The University of Manchester
Manchester
Business School

MANCHESTER 1824

Georgia Institute
of **Tech**nology

The Emergence of Distributed Technology Assessment in the USA?

From OTA to the Center for Nanotechnology in Society

Philip Shapira

Manchester Institute of Innovation Research, Manchester Business School, University of Manchester, UK
School of Public Policy, Georgia Institute of Technology, USA

Research Workshop: Foresight and Science, Technology and Innovation Policies: Best Practices. Panel on Policy Instruments for Science, Technology and Innovation (Evaluation of Science and Technology Policies)

National Research University - Higher School of Economics, Moscow, October 14, 2011

Overview

1. Rise and fall of TA in the USA
   - Case 1: OTA, 1970s-1990s ⇨ present
2. Re-emergence of new forms of TA
   - Case 2: Center for Nanotechnology in Society, 2000s
   - Real-Time Technology Assessment
3. Comparisons and Contrasts
   - Combining modes ⇨ Distributed TA
   - Broader insights

Notes: TA = Technology Assessment; OTA = US Congressional Office of Technology Assessment

OTA – Quick Recap

Technology Assessment (TA)

- Study of the likely impacts of new technologies
- To contribute to S&T decision making and policy
- Emerges in US in 1960s

US Office of Technology Assessment (OTA)

- Formed 1974 in US Congress (PL 92-484)
- Provided committees with assessments of complex technologies – *with options (pro & con)*
- 12 member bi-partisan TA Board
- c. 750 studies and reports over 23 years, many topics; c. 140 staff, $20m budget

OTA Closed ("De-funded")

- 1995 (Republican-controlled Congress)

Assessment and TA in USA since 1995

- Range of views on effectiveness of OTA
  - Pro: Much-needed body of independent scientific and technological advice for Congress and country
  - Con: Inefficient, duplicative, and in some cases biased

- Since 1995
  - Other organizations involved in TA (or "quasi-TA"), including National Academy, non-profits (RAND, Critical Technologies Institute), GAO, others (←Washington, DC-based, "expert" TA)

- Efforts to re-establish OTA or an OTA-like capability
  - Legislative proposals (beginning 2002, Rush Holt, OTA Re-establishment) and other proposals for TA services or centers aiding Congress
  - G. Morgan, J Peha, Science & Technology Advice for Congress; and others
  - Argument: Congressional TA capability is essential

Meanwhile …times change

- Development of innovation systems approaches
- Advances in ICT & knowledge systems
- New TA concepts
  - **Strategic Intelligence** (Kuhlmann, Smits)
    - Multiple instruments: Technology Forecasting, Technology Foresight, Technology Assessment, Evaluation, and Road Mapping
  - **Constructive TA** (NL); **Real-Time TA** (Guston, Sarewitz)
    - Use TA to modify technology development
  - **Participatory TA**; Technology **Consensus Conferences** (DK)
    - Broaden participation & engagement in TA decision-making

The U.S. 21st Century Nanotechnology R&D Act of 2003 (PL 108-153)


Public Law 108–153
108th Congress

An Act

To authorize appropriations for nanoscience, nanoengineering, and nanotechnology research, and for other purposes.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. SHORT TITLE.

This Act may be cited as the "21st Century Nanotechnology Research and Development Act".

SEC. 2. NATIONAL NANOTECHNOLOGY PROGRAM.

(a) NATIONAL NANOTECHNOLOGY PROGRAM.—The President shall implement a National Nanotechnology Program. Through appropriate agencies, councils, and the National Nanotechnology Coordination Office established in section 3, the Program shall—

(1) establish the goals, priorities, and metrics for evaluation for Federal nanotechnology research, development, and other activities;

(2) invest in Federal research and development programs in nanotechnology and related sciences to achieve these goals; and

(3) provide for interagency coordination of Federal nanotechnology research, development, and other activities undertaken pursuant to the Program.

(b) PROGRAM ACTIVITIES.—The activities of the Program shall include—

(1) developing a fundamental understanding of matter that enables control and manipulation at the nanoscale;

(2) providing grants to individual investigators and interdisciplinary teams of investigators;

(3) establishing a network of advanced technology user facilities and centers;

(4) establishing, on a merit-reviewed and competitive basis, interdisciplinary nanotechnology research centers, which shall—

(A) interact and collaborate to foster the exchange of technical information and best practices;

(B) involve academic institutions or national laboratories and other partners, which may include States and industry;

(C) make use of existing expertise in nanotechnology in their regions and nationally;

(D) make use of ongoing research and development at the micrometer scale to support their work in nanotechnology; and

Four key objectives:

- Framework for integrated and interdisciplinary approach to nano R&D
- Encourages applications of nano for productivity, industrial competitiveness
- Provides for nano education and training
- Requires ethical, legal, environmental, and other societal concerns to be addressed

Sec 2(b)(10):

- Establishes societal implications research program
- Requires nano research centers (NSECs) to address societal implications
- Integrates societal concerns with nano R&D
- Ensure advances in nanotech lead to quality of life improvements for all
- Provides for public input

NSF Network for Nanotechnology in Society

Two major centers:

