COLLEGE OF ENGINEERING
UNIVERSITY OF WISCONSIN-MADISON

Case for Stronger Industry-U.S. University-National Labs Partnerships

Solid State Sciences Committee

October 19, 2006

Paul S. Peercy
UW-Madison College of Engineering

Outline

- Motivation for improved G-U-I partnership
- Examples of activities underway to address this issue
  - GUIRR / UIDP
  - ASEE / EDC
  - Bay Area Industry-University Roundtable
  - Sandia Accelerating Innovation Technology Summit
- Examples of successful partnerships
  - SRC
  - NNIN
  - BASIC
- Conclusion and next steps

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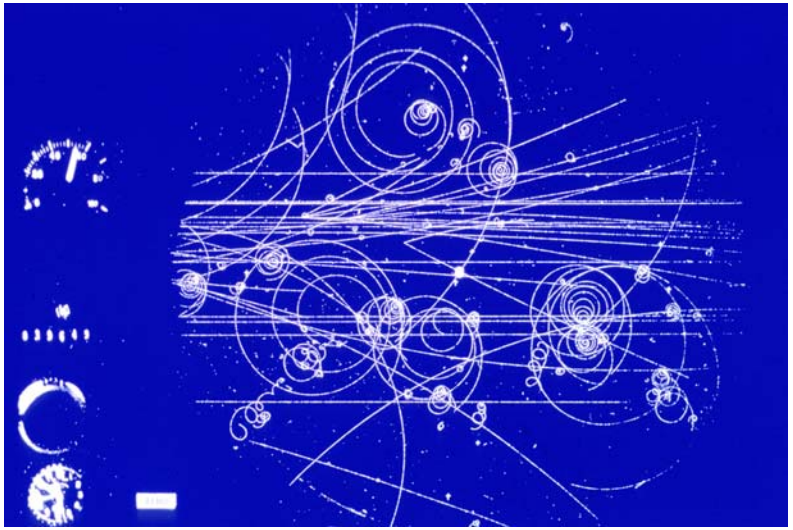
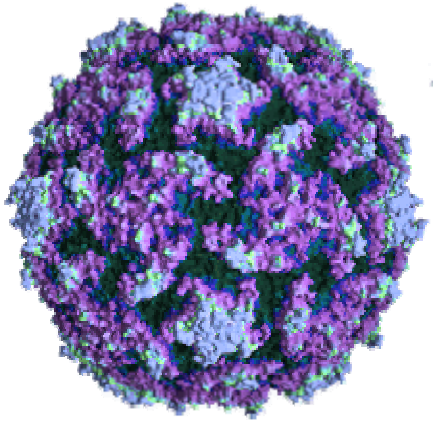
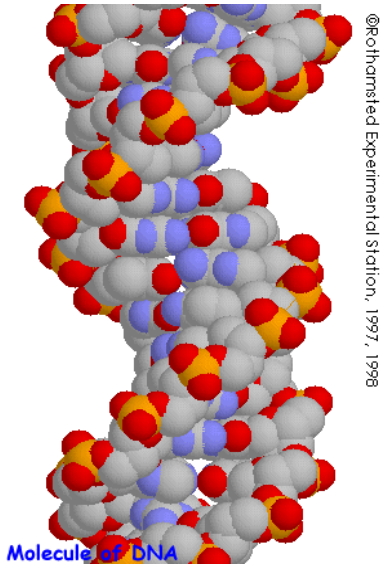
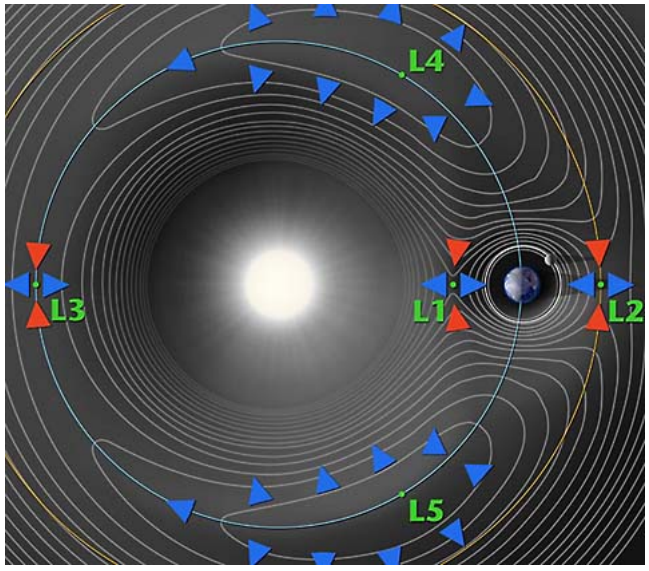




"If the 20th Century was the century of Big Science, then the 21st Century must be the century of the Engineer – the global challenges we all face simply demand it! . . .Greg Papadopoulos, CTO & EVP Sun Microsystems





Global Challenges

- **Energy**
- **Sustainability**
  - **Clean water**
  - **Other resource limitations**
- **Improving healthcare and eliminating disease**
- **Overcoming global warming**
- **National and economic security**
- **Dealing with population pressure**
  - **Hunger and disease, threats of pandemics**

Major challenges that will require government-university-industry collaboration to resolve

Where you stand has never been more important than it is in today's global environment

- On a flat earth, barriers to relocating work are minimal. Companies and jobs will flow to the communities that have the culture that attracts / retains the talent they need and business climate to nurture their company

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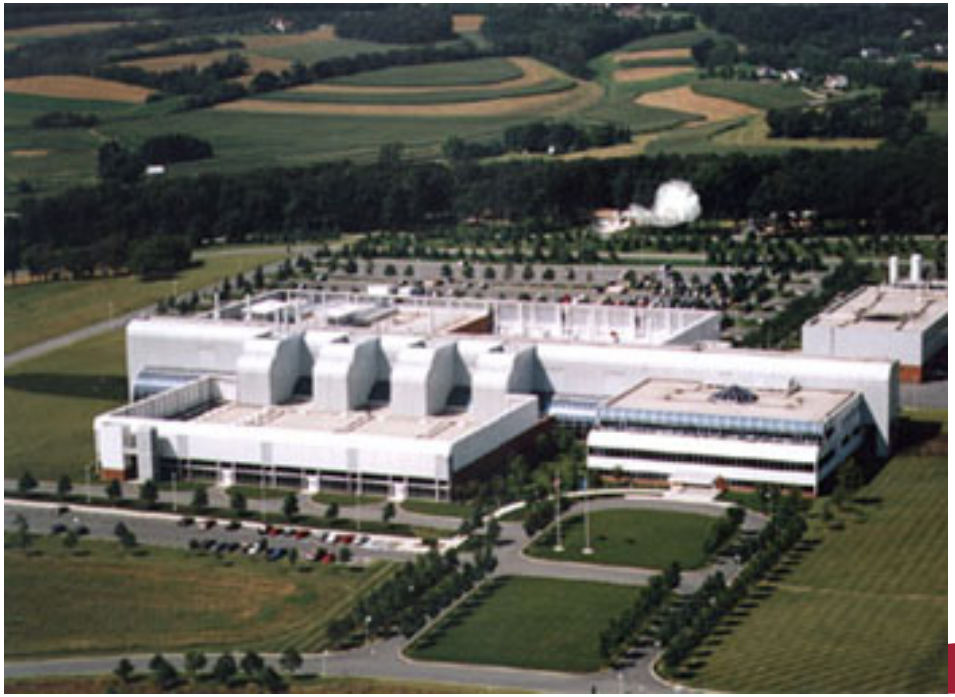
We must find new approaches to effective research management in an era of hyper development

Bell Labs – a fraction of its former self



Xerox Palo Alto Research Center
the end of an era

Such approaches should include partnerships between Government / National Labs, Universities and Industry

