



Monitoring of International S&T: Who Needs It?

Duane Shelton
International Technology Research Institute
Loyola College / ITRI; ITRI, Inc.
Baltimore, Maryland, USA



Americans should monitor international S&T because:

- Bill Clinton and the Rs say to,
- Everybody else does it,
- To avoid unpleasant surprises, and
- We might actually learn some neat ideas from those foreigners.

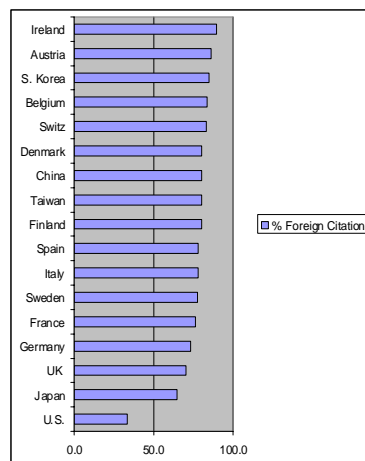
Why? President and Congress Say To

- It's a 4-letter word, but GPRA requires measurement of progress toward goals
- Bill Clinton's goal for U.S. agencies:
"Maintaining* world leadership in science, mathematics, and engineering..."
- Measurement can be done by bibliometrics and expert review

*This sort of begs the question, doesn't it? Also, the President of the National Academy of Sciences says, "The U.S. is today the undisputed world leader in S&T."

Why? Everybody Else Does it.

Use of International Literature by a Country's Scientists



The U.S. figure is **half** the next lowest one among the 71 countries in the data. From the new *NSF S&E Indicators 2000*. **Get yours today!**

Why? To Avoid Unpleasant Surprises

Some absolute indicators:

- Technical papers and citations to them
- Patents and citations to them
- International trade in high-tech goods
- R&D investment, Degrees in S&E

Some relative indicators--above divided by:

- GDP or population
- Relative impact is citations/paper normalized by world average -- a measure of average quality of papers

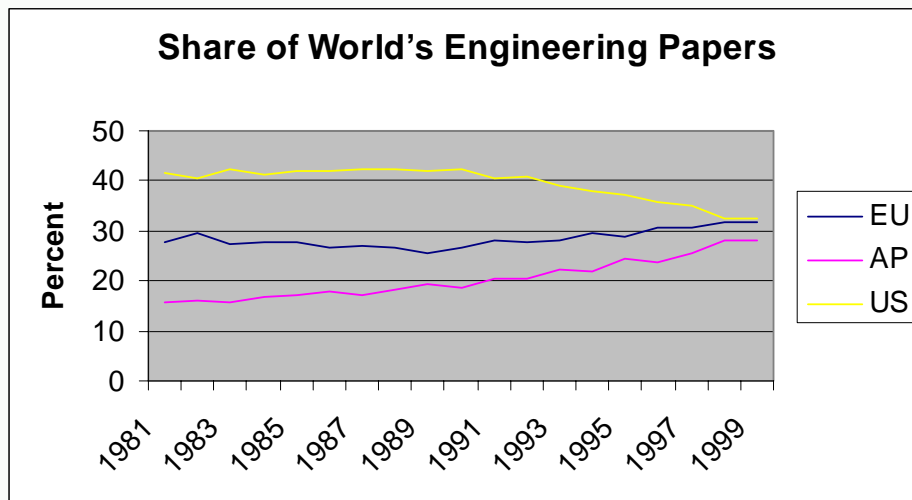
Here I will use world “market” share of papers and their relative impact. (Plus our qualitative results from peer review.)

Leadership in S&T Papers (ISI Data)

	1981	1983	1985	1987	1989	1991	1993	1995	1997	1999
Agricultural Science	US	US	US	US	US	US	EU	EU	EU	EU
AstroPhysics	US	US	US	US	US	US	US	US	EU	US
Biology & BioChem	US	US	US	US	US	US	US	US	US	US
Chemistry	EU	EU	EU	EU	EU	EU	EU	US	EU	EU
Clinical Medicine	US	US	US	US	US	US	US	EU	EU	EU
Computer Science	US	US	US	US	US	US	US	US	US	US
Ecology & Environment	US	US	US	US	US	US	US	US	US	US
Engineering	US	US	US	US	US	US	US	US	US	US
Geoscience	US	US	US	US	US	US	US	US	US	EU
Immunology	US	US	US	US	US	US	US	US	US	US
Materials Science	US	US	US	US	US	US	EU	EU	AP	AP
Math	US	US	US	US	US	US	US	EU	EU	EU
Microbiology	US	US	US	US	US	US	EU	EU	EU	EU
Molecular Bio & Genetics	US	US	US	US	US	US	US	US	US	US
Multidisciplinary	EU	EU	EU	EU	EU	EU	EU	EU	EU	EU
Neuroscience	US	US	US	US	US	US	US	US	US	US
Pharmacology	EU	EU	EU	EU	EU	EU	EU	EU	EU	EU
Physics	US	EU	US	US	EU	EU	EU	EU	EU	EU
Plant & Animal Science	US	US	US	US	US	US	US	EU	EU	EU
Psych & Psychiatry	US	US	US	US	US	US	US	US	US	US

