

Research.

# Open Innovation, Open Collaboration, Trends, Challenges, and Advances in the Global Landscape

Wayne C. Johnson

Vice President,  
HP University Relations Worldwide

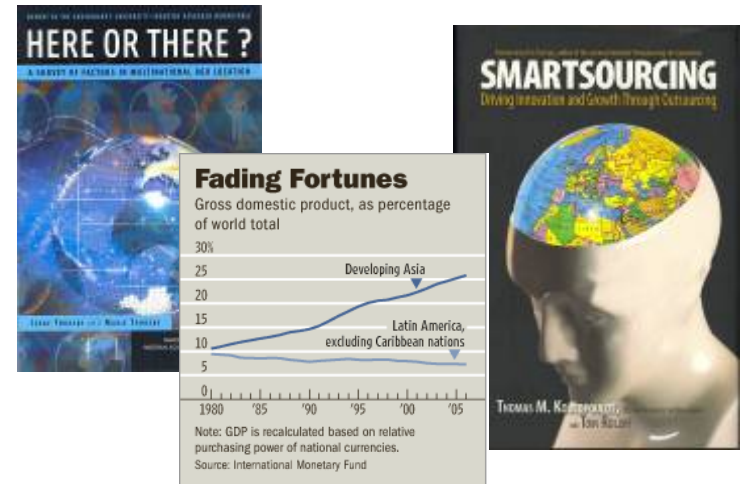
January 10, 2008



# Perspectives that Matter



~ The State of the World ~



~ The State of Business ~



~ State of Research and Education ~

# The State of the World



Globalization is here to stay,  
Driving Changes of Equilibrium in...



- Standards of Living
- Economic Performance
- Educational Success

# ...the Landscape Demands...

## **Globility:**

*Actively seeking attributes that maximize performance and optimize adaptation to evolving global circumstances, including systemic topics of:*

### **Globalization:**

- The tendency of investment funds and businesses to move beyond domestic and national markets to other markets around the globe, thereby increasing the interconnectedness of different markets.

### • **Ability:**

- competence in an activity or occupation because of one's skill, training, or other qualification.

### • **Capability:**

- an aptitude that may be developed.

### • **Flexibility:**

- Responsive to change; adaptable.

### • **Capacity:**

- actual or potential ability to perform, yield, or withstand; the maximum production possible.



# The State of Business

*Industry Adapts to Globalization*



+



=

- *Explosive Growth*  
(some regions)
- *Shrinking*  
(others)
- *Rebalancing*
- *Offshoring*
- *Onshoring*
- *Outsourcing*
- *Insourcing*
- *Downsizing*
- *Rightsizing*

Unrelenting Change

# The State of Education and Research



# World Bank – The Four Pillars of The Knowledge Economy

- *Education & Training*  
An educated and skilled population is needed to create, share and use knowledge.
- *Information Infrastructure*  
A dynamic information infrastructure-ranging from radio to the internet-is required to facilitate the effective communication, dissemination and processing of information.
- *Economic Incentive & Institutional Regime*  
A regulatory and economic environment that enables the free flow of knowledge, supports investment in Information and Communications Technology (ICT), and encourages entrepreneurship is central to the knowledge economy.
- *Innovation Systems*  
A network of research centers, universities, think tanks, private enterprises and community groups is necessary to tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new knowledge.

# Knowledge-based economy and capacity building



- Economic success in knowledge-based economies depends entirely on the capabilities of **people**
- Professional capacity building generates **better** professionals
- Better professionals will identify and **solve local problems**
- A credentialed workforce **attracts** multinational companies
- Opportunity at home eliminates **'Brain Drain'**
- Success is **managing our place** in the global marketplace through strategies for **sustainable competitiveness**

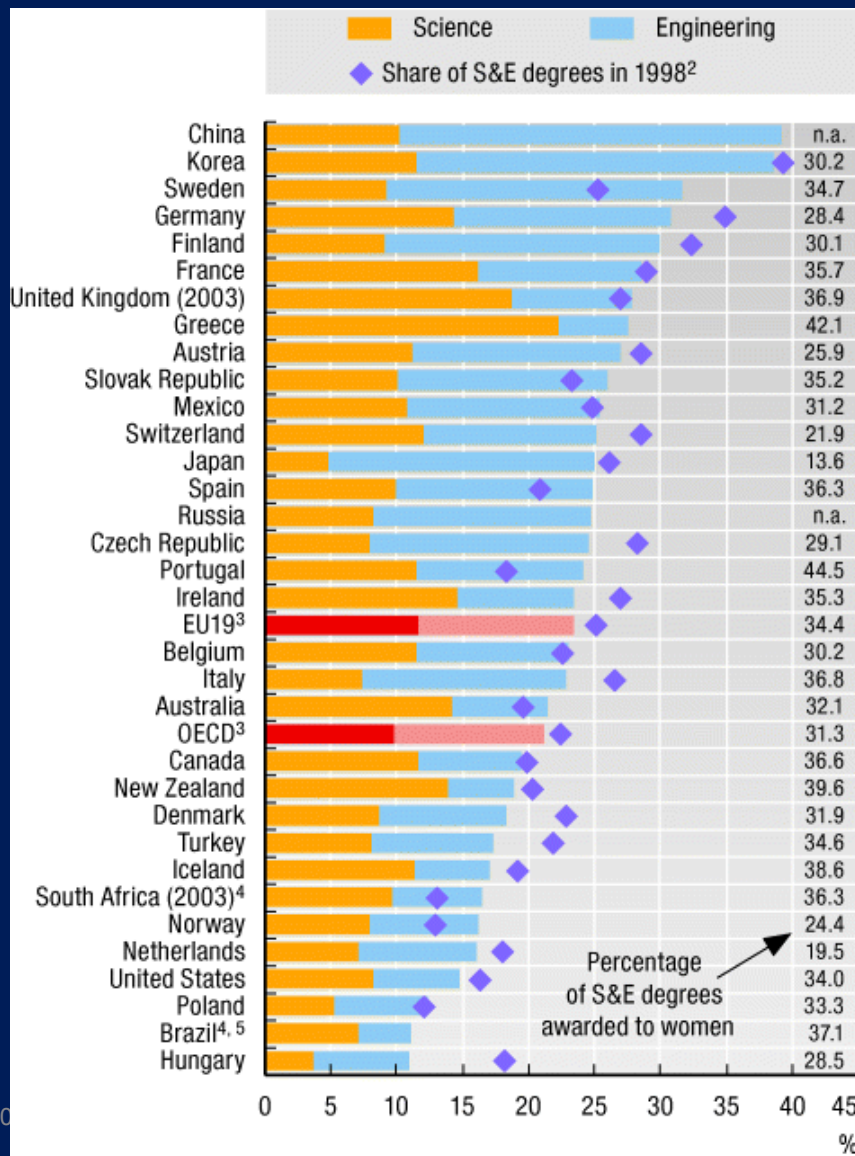
Technology-based economic development demands a holistic view and ecosystem management strategies

# Worldwide Intellectual Equilibrium is Changing Engineering Graduates (2004)

Region/Location	Number of Engineering Graduates
China	300,000
India	200,000
Japan	104,478
Russia	82,409
United States	59,536
South Korea	56,508
Taiwan	26,587
Mexico	24,184
Germany	23,196
Brazil	18,072
Romania	6,632

Source: NRC Science and Engineering Indicators - 2004

# Science and engineering degrees, 2004 as a percentage of total new degrees



## Notes:

- 2003 for doctoral degrees in science and engineering.
- 1999 instead of 1998 for the Slovak Republic and Denmark; 2000 for Portugal and Belgium. These four countries as well as Greece and Luxembourg are excluded from the calculations of EU19 and OECD in 1998.
- Excludes Luxembourg. 2003 data for the United Kingdom.
- ISCED 5B programmes are included with ISCED 5A/6.
- Share of S&E degrees awarded to women in 1998 for 2003.