Global Migration of University Research

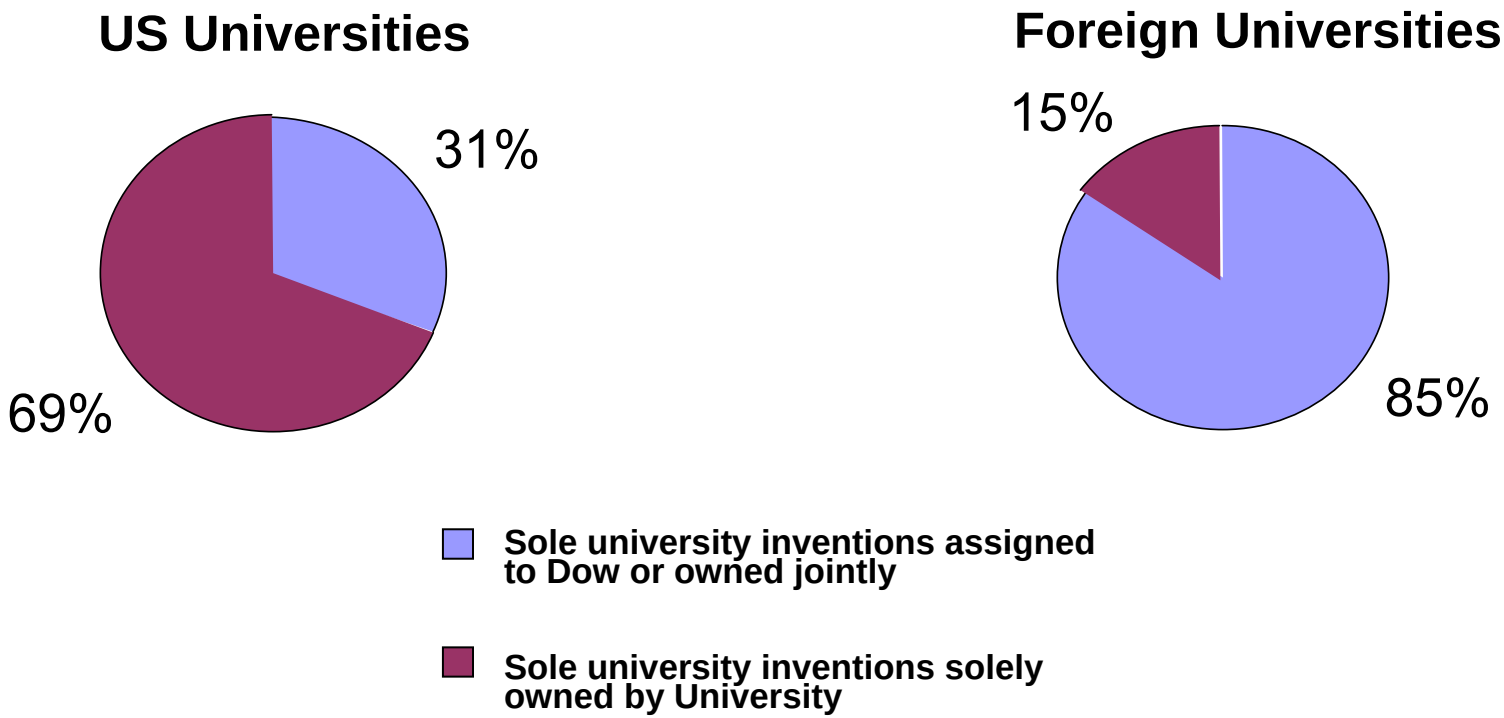
- Many large companies are finding other sources of ideas and bright young researchers in emerging countries, where they receive very favorable intellectual property agreements.

"Large US based corporations have become so disheartened and disgusted with the situation [negotiating IP rights with US universities] they are now working with foreign universities, especially the elite institutions in France, Russia and China, which are more than willing to offer extremely favorable intellectual property terms."

Stan Williams

Director, HP Quantum Science Research

Foreign Universities Are More "Sponsor Friendly"



Source: Dow Chemical

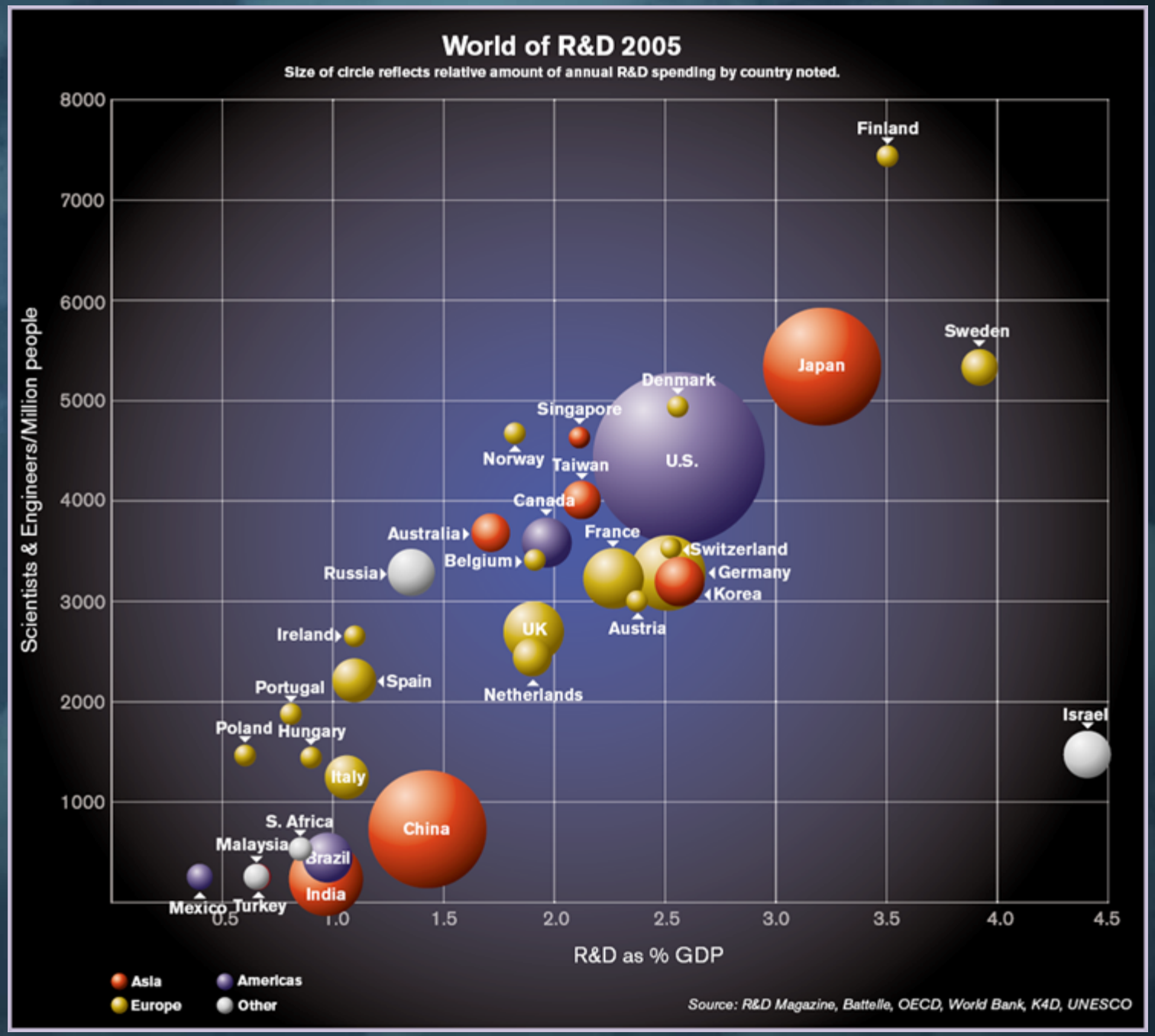
- Continued Shifting in the Global R&D Distribution
- Asia Is Becoming R&D Outsourcing Juggernaut
- R&D Continues to Slow in the US, Japan, and Europe