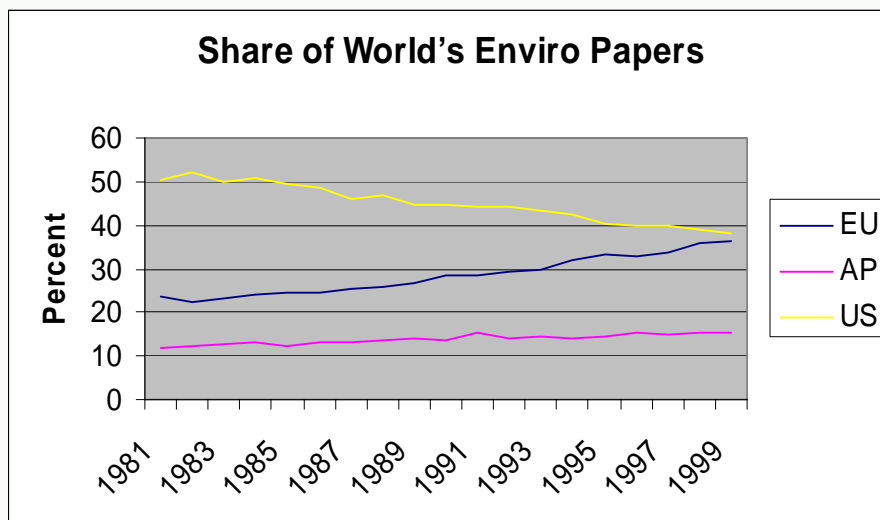
US position tanked in the 1990s. Engineering and enviro look safe here, but...

An unpleasant surprise is in store by 2002.



ISI data. There is an **absolute** decline in number of US engineering papers in elite journals. There were 17,494 US engineering papers in 1998 (peak was 18,686 in 1995). EU had 17,024. 1999 data looks flaky.

Another unpleasant surprise by mid-decade.



But the US has the best papers, right?

Not Quite. Top Nations in Relative Impacts of Papers

Engineering

- 1 Switzerland (2.08)*
- 2 Denmark (1.68)
- 3 Belgium (1.60)
- 4 Sweden (1.48)
- 5 Netherlands (1.43)
- 6 Finland (1.33)
- 7 Germany (1.31)
- 8 US (1.28)

Environment & Ecology

- 1 Switzerland (1.63)
- 2 Sweden (1.43)
- 3 Netherlands (1.42)
- 4 UK (1.32)
- 5 Finland (1.28)
- 6 US (1.17)
- 7 Denmark (1.17)
- 8 Belgium (1.14)