# My Travels and Experiences



# Emerging Nations Example – Brazil

- HP established partnerships with universities as early as 1997
- Current collaborations exist with 10+ universities and national labs
- Investments of \$5M+ (US) annually in these relationships



# China Examples

## ... Peking University



- University does all R&D
- Companies perform marketing, sales, and manufacturing
- Professors can hold executive positions in the companies
- Students move easily between university campus and company offices
  - Provides real-world experience

# China Examples

## ... Tsinghua University



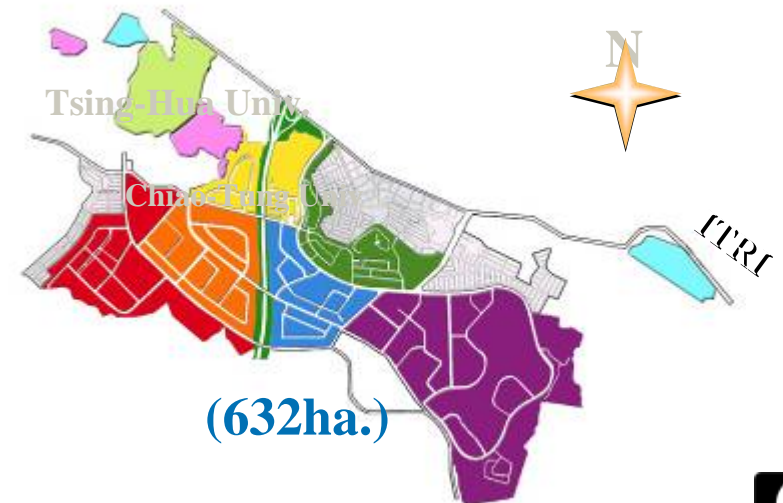
- Owns the Tsinghua Holdings Co.
  - Capital of RMB 2 billion Yuan (\$260M US)
  - Platform for science and technology development, corporate financing, research commercialization, startup incubation, international cooperation
  - Tsinghua Holdings has invested in 80+ portfolio companies in IT, energy and environment, life science, etc.

# Taiwan: The Hsinchu Science-Based Industrial Park (HSIP)

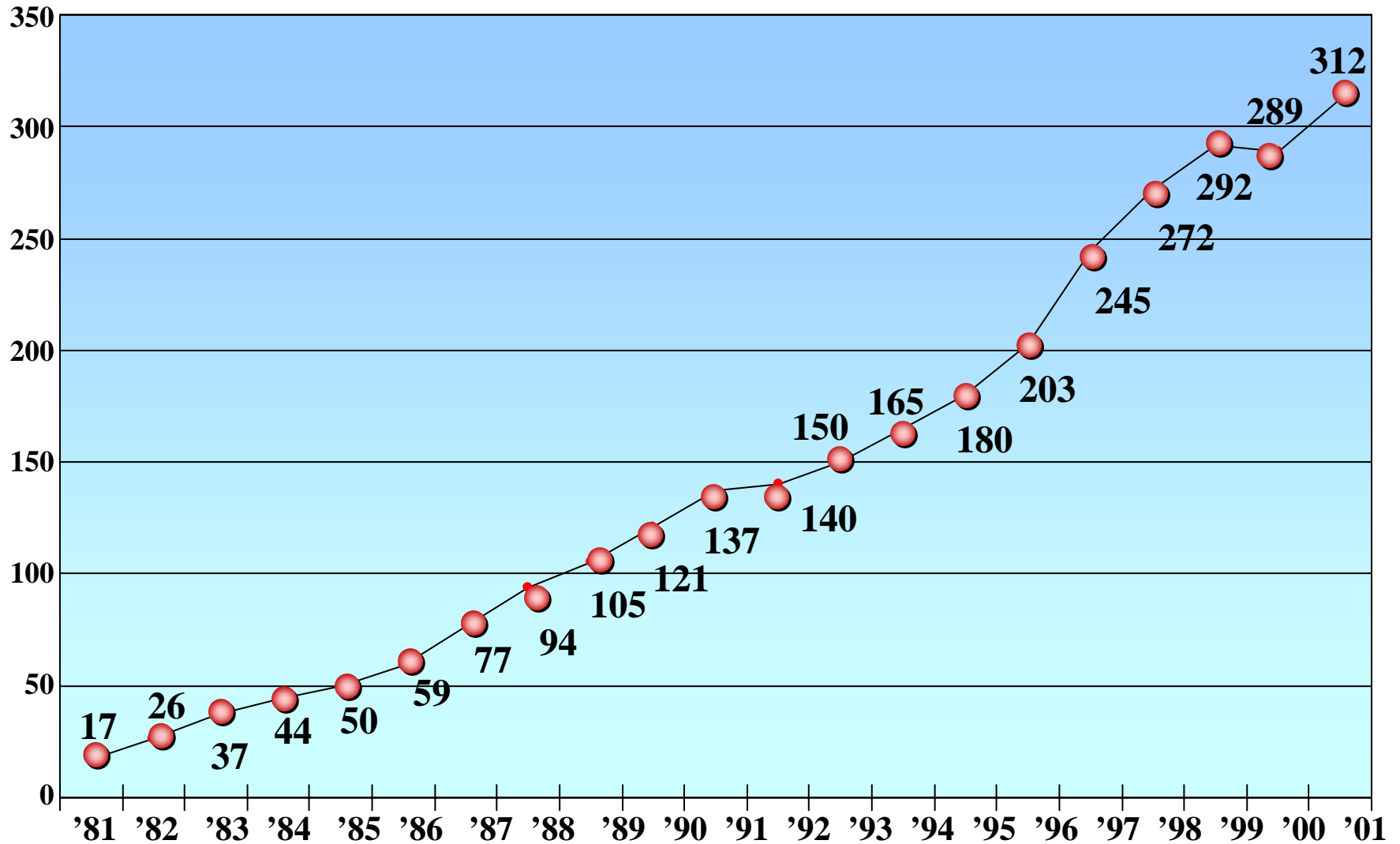
- 90,000 people employed (compared to 40,000 in Research Triangle Park, North Carolina)
- Aggressive corporate, shareholder, individual tax incentives programs
- Government investment participation through the
  - Executive Yuan Development Fund: \$8B ; \$20 B
  - Chiao Tung Bank: \$12 B
  - Government Investment  $\leq$  40%
- Focused on employment and wealth creation

# Taiwan: The Hsinchu Science-Based Industrial Park (HSIP)

- Founded in 1980; administered by the **National Science Council (NSC)**
- Purpose: to attract investment in high technology industries & stimulate local high-tech industries
- Government investment: \$520 mm in land and infrastructure
- Partnership with Chiao Tung University, Tsing Hua University and the Industrial Technology Research Institute