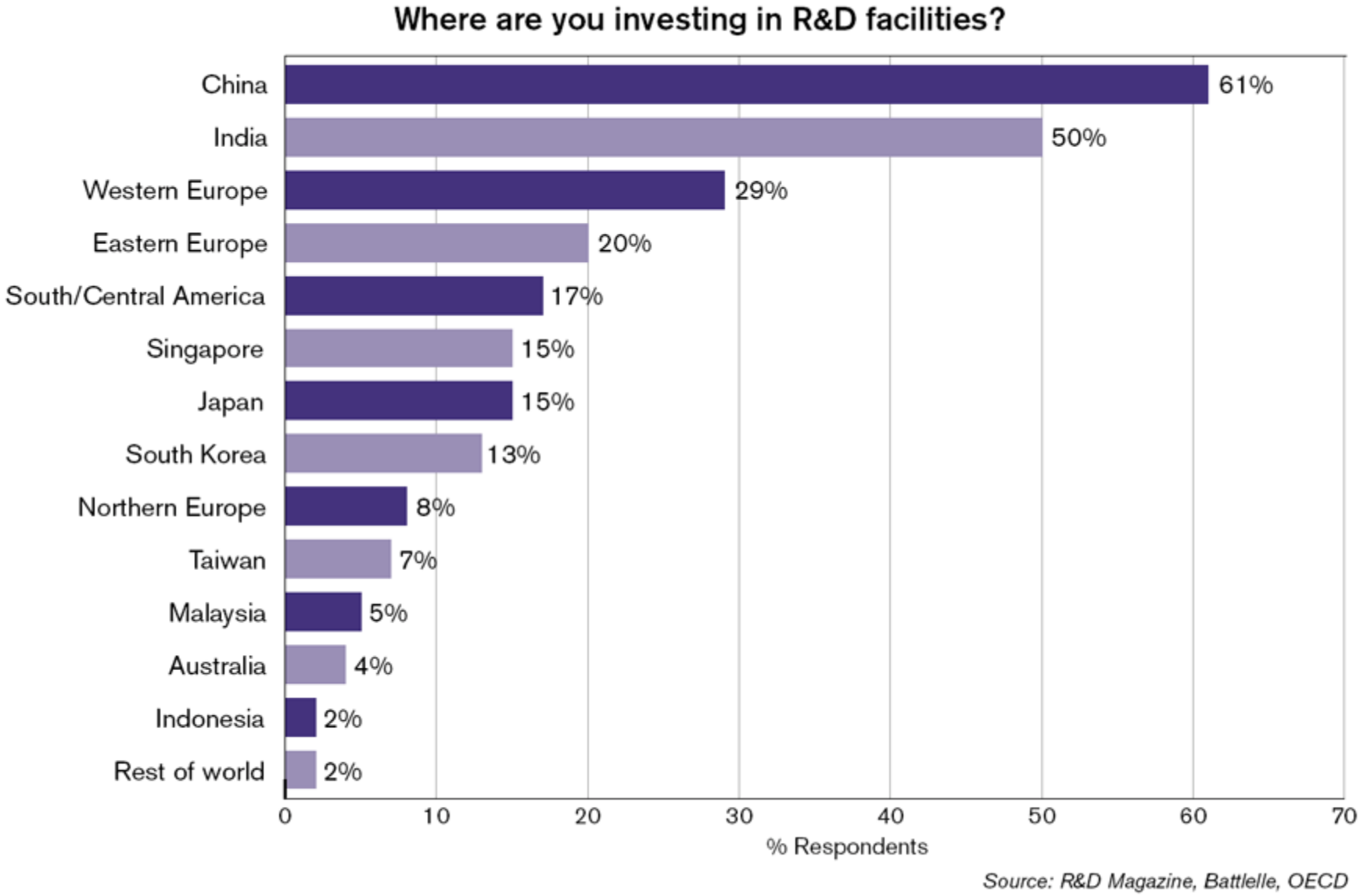
Global R&D Spending

	GDP PPP 2005 billions, $	R&D % GDP 2005 percent	R&D PPP 2005 billions, $	R&D PPP 2006 billions, $	R&D PPP 2007 billions, $
Americas	15,874	2.3	369.07	379.69	387.64
U.S.	12,192	2.6	319.60	328.90	335.50
Asia	19,086	1.8	341.30	361.85	384.01
China (Mainland)	8,859	1.4	124.03	136.30	149.80
Japan	3,890	3.2	124.48	127.84	131.29
India	3,611	1.0	36.11	38.85	41.81
Europe	12,764	1.8	236.09	240.16	244.42
Germany	2,388	2.5	59.68	60.21	60.75
France	1,879	2.2	41.36	42.10	42.86
UK	1,933	1.9	36.72	37.39	38.06
Other	2,276	1.4	31.88	33.76	35.68
World	50,002	2.0	978.34	1,015.46	1,051.75

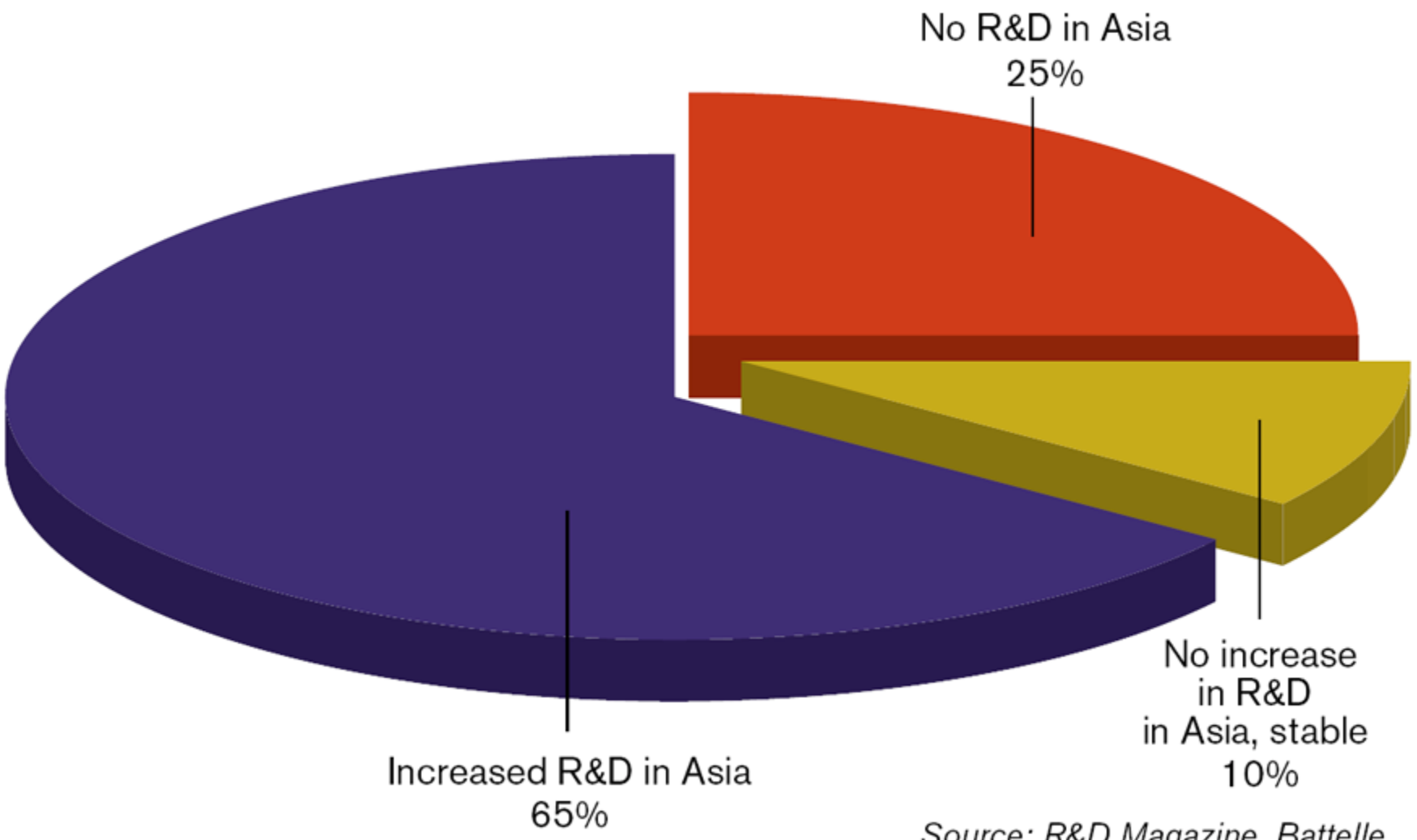
Source: R&D Magazine, Battelle, OECD, World Bank

Share of Total Global Research and Development			
	2005	2006	2007
Americas	37.7%	37.5%	36.8%
U.S.	32.7%	32.4%	31.9%
Asia	34.9%	35.6%	36.5%
China	12.7%	13.4%	14.8%
Japan	12.7%	12.6%	12.5%
India	3.7%	3.8%	4.0%
Europe	24.1%	23.6%	23.2%
Germany	6.1%	5.9%	5.8%
Other	3.3%	3.3%	3.5%
World	100.0%	100.0%	100.0%
Source: R&D Magazine, Battelle, OECD, World Bank			


World of R&D 2005
Size of circle reflects relative amount of annual R&D spending by country noted.
Scientists & Engineers/Million people
8000
7000
6000
5000
4000
3000
2000
1000
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
R&D as % GDP
Finland
Sweden
Japan
Denmark
Singapore
Norway
Taiwan
U.S.
Canada
Australia
France
Switzerland
Belgium
Germany
Russia
Korea
Austria
UK
Ireland
Spain
Portugal
Netherlands
Israel
Poland
Hungary
Italy
China
S. Africa
Malaysia
Brazil
India
Mexico
Turkey
Asia
Americas
Europe
Other
Source: R&D Magazine, Battelle, OECD, World Bank, K4D, UNESCO


Where are you investing in R&D facilities?
China
India
Western Europe
Eastern Europe
South/Central America
Singapore
Japan
South Korea
Northern Europe
Taiwan
Malaysia
Australia
Indonesia
Rest of world
61%
50%
29%
20%
17%
15%
15%
13%
8%
7%
5%
4%
2%
2%
0
10
20
30
40
50
60
70
% Respondents
Source: R&D Magazine, Battelle, OECD

Are you increasing R&D operations in Asia?



