding figure is 15%.
- Some 34% percent of doctoral degrees in natural sciences and 56% of engineering PhDs in the United States are awarded to foreign-born students.
- In the U.S. science and technology workforce in 2000, 38% of PhDs were foreign-born
- Federal funding of research in the physical sciences, as a percentage of GDP, was 45% less in FY 2004 than in FY 1976.

Method

- Review of literature, past reports, and suggestions led to 150 ideas
- Focus groups of experts discussed ideas and identified top 3-4 ideas in K-12 education, higher education, research, innovation and workforce, and homeland/national security
- Committee meeting and conference calls
- Additional expert consultations
- More than 40 anonymous reviewers
- 10 weeks from meeting to study release

GATHERING STORM RECOMMENDATIONS

- Fix K-12 Science and Math Education
- Better funding for long-term research
- Keep “best and brightest” students from around the world in the US
- Insure US is the premier place in the world to innovate

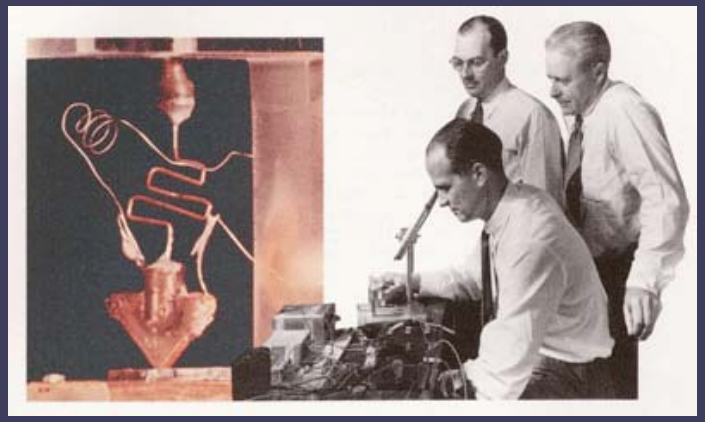
IMPLEMENTATION ACTIONS FOR INNOVATION

- Enhance intellectual-property protection for the 21st century global economy
- Enact stronger R&D tax credit to encourage private investment in innovation
- Provide tax incentives for US-based innovation
- Ensure ubiquitous broadband Internet access

From Research to Information Technology

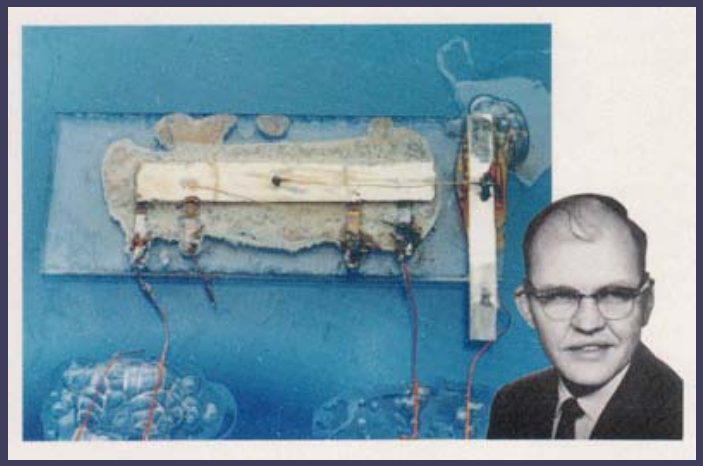
Early discoveries and inventions

Federal government and Industry (Bell Labs, Texas Instruments, others)



Transistor, 1947

Maser , 1953-54



Integrated Circuit, 1958

Laser, 1958-1960

Industrial Laboratories

- In the past, many important scientific discoveries and key technological innovations occurred at the industrial laboratories.

Activity	Corporate Sponsor	Name & Nobel Prize Date
Surface Chemistry	GE Labs	Langmuir, 1932
Electron Diffraction	Bell Labs	Davisson and Thomson, 1937
Transistor	Bell Labs	Bardeen, Brattain, and Shockley, 1956
Maser-Laser	Bell Labs/Columbia	Townes, Basov, and Prokhorov, 1964
Quantum Tunnel Junctions	IBM/GE Labs	Esaki and Giaever, 1973
Theory of Disordered Materials	Bell Labs	Anderson, Mott, and van Vleck, 1977
Cosmic Microwave Background Radiation	Bell Labs	Penzias and Wilson, 1978
Scanning Tunneling Microscopy	IBM	Binnig and Rohrer, 1986
High Temperature Superconductivity	IBM	Bednorz and Muller, 1987
Quantum Hall Effect	Bell Labs	Laughlin, Stormer, and Tsui, 1998
Integrated Circuit	Texas Instruments	Kilby, 2000

Industrial Laboratories

- The industrial laboratories served as incubators for today's academic and corporate leaders.
- In the U.S., industrial laboratories are now focused on much shorter-term research and development goals, with little emphasis on fundamental, basic research.