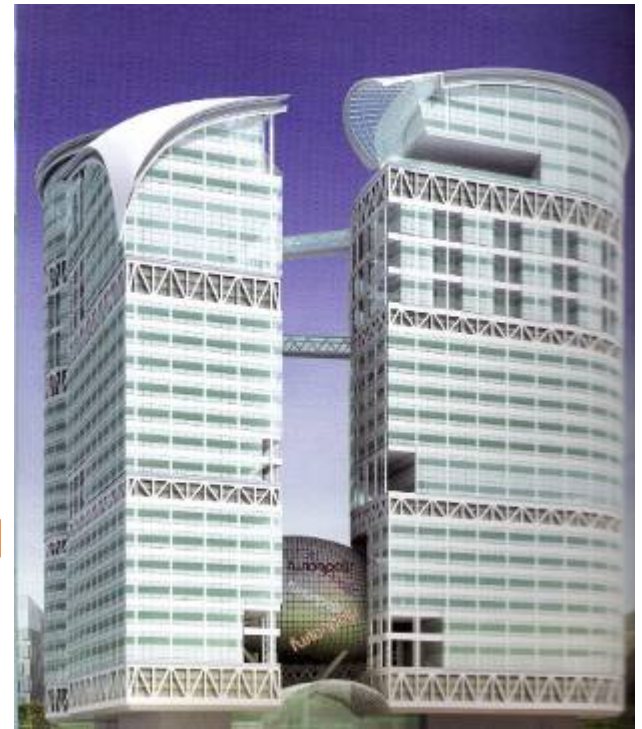


# Taiwan HSIP Growth of Companies

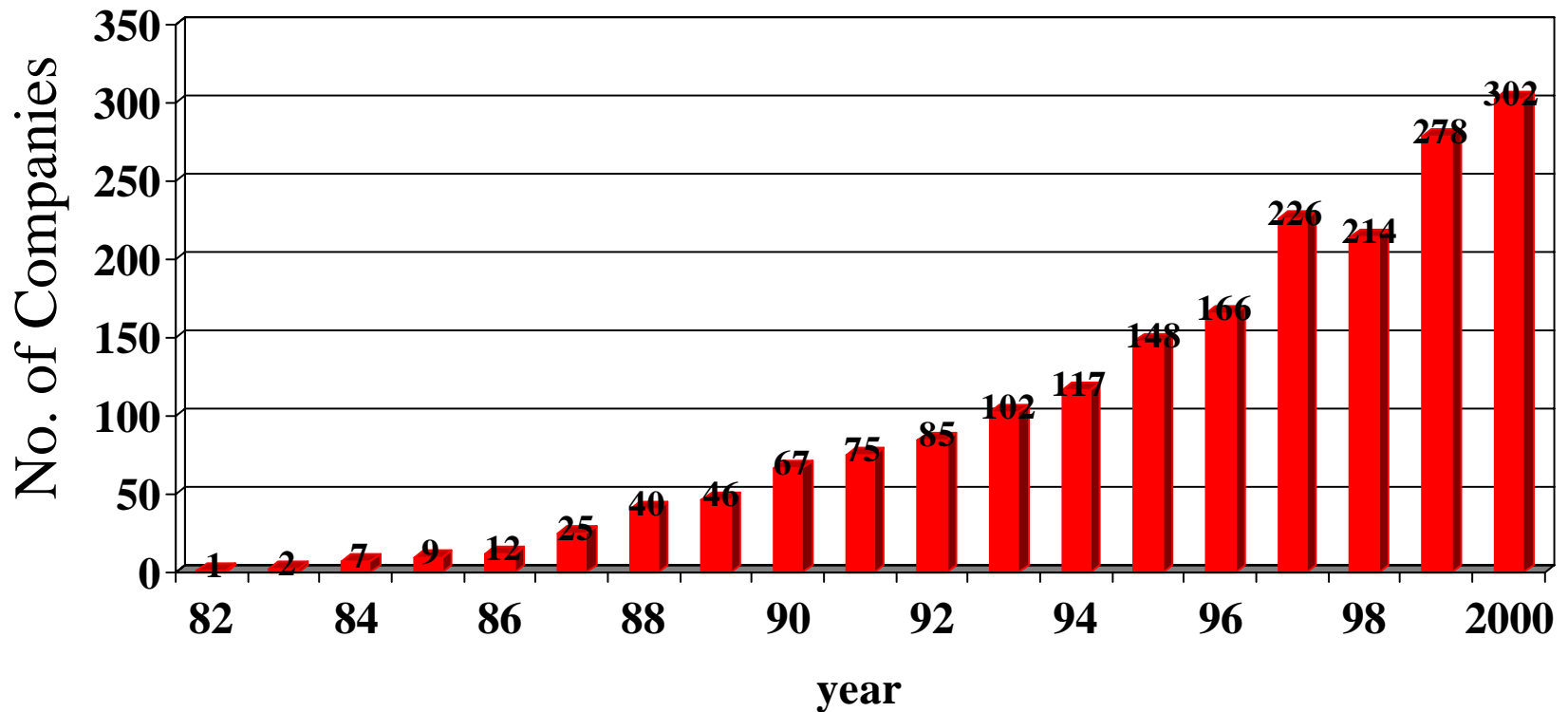


# Singapore

- The most technology-intensive nation in the world
- Singapore Science Park:
  - Asia's foremost address for R&D
  - Government sponsored initiative designed to provide a focal point for the high quality infrastructure for R&D
  - 300 technological companies
  - Prestigious location for state – of – the art research and development
    - In 2000 started the ambitious drive to become the Asian hub for biomedical research
      - US \$2.7 B in research funded by Agency for Science, Technology & Research
      - The Biopolis complex: US\$ 190 MM project
- Long term thinking, generously funded



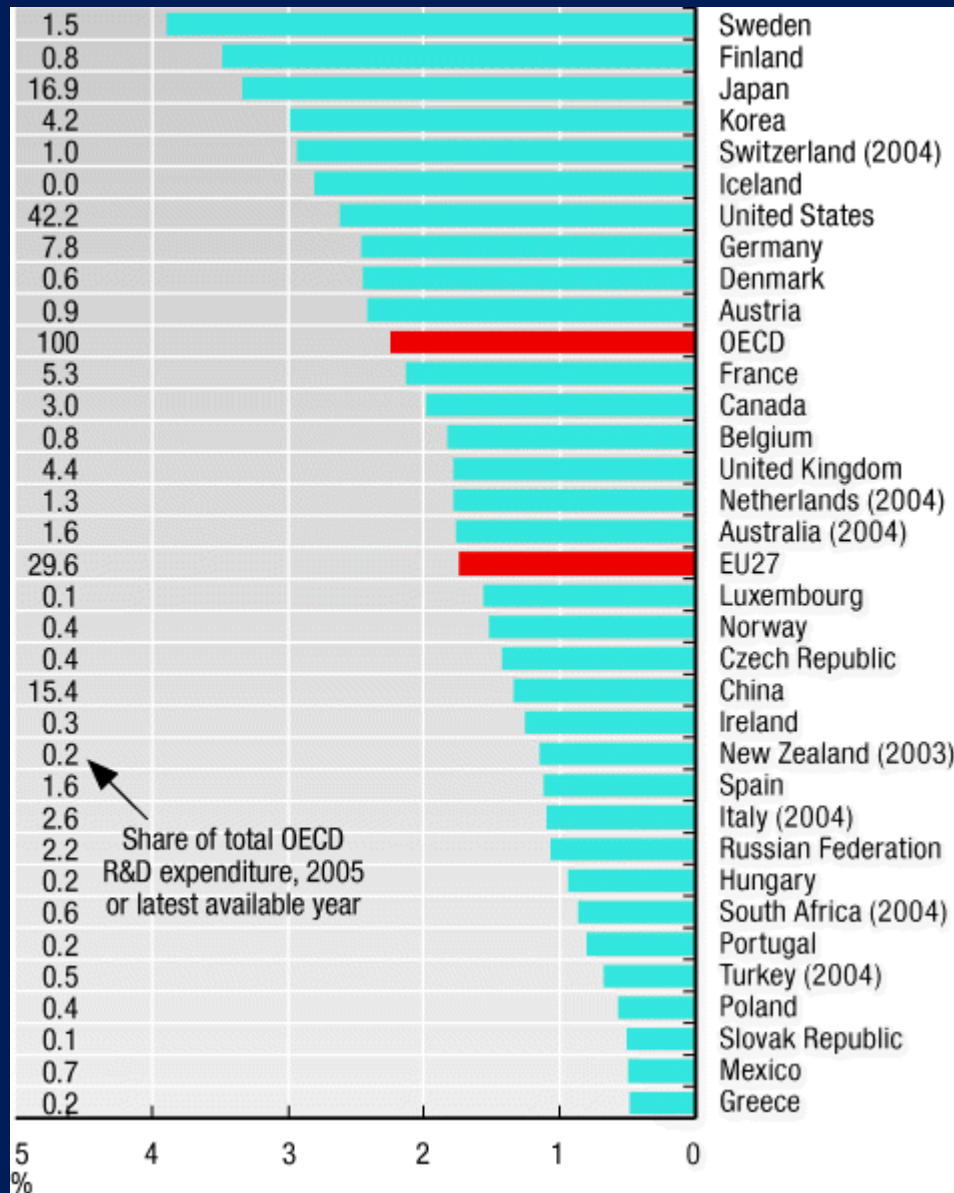
# Singapore Science Park *Growth of Companies*