Source: R&D Magazine, Battelle

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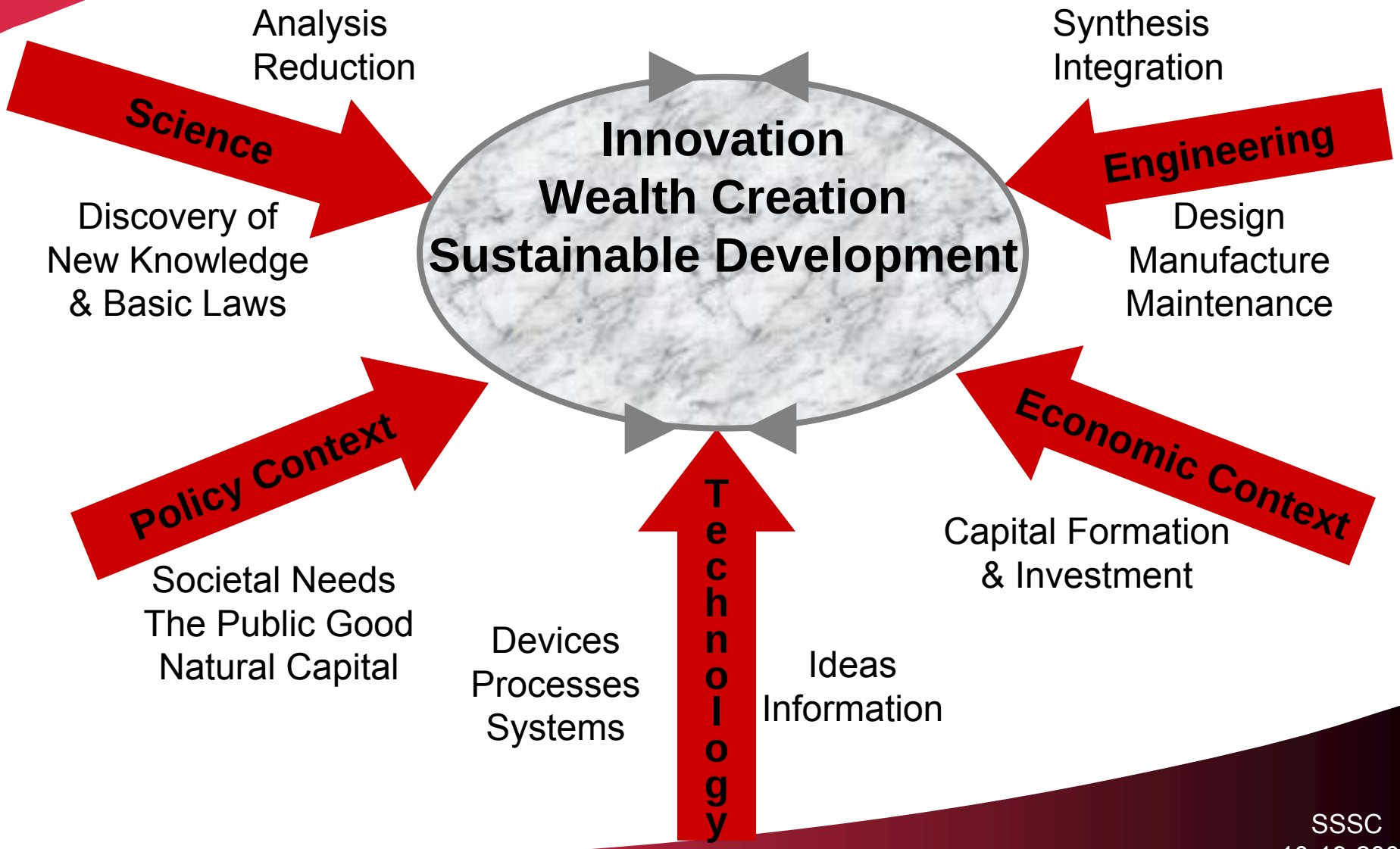
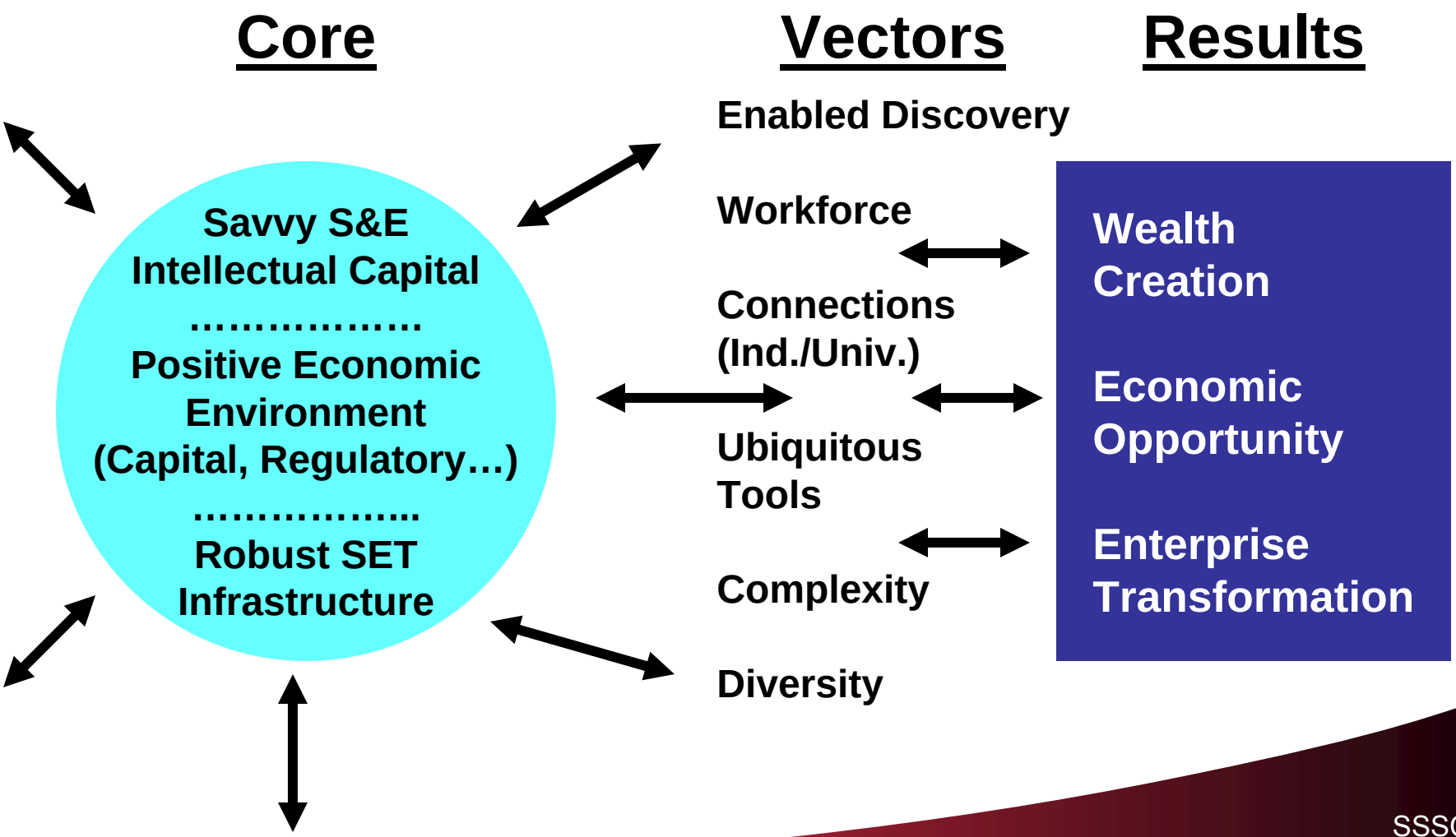
Innovation System



Innovation Dynamo



University Perspective

- It's about the students….
  - Educating leaders in science and technology, and translation of S&T to impact society in a positive manner
- And the generation of new ideas….
  - To maximize impact of research and enhance the reputation of the institution
- And early stage interaction with industry and national labs….
  - That generate ideas before they become technology
- In short, a strong collaborative relationship is essential!

Industry Perspective

- It's about the students …
  - Hiring highly educated and skilled students.
- And the flow of ideas …
  - To enrich university-industry collaborations.
- And the early-stage interactions …
  - That generate ideas before they become technology.
- In short, it's about the relationship!

Outline

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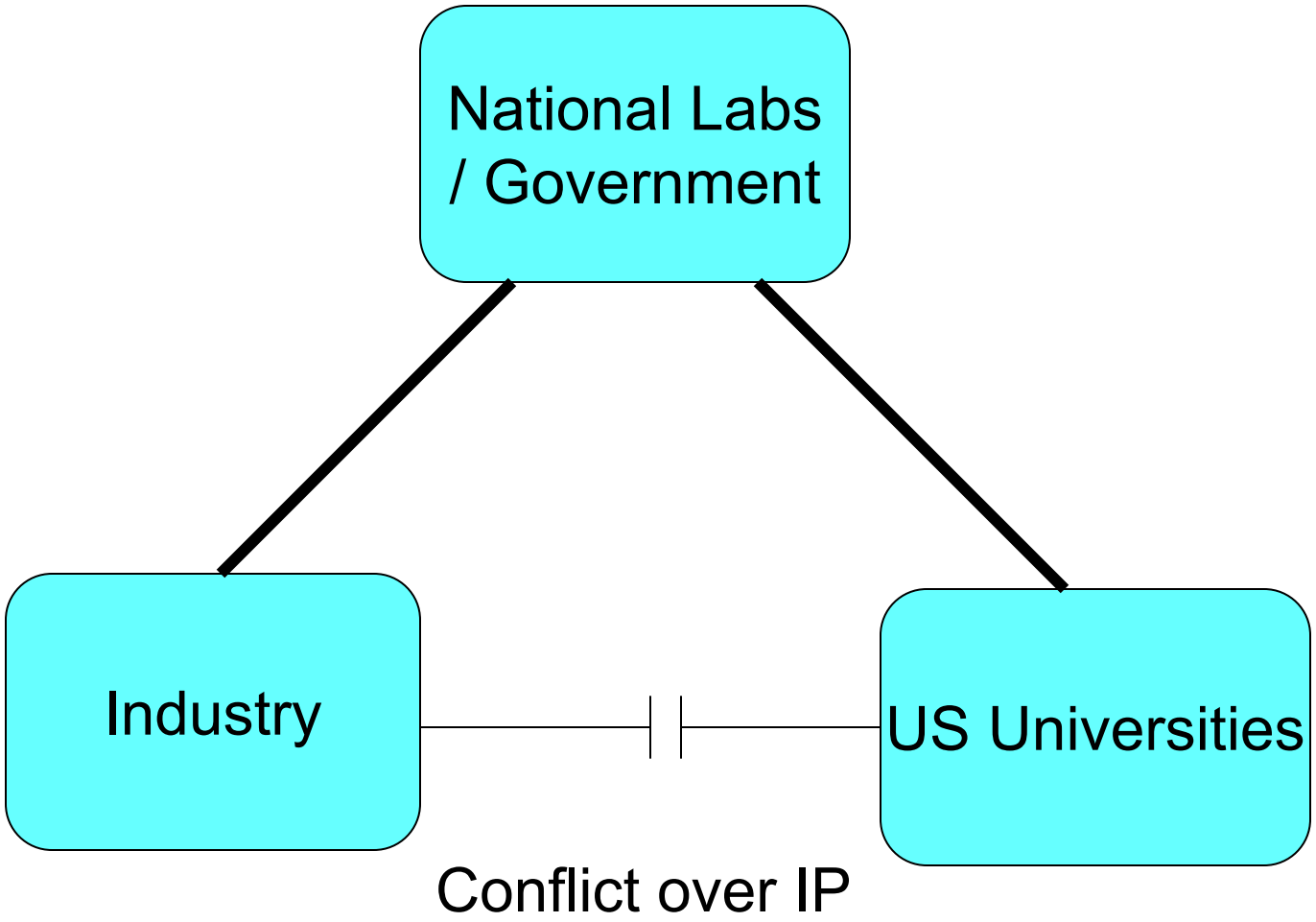
Re-Engineering the University-Industry Partnership

