

### Adapting to changes in the (national) research infrastructure

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# Evolving US corporate research ecosystem



- Corporate research operations declined during the 1990s
- Globalization of research and innovation
- Old in-house system replaced by a new federated model of collaboration among corporate, government, and academic labs, and acquisition of technology from start-up companie



#### **Fundamental shifts**

#### Economics

Hardware  $\rightarrow$  Software IT and Telecoms  $\rightarrow$  Life Sciences and Media Product  $\rightarrow$  Services

### Geography US → EU → Eastern Europe, India, China, Brazil

#### Ecosystem

Captive innovation  $\rightarrow$  Open innovation Corporate Risk Capital  $\rightarrow$  Venture Capital





### Corporate R&D Investment

	<b>US Top 100</b>	US Top 1000
Year	(\$B)	<b>(B\$)</b>
1997	89.0	113.8
1998	98.9	127.9
1999	105.0	136.0
2000	109.6	146.0
2001	116.2	154.9
2002	111.0	146.5

Source: Industrial Research Institute

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- IT and Telecoms  $\rightarrow$  Life Sciences and Media Product  $\rightarrow$  Services
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## Trends in federal research by discipline, FY 1970-2000





- Source: National Science Foundation for Research and
- Development FY 1999, 2000, and 20200, 1. FY 2000 data are
- preliminary. Constant-dollar conversions based on OMB's GDP deflators.
- APRIL '01 © 2001 AAAS



American Association for the Advancement of Science



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## *The rise of the rest*: R&D investments are growing globally . . .





Source: OECD MSTI Database, January 2004



#### **EMERGING MARKETS PHENOMENA**

Demographics of select nations (in %)

Age	India	China	USA	UK	Japan
0 to 9	22.6	15.8	14.1	12.4	9.6
10 to 19	21.1	17.3	14.5	12.8	11.1
20 to 29	17.6	17.0	13.6	13.0	14.7
Population below	61.3	50.2	42.2	38.2	35.3

#### Graduates Planning to Stay

Science and engineering doctoral graduates from other countries who intend to remain in the U.S.



Sources: CHI Research; National Science Foundation

#### **Doctoral Degrees**

In science and engineering, in the top three regions (1999 data was not available for Asia and Europe\*).



\*Britain, Germany and France

Source: U. S. Census Bureau, International Data Base, July

Tracking Achievement Indicators show that the United States is losing its lead in scientific achievement. Patents Granted by the U.S., by country of inventor. 1980 2003

> United States

51.8%

Japan

Germany

Taiwan S. Korea

Other

Countries

United States

60.2%

Japar

Germany

Othe



Source: New York Times, May 2004

#### Innovation for Emerging Economies

Mission:

Generate innovations targeted for the world's emerging economies by deeply understanding the confluence of relevant social, cultural, economic and technological drivers.







### A partnership in innovation for emerging economies



- HP Labs contribution: Market connection
- Indian Institute of Technology: Local knowledge
   IIT Tenet group: IT for rural districts
- US Universities:
  - CMU and UC Berkeley/CITRIS
- NGO's: UNDP



### Evolving global R&D ecosystems: Nanotechnology



- Considerable investments are being made on a worldwide basis that mimic the success of the research investments made by the US government after WW II (see Organization for Economic Co-operation and Development data)
- Example of global struggle to dominate nanotechnology
  - EU invested twice as much for basic research as the US in 2003
  - Japan invested 40% more than the US National Nanotechnology Initiative (NNI) budget for 2003
  - The \$200 M budget announced by China is supporting the world's largest nanotechnology effort
- Chinese universities granted 465,000 science and engineering degrees in 2001, approaching the US total
- The virtuous cycle in the US is being starved, while the rest of the world continues to invest



#### A partnership in basic research molecular electronics • DARPA contribution

- UCLA, Cal Tech collaborations
- MIT Alliance
- But... global migration is happening

# Nanotechnology – world investments



- EU 2Xs US 2003 basic research
- Japan 40 percent more than U.S. National Nanotechnology Initiative 2003 budget
- China \$200M World's largest in terms of number of researchers



### Gelato Federation



- HP encourages collaborations with and among universities worldwide, exemplified by the Gelato Federation
- The Gelato Federation is a world-wide consortium of research organizations dedicated to enabling scalable, open source Linux-based Itanium computing solutions to address real world problems in academic, government, and industrial research



www.gelato.org

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#### Impact of open innovation

- Historically, internal R&D was a strategic asset
- In the new model of open innovation, companies commercialize both their own ideas as well as innovations from other entities, e.g. universities
- Industries embracing open innovation view the research university as a source of graduates and applied research
- Researchers in companies have shifted towards advanced technology and product development

## Corporate R&D Investment compared with VC Investment



	Industrial Research Institute				PWC MoneyTree
	US/Global Industrial Research (B\$)		Top Global R&D spenders		Cash for Equity Investments
	Top 100	Top 1000	Тор	Тор	
	companies	companies	100	1000	
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1998	98.9	127.9			21.3
1999	105.0	136.0			54.5
2000	109.6	146.0			105.9
2001	116.2	154.9			40.6
2002	111.0	146.5	200.0	273.0	21.4
2003					18.2

Q1 2004 \$4.6B

## The IP problem – A relationship in crisis



- The partnership between industry and universities has been weakened over difficulties associated with negotiating IP rights in research contracts in recent times
- Largely as a result of the lack of federal funding for research, American Universities have become extremely aggressive in their attempts to raise funding from large corporations
- Industry feels that it takes too much time, effort, and money to negotiate an agreement
- This has resulted in a perceived deterioration of trust and goodwill between industry and US universities, adversely affecting the long-term partnership between industry, universities, and government

## University/Industry partnership lesson



"Of 3200 universities, perhaps 6 have made significant amounts of money from their intellectual property rights.

*IP rights should be pursued as a means for interaction with industry rather than as a means for raising revenue from commercialization.*"

John C. Hurt National Science Foundation



#### Top university license income

Institution	License income (\$M)	Research expenditures (\$M)	Income as % of expenditures
Columbia	89	279	31.9
U. California system	74	1,865	4.0
Florida State University	57	133	43.2
Yale	41	316	12.9
University of Washington	28	480	5.8
Stanford	28	417	6.6
Michigan State University	24	208	11.4
University of Florida	22	280	7.7
U. Wisconsin-Madison	18	422	4.3
MIT	16	726	2.2

Source: University Research Scorecard, Technology Review, Sep 2001

8/24/2004



#### Summary

- Corporate research operations declined during the 1990s: New fields emerging
- Globalization of research and innovation: Emerging geographies
- Old in-house system replaced by a new federated model of collaboration