# Data from the OECD Science, Technology and Industry Scoreboard 2007



# R&D intensity, 2005

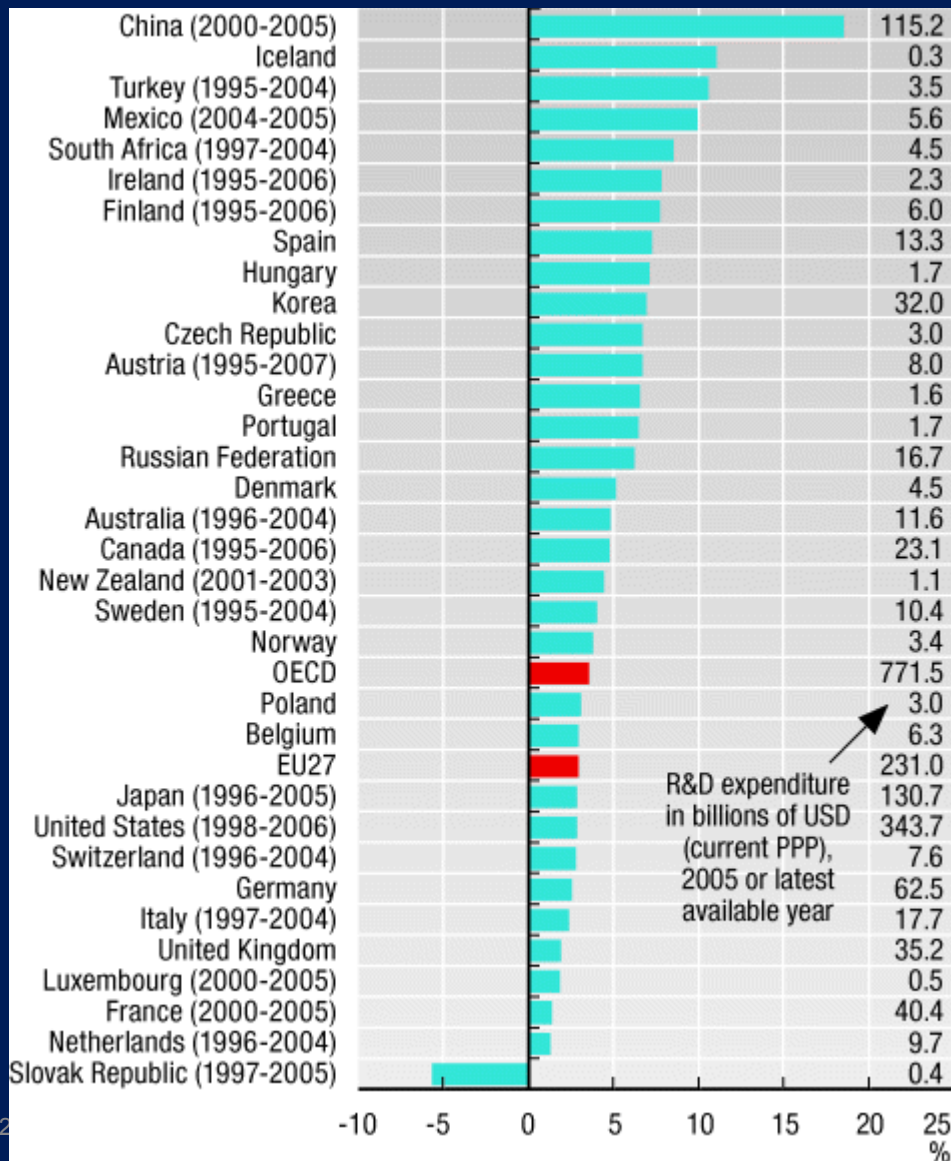


## Notes:

1. Gross domestic expenditure on R&D as a percentage of GDP.
2. Data are adjusted up to 1995.
3. USD of 2000 in purchasing power parity (PPP).

# Evolution of gross domestic expenditure on R&D, 1995-2005

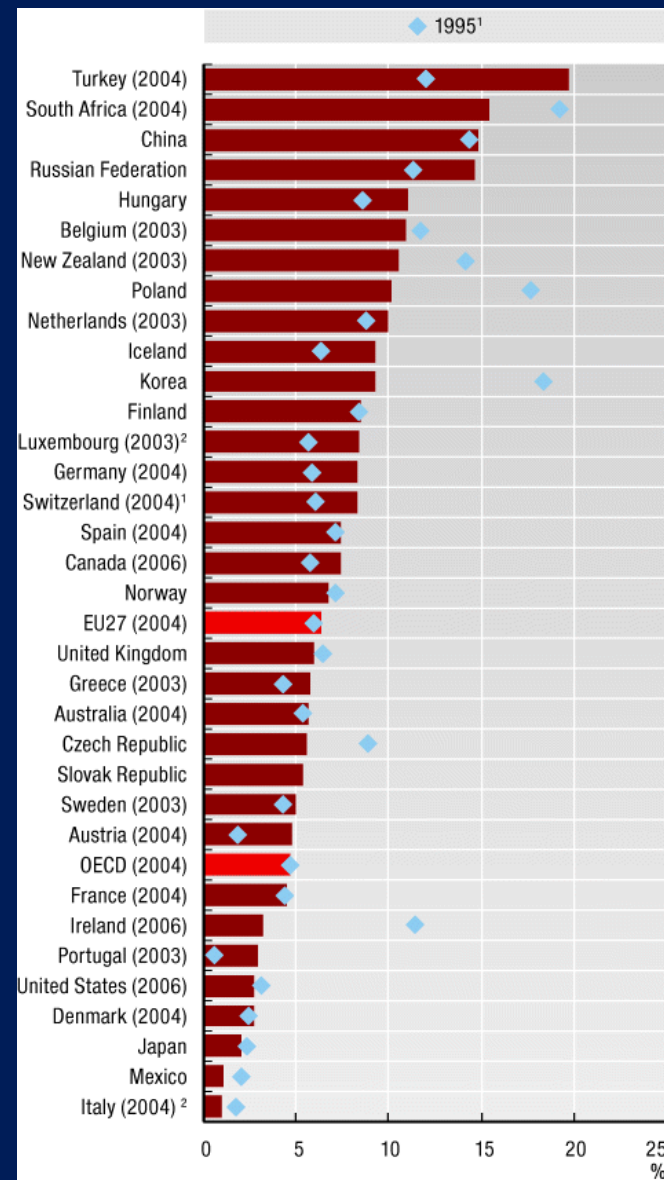
## Average annual growth rate, constant prices



### Notes:

1. Gross domestic expenditure on R&D as a percentage of GDP.
2. Data are adjusted up to 1995.
3. USD of 2000 in purchasing power parity (PPP).