From the University-Industry Congress to the University-Industry Demonstration Partnership

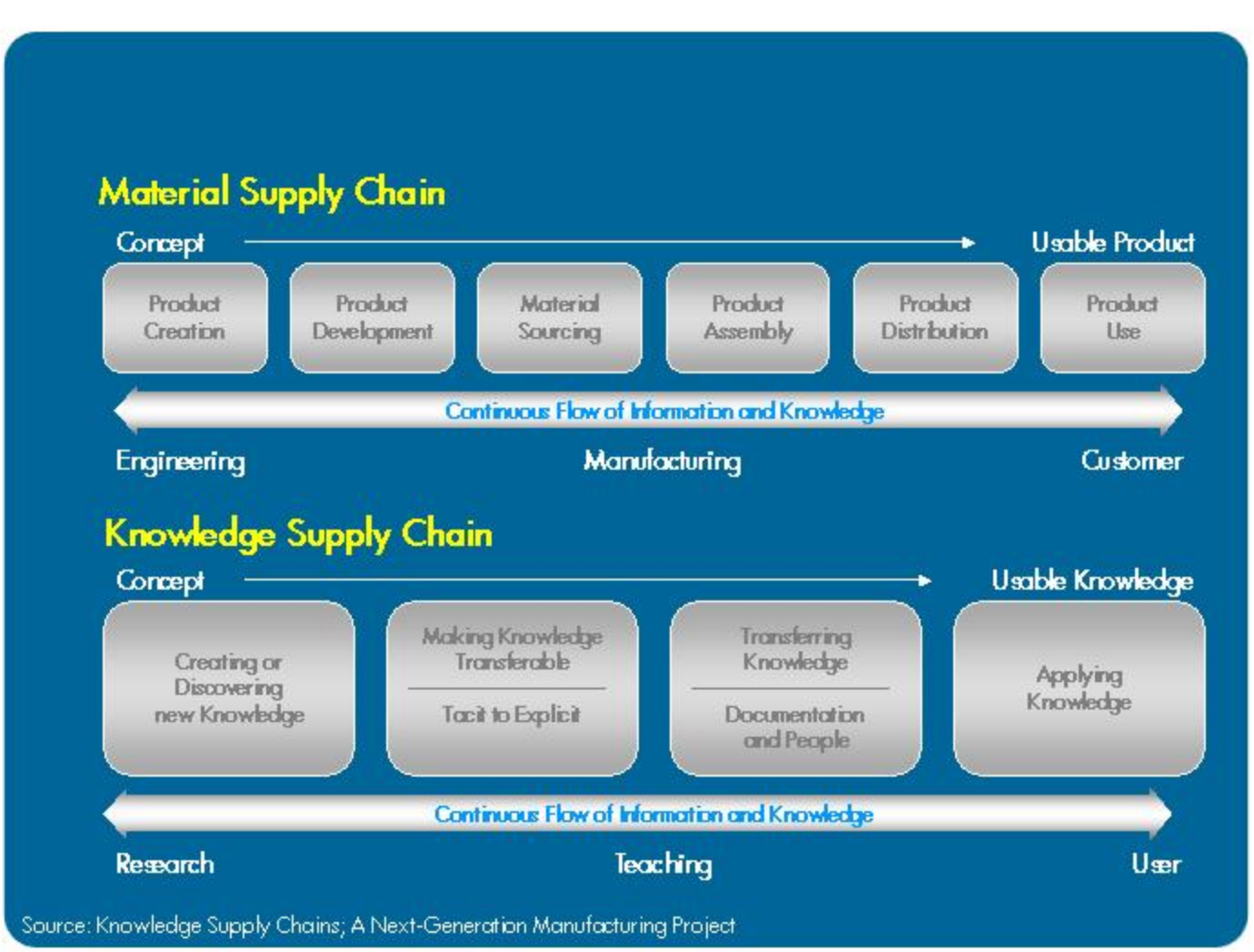
The Current State of Affairs . . .

- In the nexus between Government, Universities and Industry two of the three links work reasonably well. However, much could be done to improve the link between Academia and Industry
- Relations between Industry and Universities often flounder on the issue of Intellectual Property, and academic institutions are often seen as an impediment to commercialization, despite the existence of the Bayh-Dole Act.
- For effective transfer of academic innovation into commercializable products one must work on making the weak link stronger.


National Labs
/ Government
Industry
US Universities
Conflict over IP

Knowledge Supply Chain

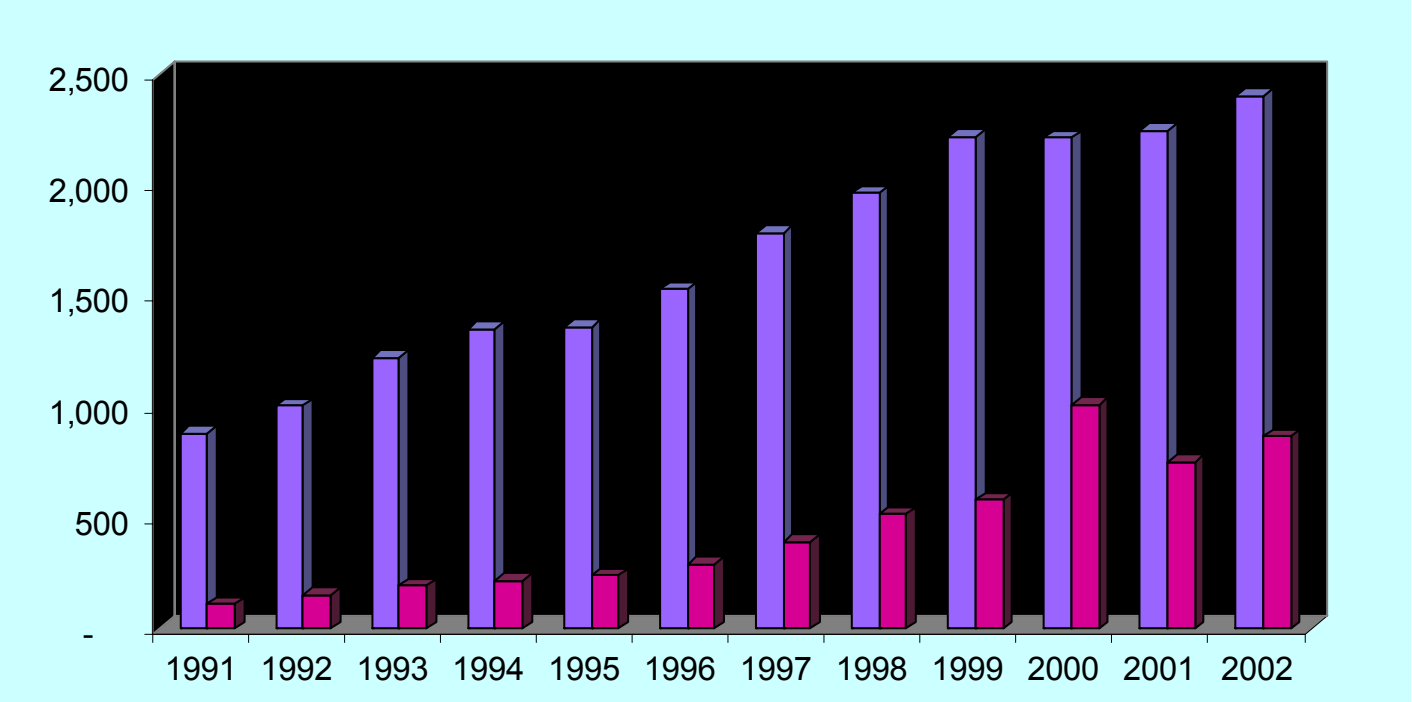
- Universities and industry generate knowledge and transfer knowledge.
- Barriers between the two cultures impact the ability to create new knowledge to satisfy society.