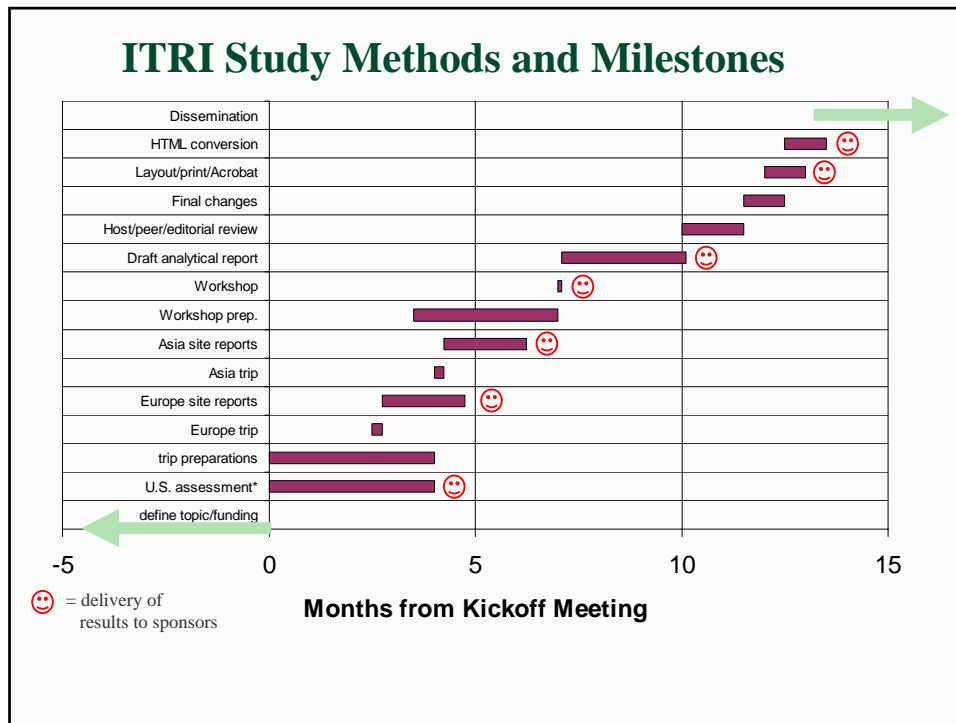
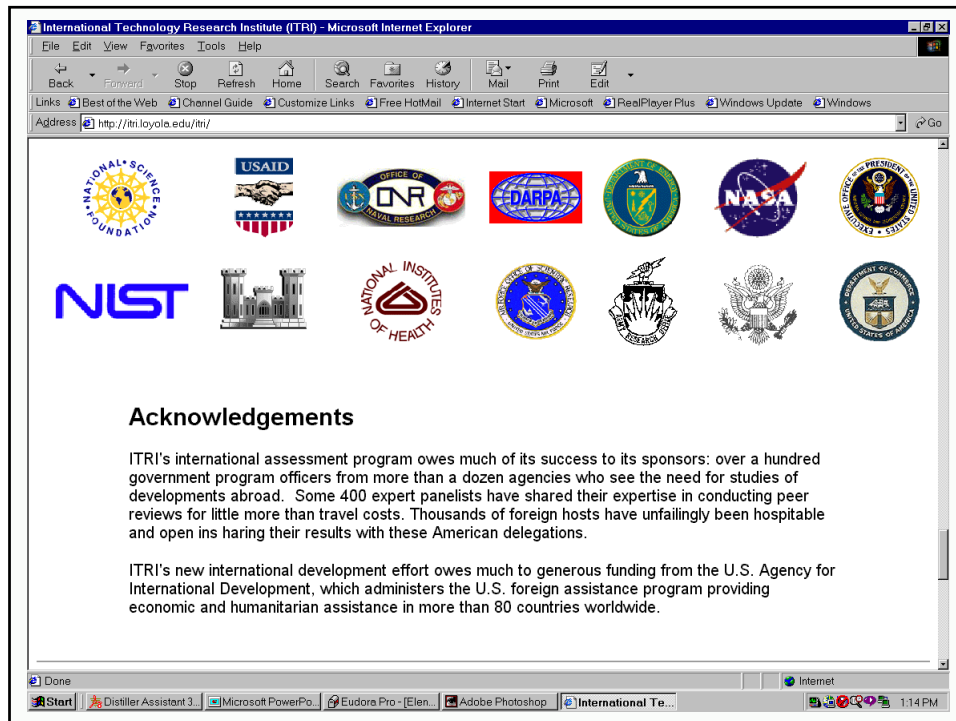
* Citations/Paper normalized by world average. Swiss engineering papers were cited about twice as often as the average paper in the ISI database. Japanese impacts are only 0.89 and 0.75. (1997 data)

Why? Picking up Good Ideas Abroad

✿ ITRI has done 50 international technology assessments using on-site peer review since 1989. Underway now:

- Wireless (worldwide)
- Molecular Modeling (worldwide)
- High Temp Electronics (Europe)
- Electronics Manufacturing (China)
- Benign Manufacturing (worldwide)
- Tissue Engineering (worldwide)

✿ But first a word from our sponsors...













Some Fields Which US Does **Not** Lead

R&D Field	Leads US	Panel Chairs	Year
Wireless communications	Europe, Japan tie	Ephremides	2000
SiC electronics	Europe	Dmitriev	1999
Optical storage	Japan	Kryder Esener	1999
GaN electronics	Japan	Dmitriev	1998
Digital Library; Displays, virtual reality, digitization, IP policy, commercialization	Japan	Reddy	1998
Electronic device applications of nanotechnology	Japan Europe	Siegel Hu	1998
Launch technology for satellite communications	Europe	Pelton Mac Rae	1998
Refrigeration for superconductivity; materials science of thin HTS films; SQUID systems	Japan	Rowell	1998
Polymer composites in civil engineering	Japan	Karbhari	1998

More Fields **Not** Led by the US

R&D Field	Leads US	Panel Chairs	Year
Several mass market electronic packaging techniques	Japan	Kelly, Boulton	1997
Superconducting generators, Maglev applications, current limiters, certain wire materials	Japan	Larbalestier	1997
Superconducting transformers	Germany	Larbalestier	1997
Gravity casting, advanced manufacturing, and process development in metal casting	Europe	Flemings	1997
Rapid solidification, metal matrix composites, pressure die casting, environment, and energy in metal casting	Japan	Flemings	1997
Consumer optoelectronics; optical packaging	Japan	Forrest	1996
Electronics manufacturing technologies	Japan	Kelly, Boulton	1995
Micropure water, hydrometallurgical separation technologies	Japan	King	1993
Spacecraft antennas and power systems	Europe	Pelton, Edelson	1993

But, Does the U.S. Lead in S&T Overall?

1 st	2 nd	Metric:
		R&D Investment Overall
		R&D Investment Relative to GDP
		Papers
		Impacts
		Patents

It depends on which indicator you use. Continued on next slide.

Does the U.S. lead in S&T Overall?

1 st	2 nd	Metric:
		Ph.D. Production
		Hi-Tech Markets
		Productivity
		Expert Review*

Results are mixed, but no single nation surpasses the U.S.

* There are many disciplines where Japan leads the US. See *American Leadership of S&T: Reality or Myth?* by Shelton, Mooney, and Holdridge. <http://justice.loyola.edu/~rds/myth.pdf>

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