# Business-funded R&D in the higher education and government sectors, 2005, as a percentage of R&D performed in these sectors (combined)



## Notes:

1. Data for Australia and Switzerland: 1996; Luxembourg and China: 2000; Austria: 1998; and South Africa: 2001.
2. Government sector only.
3. Higher education sector only.

# Innovation Network Roundtable



# Innovation Network Roundtable – Insights & Experiences of Innovation Today

- Event held in San Francisco Bay Area/“Silicon Valley” on 4/5/07
- Invitation-only meeting; approx. 40 participants
- Involved high-level thought leaders, seminal thinkers, CEOs, and senior leaders from multiple industry sectors, universities, the venture capital community, and from government
- Focus was on *“Identifying Emerging Patterns and Drivers of the Next Wave of Innovation”* (new companies, existing companies, and established ecosystems)



# Innovation Network Roundtable – Key Insights



- Multi-disciplinary and multi-cultural aspect to today's innovation practices, not seen before
- Innovation is literally “everywhere” – it's no longer the exclusive purview of specific regions and locations
- Individuals and companies are highly networked across geographies and continents, reflecting the global ecosystem
- New companies – “start-ups” are forming themselves global right from the onset, even if they have as few as 5-10 employees
- Moved significantly beyond the “branch offices in remote locations” models of the past, and are well on the way to full integration across geographies



# The Next Wave of Innovation ... ***Innovation is Disintermediating!***

- Form and structure of innovation is changing.
- Ways that we innovate, both individually and collectively, are changing (assumptions, values, interconnectedness)
- Environment and habitat in which we innovate are different

# Partnership Models



# Partnership Models

- 1-Element (“go it alone”)
- 2-Element: Industry-University
- 3-Element: Industry-University-Government
  - Sabato’s Triangle
- MegaCommunities

# The Partnership Continuum



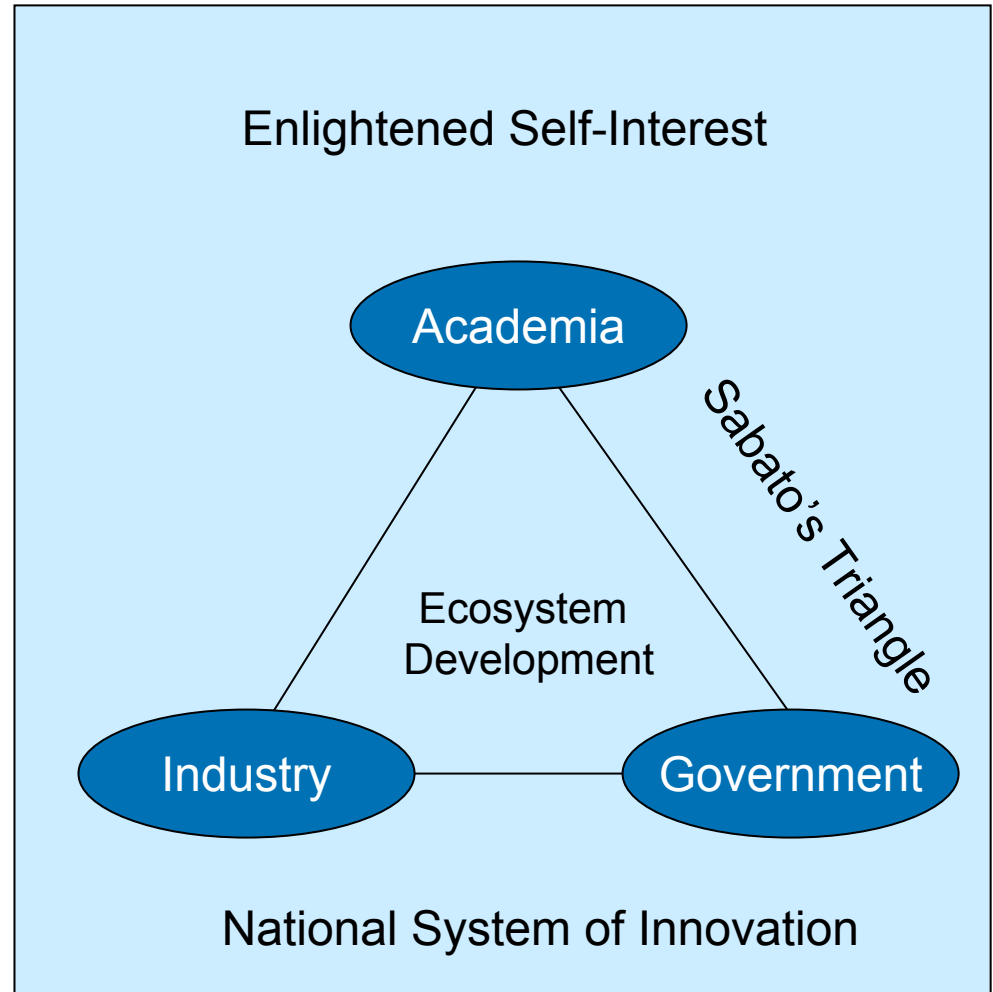
# Creating the Next Innovation Ecosystem



Think Globally,  
Act Locally



*Think Locally,*  
*Act Globally*



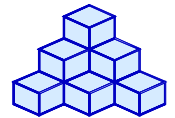
# Model Evolution

- Over time, the higher-impact models have evolved from
  - 1-element (go-it-alone),
  - to 2-element partnerships,
  - and more recently to 3-element partnerships,
  - and finally Megacommunities

# Vertically-Integrated Value Chains



Ideas, R&D,  
Technology

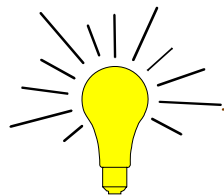


Products,  
Services

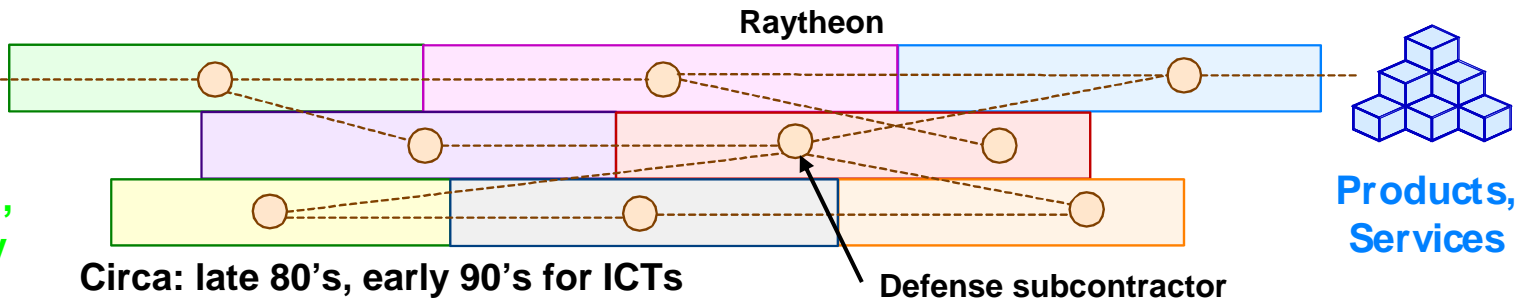
Circa: 70's, 80's for ICTs

- Closed value-delivery systems (VDS)
- Example: IBM in the early 70's
- “Go it alone” or, “Do everything yourself” philosophy
- Little visibility to competencies “inside” the single VDS
- Competitive at the “ends” of the model (Research, and Customer Delivery)
- Essentially, a “black box” model, where something wonderful comes out at the end
- Middle notes in VDS remain hidden from view, not exposed to competition, and relatively unoptimized