Two Financial Reasons Why it is Important to Solve This Problem

Industry Sponsored Research (Millions of $)

Net Licensing Income (Millions of $)



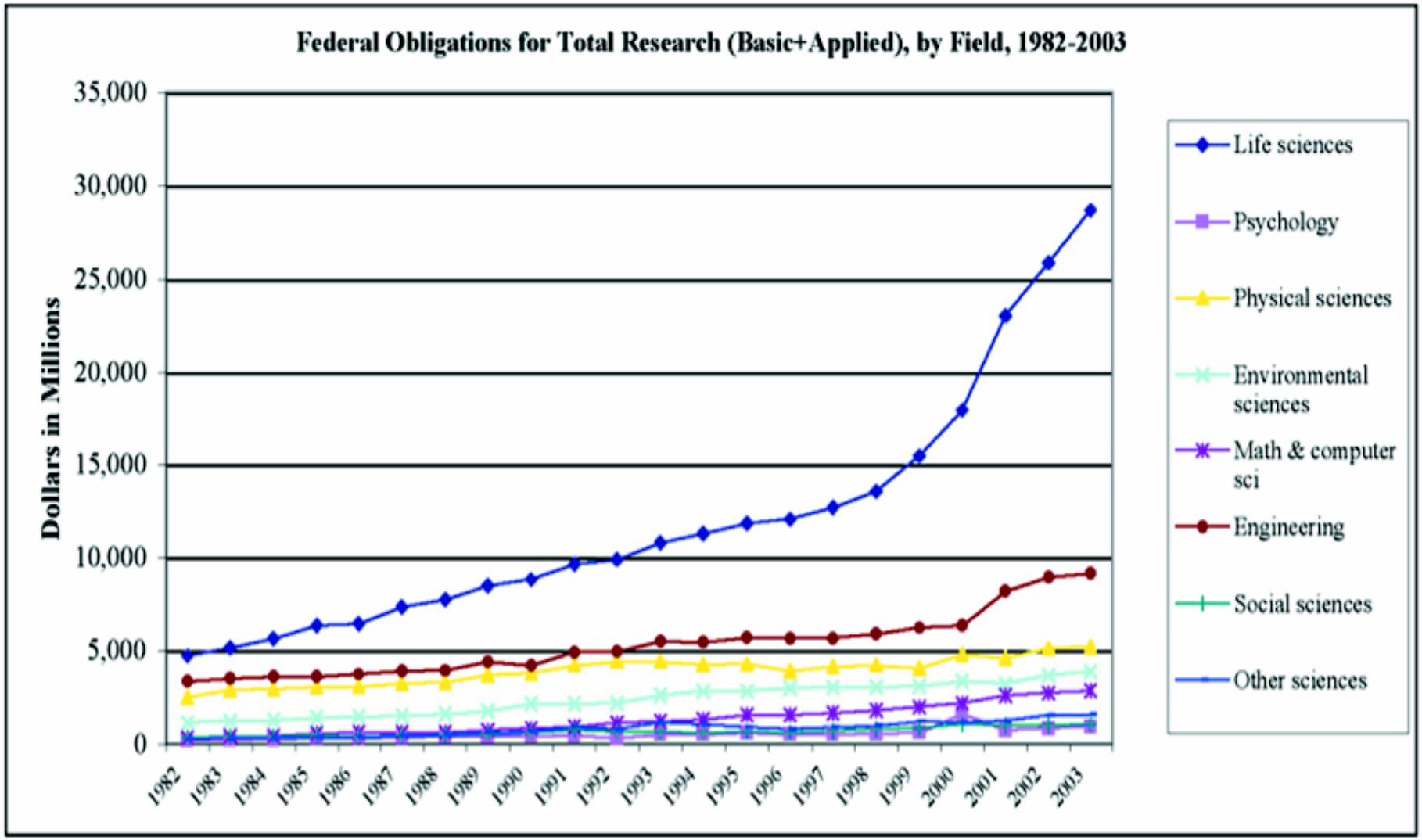
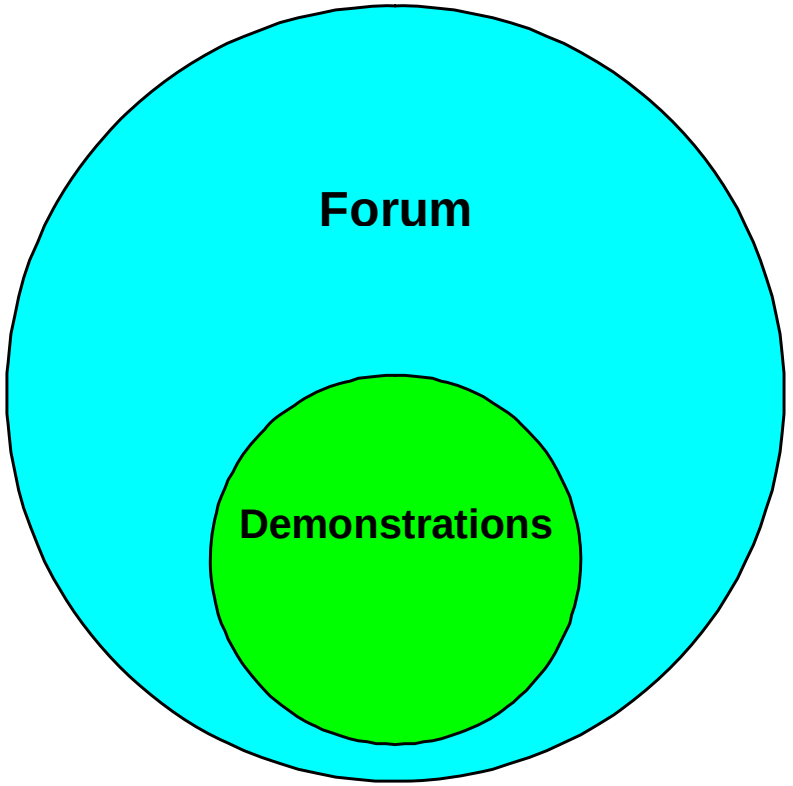


FIGURE 1 Federal funding for basic and applied research in all fields, 1982–2003.
Source: NSF, 2003, 2004a.

Launching the UIDP will allow for institutional beta-testing of new approaches to contracting arrangements

- **Working groups will be focused on designing institutional experiments.**
- **There will be a broad information-sharing forum on latest news, best practices, etc.**
- **UIDP is modeled on the 20 year success of the Federal Demonstration Partnership in driving institutional change on a national level.**



GUIRR University-Industry Partnership

Objective

- Develop national acceptance of general principles governing intellectual property negotiations between U.S. universities and industry, thereby allowing the once-healthy relationship between education/training and commercial/economic development to reestablish itself in the U.S.

Outcomes

- Guiding principles
- Living studies in sponsored research negotiations highlighting lessons learned
- April 2006 Summit to launch University-Industry Demonstration Partnership

ASEE (American Society for Engineering Education) Strategic Plan

- Improve the quality of engineering education in America
- Move forward with more “modern” ideas of engineering – what it is, and what it can be, what an engineering degree is for, what engineers do, etc.
- Increase the number of engineers graduating in America vs. China, India, etc.

IP Impacts on University-Industry Collaborations

- Barriers to university-industry research collaborations limit the relevant research experiences that students can have
- Creates downstream problems when these research advances don’t occur and fail to be reflected in curricula advances
- Creates barriers to funding streams
- “Impedance match” when hiring students

Overall Considerations by the EDC

- Current U.S. R&D investment model
- Characteristic times of the two cultures differ
- Big issues that transcend the short term
  - U.S. innovation; “off-shoring”; future of engineering education
  - U.S. can “win the battle but lose the war”
- Attitude matters: collaborative, mutually beneficial relationship versus negotiate the best deal

EDC University-Industry Intellectual Property Workshop

- Convened a group of diverse stakeholders to discuss effectiveness of transferring university R&D to industry to:
- Identify processes and approaches to overcome barriers to tech transfer
- Discuss guiding principles for U-I interactions
- Develop policies and practices to improve tech transfer and enhance relations between academic and industry sectors
- Provide a basis for continued engagement of academic deans of engineering in informing national discussions relating to tech transfer