NSEC/Center for Nanotechnology in Society at Arizona State University (CNS-ASU)

- Real-time technology assessment; education & outreach: $6.2m (2005-2010); $6.5m (2010-2015)

NSEC/Center for Nanotechnology in Society at UC Santa Barbara (CNS-UCSB)

- Nano development; response to nano; education, outreach. $5m (2005-2010) $6.1m (2010-2015)

Additional projects and networks

- Nanoscale Interdisciplinary Research Team Projects

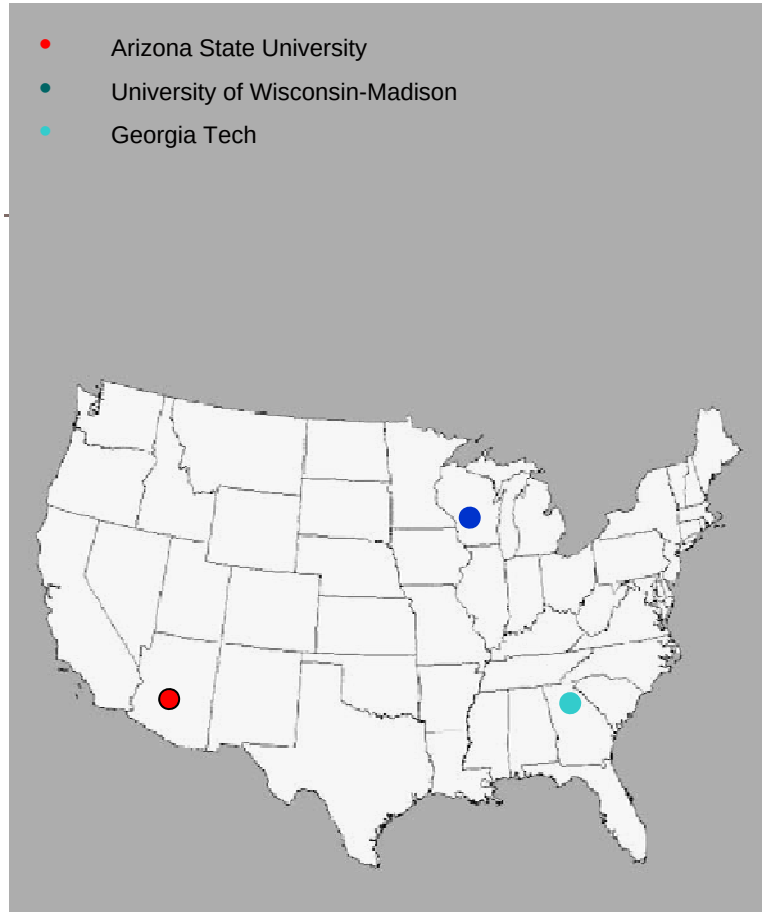
  Harvard/UCLA/NBER ($1.7 M); University of South Carolina ($1.4 M)

- Also: Michigan State University; NanoBank; Nanoscale Informal Science Education Network (NISE); National Nanotechnology Infrastructure Network

Center for Nanotechnology and Society (CNS-ASU)

MISSION

- Research the societal implications of nanotechnologies
- Train a community of scholars with new insight into the societal dimensions of nanoscale science & engineering (NSE)
- Engage the public, policy makers, business leaders, and NSE researchers in dialogues about the goals and implications of NSE
- Partner with NSE laboratories to introduce greater reflexiveness in the R&D process



CNS-ASU involves the activities of more than 80 individuals at 3 major collaborating institutions, as well as other collaborators, partners, and consultants

CNS-ASU aims to encourage reflexivity among the NSE research establishment and build capacity for anticipatory governance

Reflexivity

- a capacity for social learning (by individuals, groups, institutions, publics) in the NSE enterprise narrowly and society broadly that expands the domain of and informs the available choices in decision making about nano.

Anticipatory Governance

- a broad-based capacity extended through society that can act on a variety of inputs to manage emerging knowledge-based technologies while such management is still possible.

CNS-ASU Research Programs

Real-Time Technology Assessment

1. **Research and Innovation Systems Analysis (RISA)**
2. **Public Opinion and Values (POV)**
3. **Deliberation and Participation (D&P)**
4. **Reflexivity Assessment and Evaluation (RAE)**

Thematic Research Clusters

1. **Equity**
2. **Urban Design, Materials & the Built Environment** (Nano & the City)

RTTA 1: Research and Innovation Systems Analysis

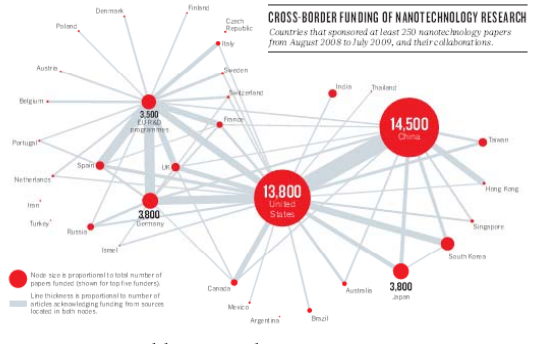
Who is doing what kind of NSE research & innovation?