# Partnered, Value Networks



Ideas, R&D,  
Technology



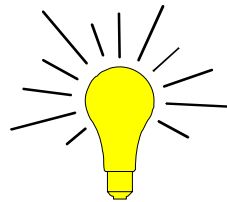
Circa: late 80's, early 90's for ICTs

Defense subcontractor

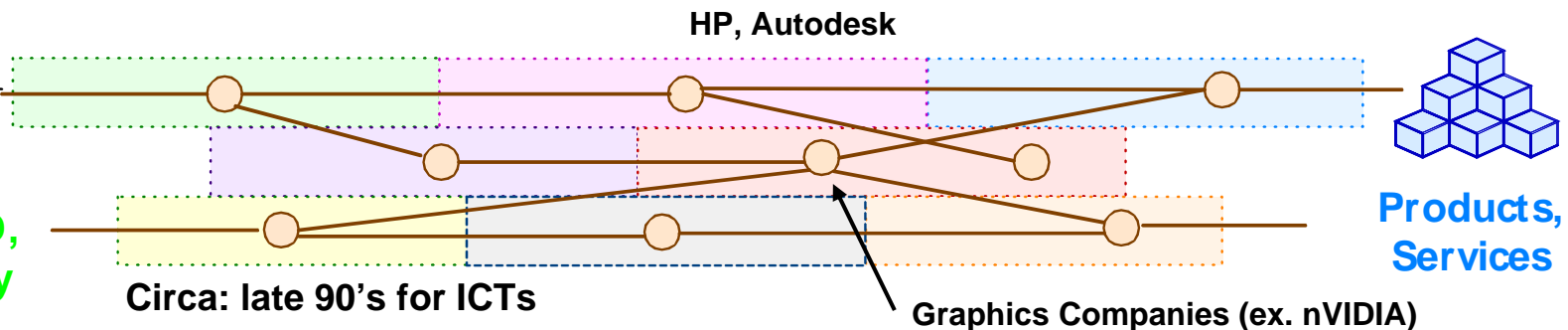
- Beginning of transparent value-delivery systems (VDS)
- Examples: Raytheon, defense subcontractors
- Some outsourcing is taking place, along with selective insourcing and partnering (non-competitive)
- Partners are still discouraged from working with competitors
- Model is competitive at the “ends” (Research, and Customer Delivery), and co-operative in the middle
- Distinctive competencies begin to emerge
- Business leaders seek to gain leverage on the competencies they choose to keep “in-house”

# The Emergence of Ecosystems

... the Beginning of "Open"



Ideas, R&D,  
Technology

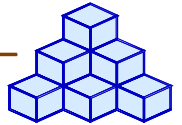
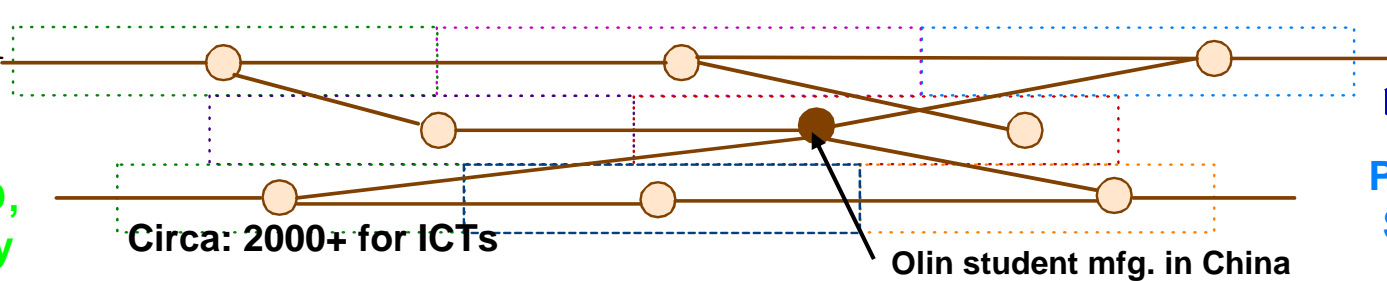


- Optimization around distinctive (core) competencies
- Examples: Boeing, HP, Autodesk, nVIDIA
- Lines between "competitors" and "partners" begin to blur
- All forms of cooperation are entertained
- Model is both co-operative and competitive at each node in the VDS ("co-opetition")
- Disintermediation becomes the norm; spin-offs are common
- Costs are driven down, efficiencies are gained, and the end-users and customers benefit significantly from increased contribution at much lower cost
- Model decisions are managed and optimized on the 1<sup>st</sup> derivative – how things evolve and change over time (vs. static position, competitive position of today)

# “Open” Value-Net based Ecosystems



Ideas, R&D,  
Technology



Products,  
Services

- Highly networked, multi-output, multi-stakeholder model
- Examples: Individual entrepreneurs, Olin student
- “Open Standards” enable rapid evolution, and intense competition
- New value nodes are created and destroyed easily and frequently
- World-class competencies are needed, in order to survive
- One company’s deficiency becomes another company’s opportunity
- Cross-discipline, cross-industry contributions are the norm
- Cross-geography, cross-cultural “localizations” are the norm
- Economies of scale are present, that are simply not possible in other models

# Characteristics of a good partnership

- Recognize that there are other players at the table
- Partnerships are open and collaborative in nature and the partners are open to working with other people
- Don't have a winner-take-all attitude (win-lose)
- What we strive for is that everyone gets something (win-win-win) – different partners get different things (some of these things may be proprietary, but not everything)
- When you have an open collaboration, multiple people pursue multiple things in parallel (vs. serial models of tech transfer where things happen at the end and are obsolete)  
→ acceleration
- Open collaboration provides relevance – multiple people get to shape things at the beginning of the collaboration based on application knowledge

# Partners Invest Together in an Ecosystem Environment




- Cost sharing is the most important driver in creating alignment between the private sector and university research (“skin in the game”)
  - The in-kind discussion is especially relevant to the IT industry and most of the major corporation make extensive use of this approach in their strategic partnering, esp. software (MSFT, et al).
- Cost sharing is also the most important driver in determining whether the outcomes are meaningful
- Competition requires an ecosystem, not a point-source contribution (see John Kao’s book “Innovation Nation: How America is Losing Its Innovation Edge, Why It Matters, and What We Can Do to Get It Back”)
- Ecosystems provide self-reinforcing (amplifying) and virtuous cycles
- Ecosystems are alive and well in Brazil, Russia, India, China, etc.
  - HP is actively engaged in all of them
  - The difference is that everyone (Government, Private Sector, Universities) is on the same page (greater alignment than the US system; we have work to do here)