** ASEE developed a White Paper and Prism article prior to Workshop*

Identified key areas of concern

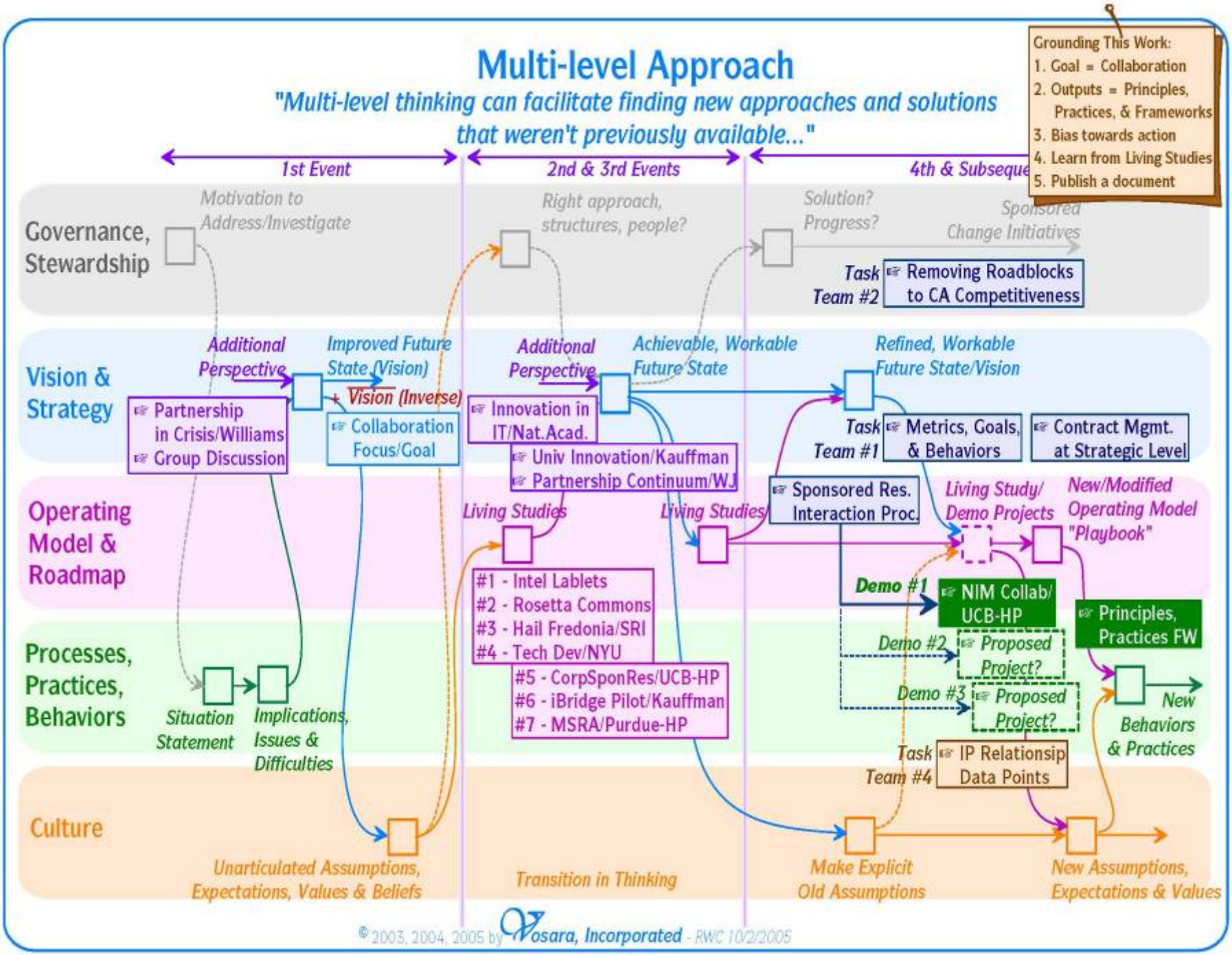
- Importance of the overall relationship
- Guaranteed access to technology
- Process and policy improvements
- Global/international considerations

Bay Area Science and Innovation Consortium (BASIC) IP Project

- BASIC is a collaboration of the Silicon Valley region's major research universities (Stanford, UC Berkeley, UCSF, …), businesses (IBM, Genencor, HP, Lockheed, SIA,), and national labs (Lawrence Livermore, NASA Ames, Sandia, …)
- BASIC is dedicated to developing programs that take advantage of the unique capabilities at Bay Area R&D institutions to provide solutions for critical national and regional challenges
- Goal of the IP Project is to achieve a shared understanding of general principles that will more effectively advance the IP interests of public and private research institutions
- Motivation is driven by recognition that a problem exists and is becoming more contentious and complex over time

Bay Area Science and Innovation Consortium (BASIC) IP Project

- Desired Impact and Outputs of the IP Project
  - A set of general principles
  - Achieve social / culture change in the total IP system
  - Enhance economic and business development – create a virtuous cycle/environment rather than a vicious cycle


Multi-level Approach
"Multi-level thinking can facilitate finding new approaches and solutions that weren't previously available..."
Grounding This Work:
1. Goal = Collaboration
2. Outputs = Principles, Practices, & Frameworks
3. Bias towards action
4. Learn from Living Studies
5. Publish a document
1st Event
2nd & 3rd Events
4th & Subseque
Governance, Stewardship
Motivation to Address/Investigate
Right approach, structures, people?
Solution? Progress?
Sponsored Change Initiatives
Task Team #2
Removing Roadblocks to CA Competitiveness
Vision & Strategy
Additional Perspective
Improved Future State (Vision)
+ Vision (Inverse)
Partnership in Crisis/Williams
Group Discussion
Collaboration Focus/Goal
Additional Perspective
Achievable, Workable Future State
Innovation in IT/Nat.Acad.
Univ Innovation/Kauffman
Partnership Continuum/WJ
Refined, Workable Future State/Vision
Task Team #1
Metrics, Goals, & Behaviors
Contract Mgmt. at Strategic Level
Operating Model & Roadmap
Living Studies
Living Studies
Sponsored Res. Interaction Proc.
Living Study/ Demo Projects
New/Modified Operating Model "Playbook"
#1 - Intel Lablets
#2 - Rosetta Commons
#3 - Hail Fredonia/SRI
#4 - Tech Dev/NYU
#5 - CorpSponRes/UCB-HP
#6 - iBridge Pilot/Kauffman
#7 - MSRA/Purdue-HP
Demo #1
NIM Collab/ UCB-HP
Principles, Practices FW
Demo #2
Proposed Project?
Demo #3
Proposed Project?
Processes, Practices, Behaviors
Situation Statement
Implications, Issues & Difficulties
New Behaviors & Practices
Task Team #4
IP Relationsip Data Points
Culture
Unarticulated Assumptions, Expectations, Values & Beliefs
Transition in Thinking
Make Explicit Old Assumptions
New Assumptions, Expectations & Values
© 2003, 2004, 2005 by Vosara, Incorporated - RWC 10/2/2005

Accelerating Engineering Innovation Summit

- Sandia National Laboratories, May 31-June 2, 2006
- Leaders from industry (9 companies), academia (14 universities), national laboratories, and government
- Purpose: Examine issues in engineering innovation and recommend approaches to increase U.S. competitiveness in the global marketplace
- Next planning meeting October 25, 2006

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G-U-I Research Partnership Successes

- We have models of successful university-government / national labs-industry interactions
  - SEMATECH (when it was a U.S. consortium)
    - SEMATECH Centers of Excellence
    - SEMATECH-Sandia CRADA
  - SRC (Semiconductor Research Consortium)
    - Funds university research
  - MARCO (managed by the SRC)
    - Funds university research to address Roadmap Grand Challenges
  - NNIN
    - Network of nanotechnology research capabilities for collaborative R&D

The SRC Vision

The SRC operates research programs *both in the U.S. as well as* globally to provide competitive advantage to its members as the world's premier university research management consortium delivering relevantly educated technical talent and early research results

Mission *For SRC Global Research Collaboration (GRC)*

SRC

The SRC's mission is to manage a range of worldwide, consortial, academic-based research and education programs, each matching the needs of their sponsoring entities. SRC maximizes synergy between the efforts in order to optimally address members' research needs, and controls redundancy in order to maximize value to common members

SRC-GRC's mission provides:

- Innovative, strategic, pre-competitive research guided by the ITRS, focusing on universities globally
- University graduates with high rate of placement in member companies
- A global forum for pre-competitive collaboration among all segments of the semiconductor industry, universities and governments
- Advocacy to various government and other funding agencies for support of University semiconductor research
- A comprehensive Value Proposition that focuses on maximizing member value

An SRC Unique Core Competency

Knowledge

- Understanding leading-edge, semiconductor-related technology
- Understanding the needs and methods of industry, university and government technology organizations

Unique!

SRC-GRC Technology Management

- Managing a large, dispersed, research program:
  - Engaging members in managing the research efforts
  - Effectively engaging the university community
  - Providing useful, accessible research results to SRC-GRC members
  - Delivering a stream of graduates to SRC-GRC members
- Leveraging research through external partnerships
- Creating forum for information exchange that involves all segments of the IC industry and the best research universities

In ’05, approximately $70M of member and government leverage funds covering 350 projects in North America, Europe and Asia

Currently 103 Universities

Andes Univ.
Arizona State University
Auburn University
Binghamton University – SUNY
Brown University
Carnegie Mellon University
Case Western Reserve University
Chalmers Univ. of Tech
Clarkson University
Columbia University
Cornell University
Delft University of Tech
DeMontfort Univ.
Duke University
Florida International University
Georgia Institute of Technology
Harvard University
Helsinki Univ. of Tech
Indian Institute of Science
Iowa State University
Lehigh University
Mass. Institute of Technology
McGill University
Nanyang Tech Univ.
National Chia Tung Univ.
National Taiwan Univ.
National Univ. of Singapore
Naval Post-Graduate School
New Jersey Institute of Technology
New York University
North Carolina State University
Northwestern University
Oregon State University
Pennsylvania State University
Politecnico di Torino
Portland State University
Princeton University
Purdue University
Qatar Univ.
Rensselaer Polytechnic Institute
Rice University
Rochester Institute of Technology
Royal Institute of Tech (KTH)
Rutgers University
Southern Methodist University
Stanford University
Stony Brook University
Technical Univ. of Braunschweig
Technical Univ. of Vienna
Technion-Israel Institute of Tech
Texas A&M University
The Ohio State University
Univ. at Albany - SUNY
Univ. at Buffalo - SUNY
Univ. de Valladolid
Univ. of Alabama
Univ. of Alberta
Univ. of Arizona
Univ. of Arkansas/Fayetteville
Univ. of Bologna
Univ. of California/Berkeley
Univ. of California/Davis
Univ. of California/Irvine
Univ. of California/Los Angeles
Univ. of California/Riverside
Univ. of California/San Diego
Univ. of California/Santa Barbara
Univ. of California/Santa Cruz
Univ. of Central Florida
Univ. of Colorado/Boulder
Univ. of Connecticut
Univ, of Federal do Rio Grande do Sul
Univ. of Florida
Univ. of Houston
Univ. of Illinois/Chicago
Univ. of Illinois/Urbana-Champaign
Univ. of Iowa
Univ. of Maryland
Univ. of Massachusetts
Univ. of Michigan
Univ. of Minnesota
Univ. of Minnesota/Twin Cities
Univ. of New Mexico
Univ. of New South Wales
Univ. of North Texas
Univ. of Pennsylvania
Univ. of Rochester
Univ. of Southern California
Univ. of Tennessee/Knoxville
Univ. of Texas/Arlington
Univ. of Texas/Austin
Univ. of Texas/Dallas
Univ. of Toronto
Univ. of Utah
Univ. of Virginia
Univ. of Washington
Univ. of Waterloo
Univ. of Wisconsin-Madison
Universita di Urbino
Univ. of Ferrara
Virginia Polytechnic Institute
Washington State University
Yale University

Including 26 outside the U.S.