S&T FOR “INTELLIGENT TAIWAN”

- Government role
- Private role
- University role

PRIVATE ROLE

- ADOBE SYSTEMS
  - Founded 1983, $3.5 B sales, PARC technology, industry experience, market niche, VC funding
- TSMC
  - Founded 1987, $11B sales, industry experience, Government and private funding, market niche

LESSONS

- Bright passionate people
- Best University training
- Industry experience
- Identify a market niche
- Adequate funding
- Flexibility
- Global market

THE FUTURE

- ANOTHER TSMC BY 2030
- THIS TNTC* REQUIRES
  - Graduate in 2000
  - Now employed in industry
  - 2010 starts TNTC
  - 2030 $50B revenue, 24,000 employees

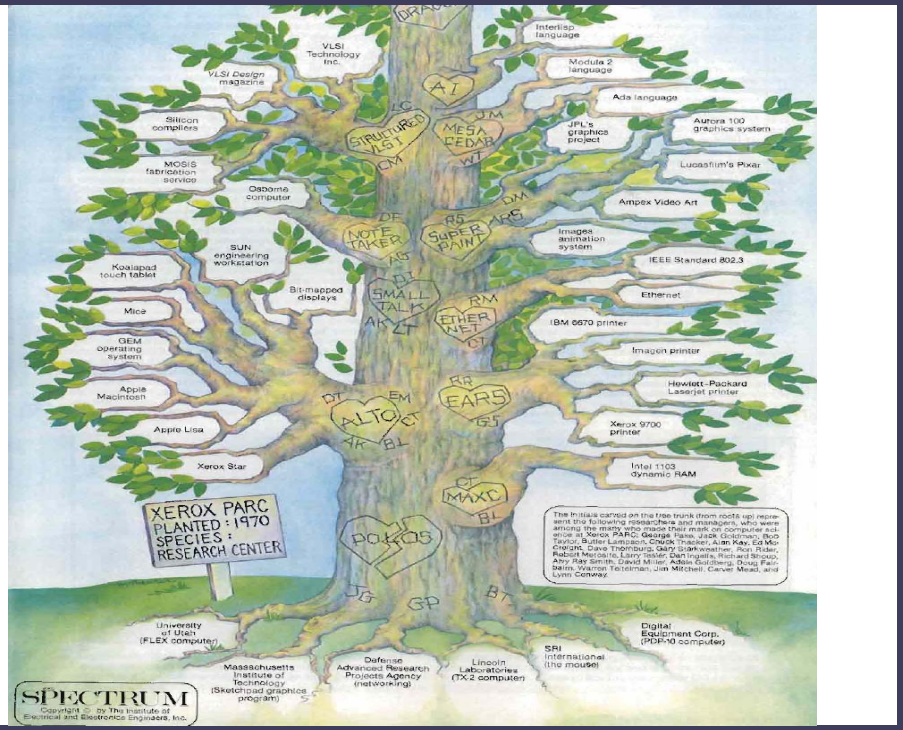
*Taiwan New Technology Corporation

AND IN ADDITION

To have a TNTC with $50 Billion in revenues and 24,000 employees world wide will require that 10-20 new companies are started in 2010!

THANK YOU

ENJOY THE RIDE, IT IS A TIME OF GREAT OPPORTUNITY FOR COUNTRIES WITH LEADERSHIP AND VISION


XEROX PARC
PLANTED: 1970
SPECIES:
RESEARCH CENTER
VLSI Technology Inc.
VLSI Design magazine
Silicon compilers
MOSIS fabrication service
Osborne computer
SUN engineering workstation
Koalapad touch tablet
Mice
GEM operating system
Apple Macintosh
Appre Lisa
Xerox Star
Bit-mapped displays
Interlisp language
Modula 2 language
Ada language
JPL's graphics project
Aurora 100 graphics system
Lucasfilm's Pixar
Ampex Video Art
Images animation system
IEEE Standard 802.3
Ethernet
IBM 6670 printer
Imagen printer
Hewlett-Packard Laserjet printer
Xerox 9700 printer
Intel 1103 dynamic RAM
University of Utah (FLEX computer)
Massachusetts Institute of Technology (Sketchpad graphics program)
Defense Advanced Research Projects Agency (networking)
Lincoln Laboratories (TX-2 computer)
SRI International (the mouse)
Digital Equipment Corp. (PDP-10 computer)
SPECTRUM
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