# Major Themes



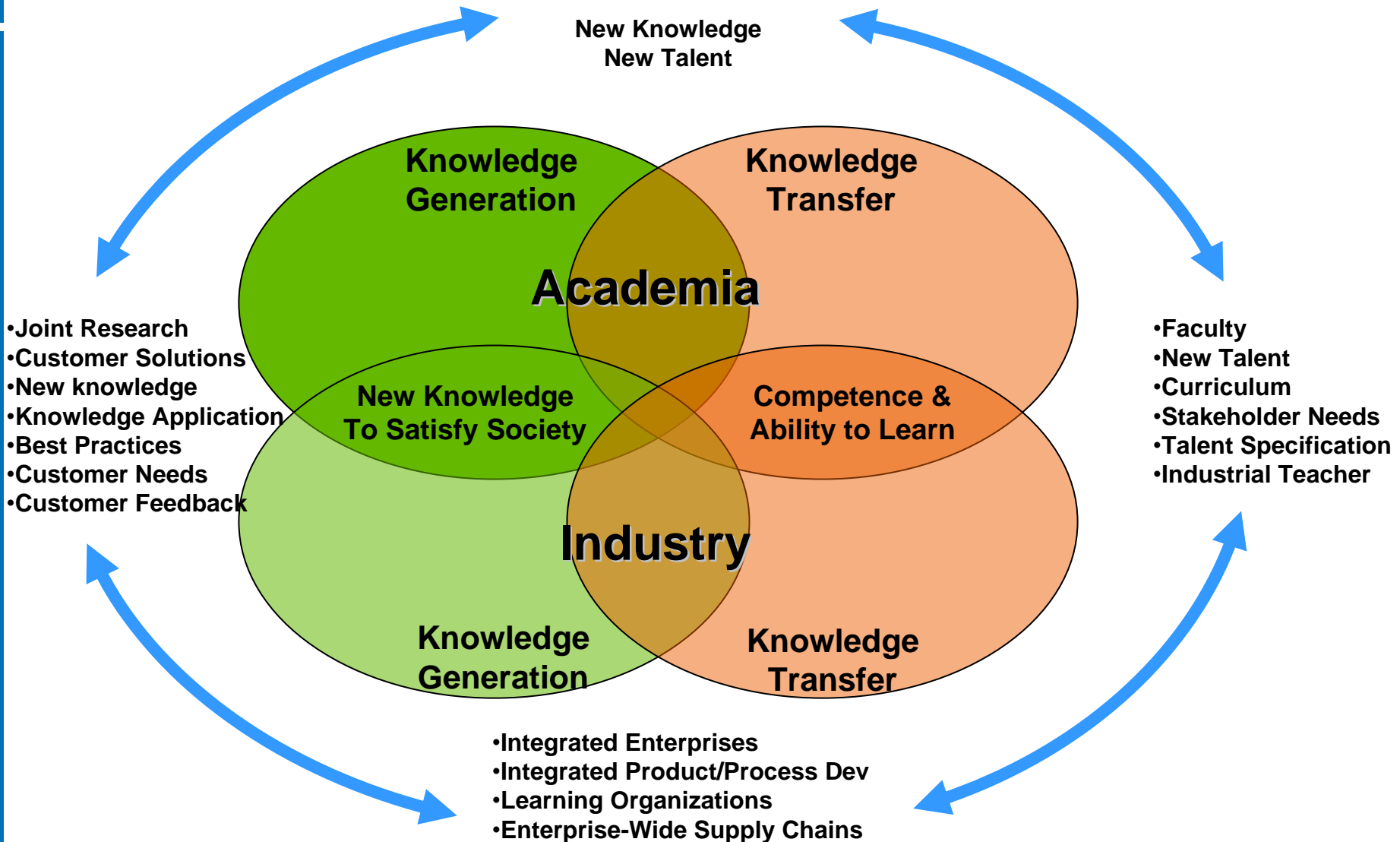
# Range of Development Models

Elements, Attributes, Characteristics of the Current & Emerging Paradigms...

	 <p><i>Linear Patent/License Model</i></p>	 <p><i>Various Hybrid Models</i></p>	 <p><i>"Open" Innovation</i></p>
<b>Focus</b>	<ul style="list-style-type: none"> <li>- Invention-centric</li> <li>- IP &amp; Patents</li> <li>- "Things"</li> </ul>		<ul style="list-style-type: none"> <li>- Innovation-centric</li> <li>- Flow of ideas</li> <li>- "People", "creativity"</li> </ul>
<b>Characteristics</b>	<ul style="list-style-type: none"> <li>- Serial</li> <li>- Single outcome</li> <li>- Transfer at end of the process</li> <li>- Go it alone</li> <li>- Retarget after selection</li> <li>- "Home run" idea</li> <li>- Idea lives in invention</li> <li>- Invent then apply/seek applications</li> <li>- "Technology on the shelf"</li> <li>- Slow, inefficient</li> </ul>		<ul style="list-style-type: none"> <li>- Parallel</li> <li>- Multiple outcomes</li> <li>- Collaborate from beginning</li> <li>- Multiple participants</li> <li>- Utilize during creation</li> <li>- Feedback throughout process</li> <li>- Course correct along the way</li> <li>- Multiple ideas &amp; contributions</li> <li>- Application drives innovation</li> <li>- Flow of contributions</li> <li>- "Invention that matters"</li> <li>- Rapid, multiple parties working on it</li> </ul>
<b>Accelerators</b>	<ul style="list-style-type: none"> <li>- IP Protection</li> <li>- Exclusivity</li> <li>- Single solution control points</li> <li>- Secrecy, protection of ideas/information</li> </ul>		<ul style="list-style-type: none"> <li>- Network model</li> <li>- Communities</li> <li>- Open models, "commons"</li> <li>- Flow of information</li> </ul>

Obsolete

# The Knowledge Process of the Future



Source: Knowledge Supply Chains; A Next-Generation Manufacturing Project

# Infrastructure



# World Bank – The Four Pillars of The Knowledge Economy

- *Education & Training*

An educated and skilled population is needed to create, share and use knowledge.

- *Information Infrastructure*

A dynamic information infrastructure-ranging from radio to the internet-is required to facilitate the effective communication, dissemination and processing of information.

- *Economic Incentive & Institutional Regime*

A regulatory and economic environment that enables the free flow of knowledge, supports investment in Information and Communications Technology (ICT), and encourages entrepreneurship is central to the knowledge economy.

- *Innovation Systems*

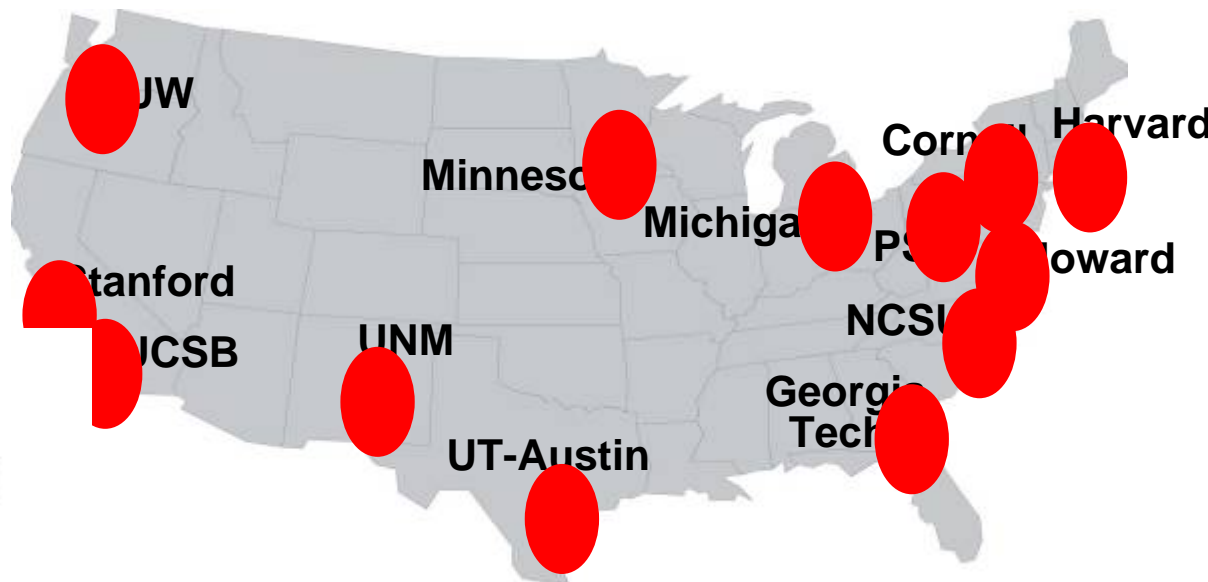
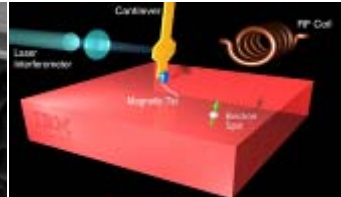
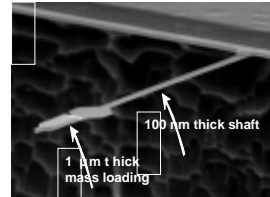
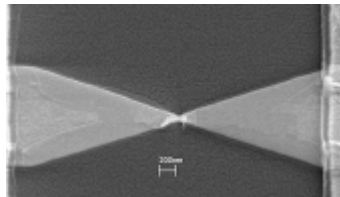
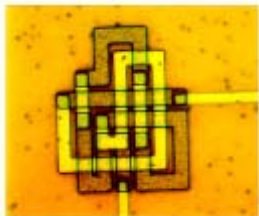
A network of research centers, universities, think tanks, private enterprises and community groups is necessary to tap into the growing stock of global knowledge, assimilate and adapt it to local needs, and create new knowledge.