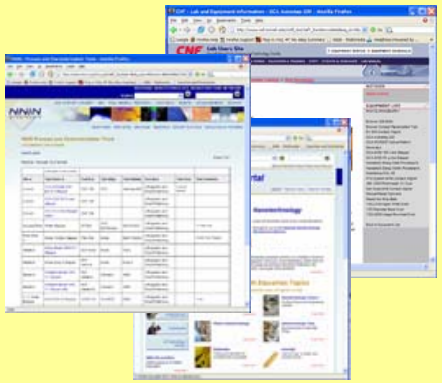
Report generated on 8/30/06

NNIN Resources & Output

Equipment
800 major tools

People
~200 FTE

Information
Processes and expertise

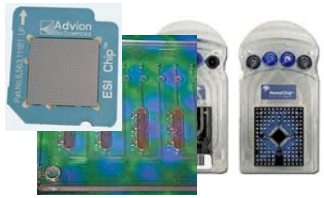


Discipline and User-centric Culture

Education

Research

Development

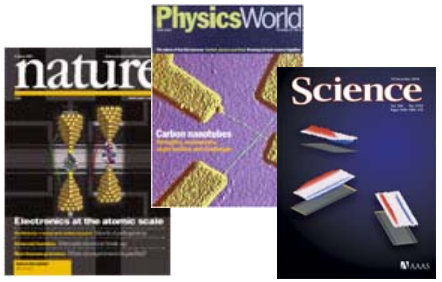


Society & Ethics

NNIN
www.nnin.org
Nanoscale Science, Engineering & Technology

NNIN Impact: Current Year

- Undergraduates conducting research: > 150 per year
- Graduate students conducting research: > 3200 per year
- Small Companies: >250 per year
- Attendees in workshops (on site):
  - >200 in 2004
  - Est. >700 in 2005
- Scholarly Publications: >1700 March 2004-June 2005

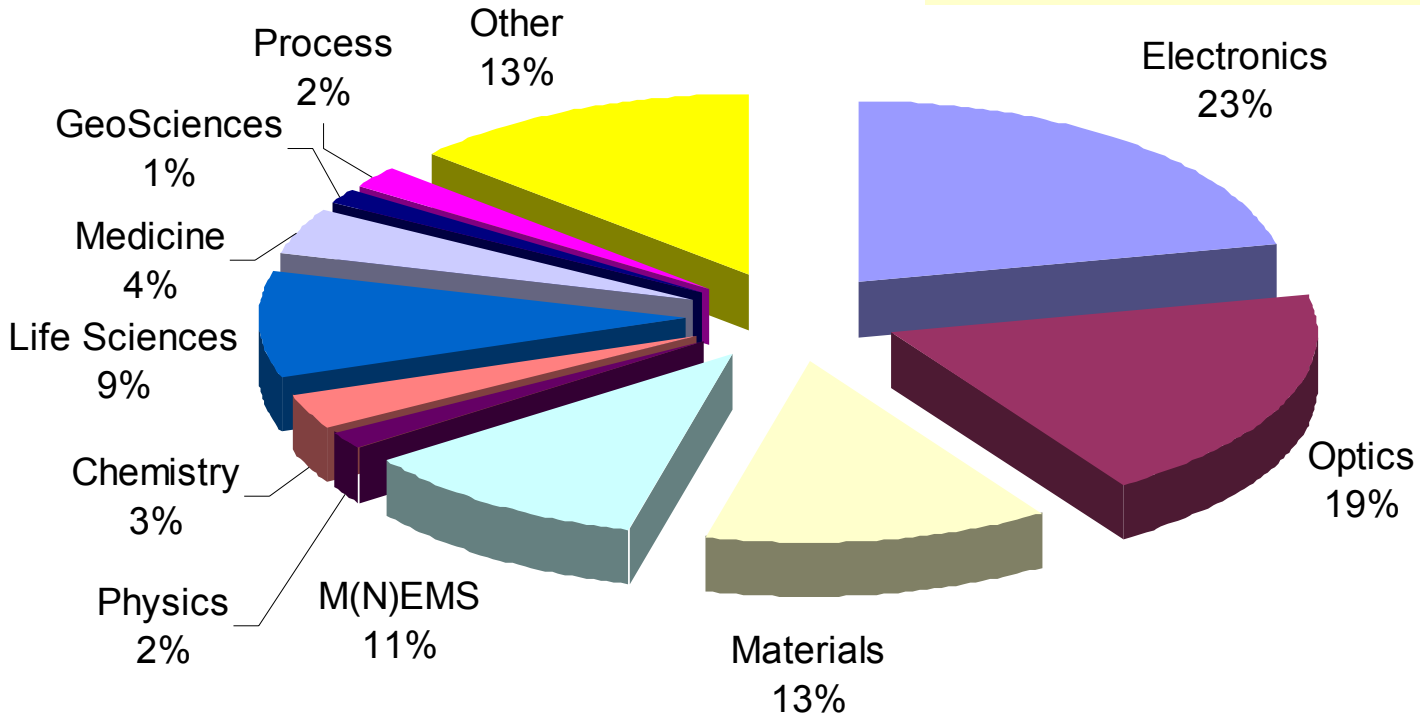


NNIN
www.nnin.org
Nanoscale Science, Engineering & Technology

Small Companies Usage (Yr. as of Oct. 2005)

Small Companies: 254 (Current Year Profile)

Small Companies: < 500 employees
Total Network Users > 4500



Low barriers to use, IP protection, and large leverage of resources (equipment & knowledge) catalyze an easy path to the initial stage of commercialization.

Network also provides remote usage.

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Outline

- Motivation for improved G-U-I partnership
- Examples of activities underway to address this issue
  - GUIRR / UIDP
  - ASEE / EDC
  - Bay Area Industry-University Roundtable
  - Sandia Accelerating Innovation Technology Summit
- Examples of successful partnerships
  - SRC
  - NNIN
  - BASIC
- **Conclusion and next steps**

Recommendations from G-U-I IP Workshop

- Stress importance of overall relationship, not negotiation to get the “best deal” on a relatively insignificant project
- Universities and industry should insure that faculty and students are valued as the core resource
- Need clarity on legal, public policy issues; e.g., Bayh-Dole, tax-exempt status, indemnification
- Recognize the spectrum of U-I interactions: no “one size fits all” agreements are possible
- Agreement templates should be developed that are sector-specific and have flexibility

Recommendations from G-U-I IP Workshop

- Develop better understanding of the competitive advantages that foreign universities offer
- Deans may be the best “level” to insure the academic perspective is central
- ASEE should collaborate with GUIRR and other groups to represent faculty/students in developing tech transfer policies
- EDC should follow up on specific issues

Workshop Conclusions and Next Steps

- Constructive and informative exchange of views from multiple stakeholders
- Identified several key issues that ASEE/EDC can help address
- ASEE will participate in GUIRR conference in April
- EDC Committee will consolidate key issues and recommendations and distribute a summary to deans
- EDC will discuss next steps at Spring meeting
  - (EDC subsequently joined GUIRR)

Sandia AEIS Summary

- Industry Perspectives
  - Engineer employees need to know how to quickly build successful partnerships
  - Partnering among U.S. institutions must be made simpler
  - Engineers need to be more broadly educated
- University Perspectives
  - Recognize need / challenges for multidisciplinary approach
  - Too much to teach in four years
  - Need to greatly strengthen U.S. student pipeline

Sandia National Laboratories

Sandia AEIS Summary

- Government / National Labs Perspectives
  - Students are attracted to engineering by challenging problems of national importance and access to state-of-the-art facilities
  - Realistic time horizons for engineering and research are needed
  - Industry, universities, and national laboratories are all subject to many of the same challenges relative to engineering innovation

Sandia National Laboratories

Summary

- Stronger partnerships are needed between U.S. research universities, industry, and National Labs
- All participants have multiple strong motivations and potential advantages from stronger partnerships
- Benefits of such partnerships are vividly demonstrated by selected partnerships
- Multiple groups and approaches are being explored to develop stronger partnerships between U.S. universities, industry, and National Labs
- The dialogue should continue and intensify
  - ***this issue must be resolved!***

Thanks!!

Questions / comments / discussion