# Infrastructure Element: Internet Bandwidth

- The US is falling behind in global broadband
  - In 2001, US was 4<sup>th</sup> in number of broadband subscribers per capita
  - Today, the US is 15<sup>th</sup>
- High-speed internet service in countries like Japan, France and South Korea is many times faster than the US and less expensive
- In some Asian and European countries, quicker connections are pushing new applications, such as low-cost video conferencing, online classrooms and telemedicine
- Venture investing in the US could suffer if Europe and Asia become the new test beds for emerging Internet applications
- “... in the long run it threatens our economy, our innovation, our health care, our education and job creation” – Rep. Edward Markey, D-Mass, Chair of House subcommittee on telecommunications and the Internet



# National Nanotechnology Infrastructure Network (NNIN)



- Cornell U (Lead)
- Stanford U
- U Michigan
- Georgia Tech
- U Washington
- Penn State U
- UC Santa Barbara
- U Minnesota
- U New Mexico
- U Texas –Austin
- Harvard U
- Howard U
- No. Carolina State U

**An integrated national network of user facilities providing researchers open access to resources, instrumentation and expertise in all domains of nanoscale science, engineering and technology**

25 February 2008

<http://www.NNIN.org>; Est. 5000 users (~14% industry) in 2007, NSF 3,500/user



# Network for Computational Nanotechnology

A national resource for research, education and user-facility to accelerate the transformation of nanoscience to nanotechnology through theory, modeling, and simulation and collaboration enabled by cyberinfrastructure

Norfolk State U.

U. Texas-El Paso

**NCN** (7 nodes)

Stanford U.

Purdue U.

U. Florida

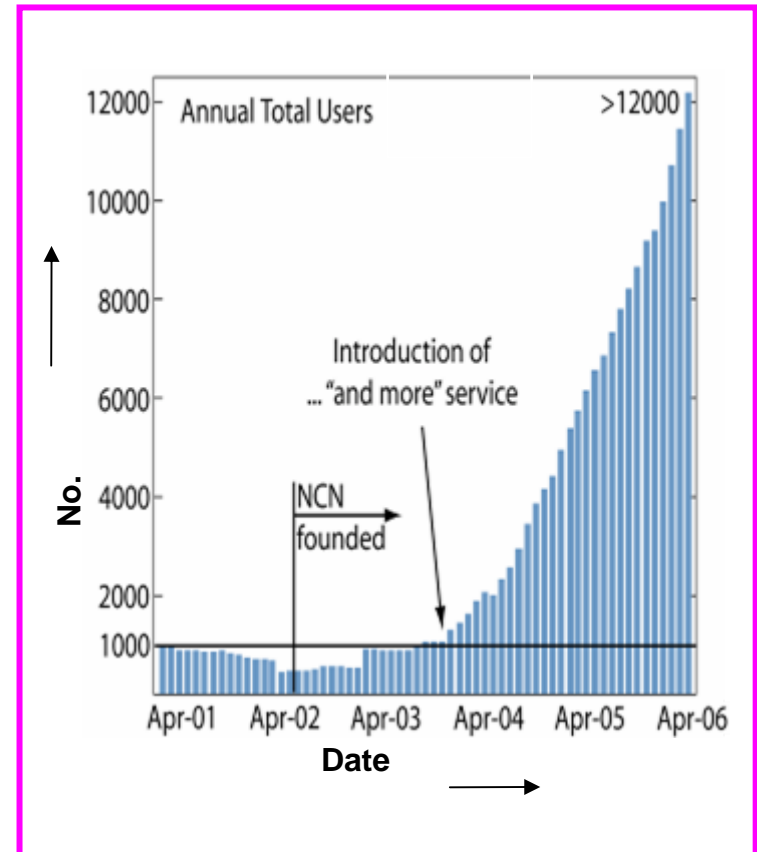
Northwestern U.

U. Illinois-Urbana Champaign

Focus: "from atoms to systems";  
"same equations for various applications"

<http://www.nanoHUB.org>

Est. 25,000 users (~10% ind) in 2007; NSF \$200 / user



# Challenges We Face



# I See Three Challenges ...



- The “innovation” challenge
- The “disintermediation of research” challenge
- The “model” challenge

# The Innovation Challenge

- Innovation is everywhere
- I + U + G partnership investments over the past 3 decades have provided us with a nearly-pervasive infrastructure to support innovation
- This infrastructure, together with the “flattened world” has enabled almost anyone to make the contributions they desire  
( = globalization )
- Challenges:
  - How to build out the innovation infrastructure in places where it has not been previously developed
  - How to refine the roles of I + U + G with the huge shifts that are taking place in the world
- And,
  - To look ahead into the future and determine which elements of the *next innovation platform* must be put into place today

# The Disintermediation of Research Challenge

- When our research structures and organizations are distributed and “spread out”, we must actively seek to understand
  - “What holds us together?”
  - “Why are we together?”
  - And, “What does it mean to be a part of one, global institution or organization?”
- One possible answer to the questions posed, has to do with shared values.
- Another answer could be the use of common language
  - One of our global research collaborations has established a common language for their work so that multidisciplinary work can be understood
- What are elements that help our research to be cohesive, and how do they support the mission of our organizations and institutions, going forward?

# The Model Challenge

- Based upon the experience of industry, there won't be one single model for globalizing; there will be many.
- Emerging models will be based on
  - Rapid growth in some regions,
  - And rapid contraction in others
- In adapting to a globalized world, there will be significant restructuring along the way, as the organizations and institutions attempt to deal with new forces, while continuing to deliver on their mission
- The challenge will be to find the structures that work, while extending our reach, and maintaining cohesion, and at the same time a sense of community

# Summary

- Closed systems produce things that are obsolete and will not be competitive going forward – open collaboration is the paradigm of choice for accelerating innovation
- Good partnerships are holistic, open, collaborative (win-win-win)
- US competitiveness – only way we will be competitive is if we collaborate and innovate openly
- There are other innovation ecosystems out there that are alive and well and prospering
- Commitment to education globally – everyone who invests in education globally will win
- Commitment to infrastructure in an open way – everyone who invests in infrastructure globally will win

# Questions to Consider

- How do you see other players in the global community showing up in your ecosystem?
- Who are the competitors to NSF (other funders with \$\$ (or £, €, ¥, ¥, R\$ ...) and resources at a global level)?
- As partners, what else do they bring to the table, beyond money and resources?
- What does thought-leadership look like in this space?
- What keeps you awake at night? What do you worry about, at the highest level?
- If there was only one thing you could do in the way research is conducted to advance the US Innovation Ecosystem, what would it be?



**Thank You**

**[wayne.johnson@hp.com](mailto:wayne.johnson@hp.com)**



i n v e n t