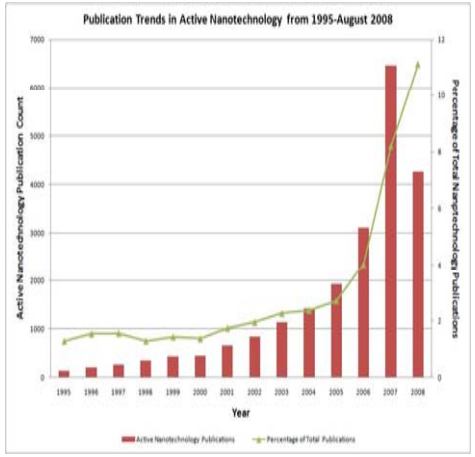
How can we measure NSE's contribution to broad social goals?

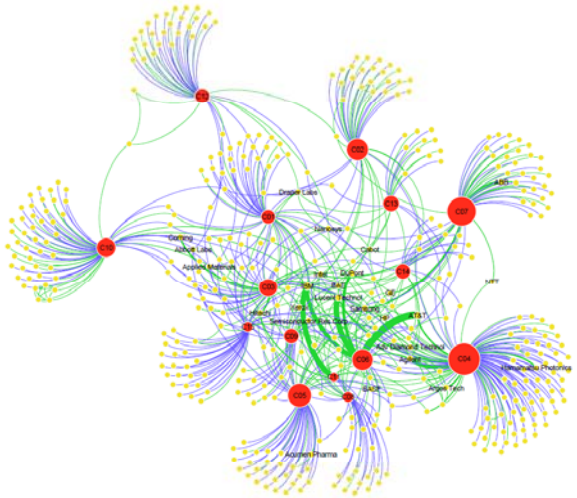
What nano training do we need in regional markets?

- **Research & Innovation Assessment**
  - Trajectories of emerging nano-science
  - Nanotechnology enterprise, applciations & innovation pathways
- **Public Value Mapping**
  - Conceptual development
  - To connect research to promised public values
- **Workforce Assessment**
  - Supply & demand analysis
  - To assess regional nano workforce

RTTA1 Group
Visualizing Nano Research & Innovation



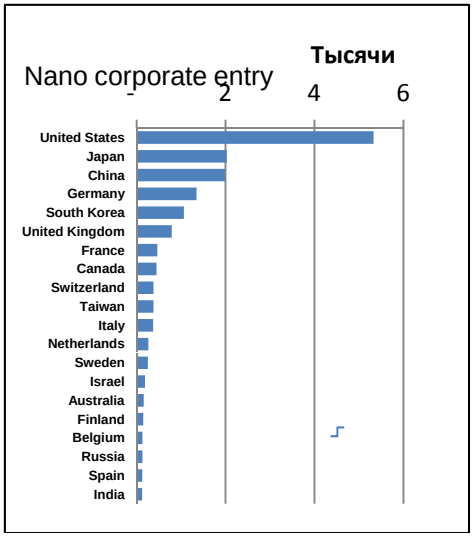


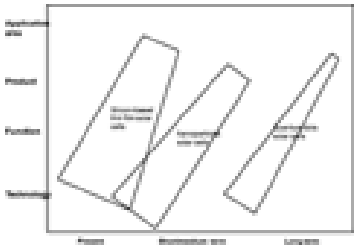


↑ Who funds nano?
Corporate entry ↓

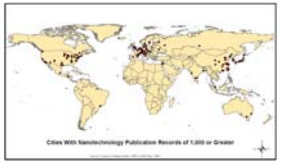
↑ Active nano?
Innovation paths ↓

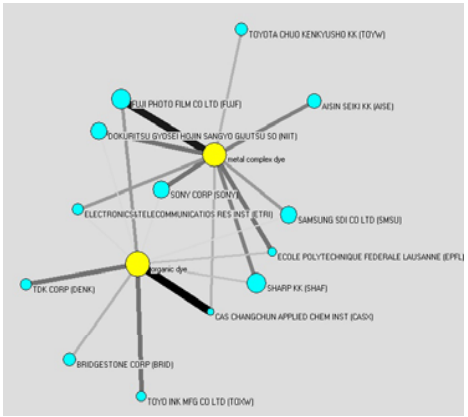
↑ Univ-Corp Networks
Patent linkages ↓





← Who, what, & where?↓





RTTA 2: Public Opinion and Values

What does the public know and feel about nanotechnology?

How does the media influence the public perspective?

What do NSE researchers know and feel about nanotechnology?

- **Public Opinions**
  - Longitudinal surveys, linked to themes
  - To assess changes in public opinion
- **Media Influence**
  - Tracking science news stories, new media forms
  - To assess media influence
- **Scientists' Opinions**
  - Surveys of nano researchers
  - To assess & compare scientists' values

RTTA 3: Deliberation and Participation

What are plausible nano-enabled futures?

How can we envision responsible NSE products?

What are the cultural resonances of NSE futures?

How can the public be engaged in NSE decision-making?

- **Scenario Development Workshops**
  - Deliberative exercise among experts
  - To provide plausible technological futures
- **Innovation Space**
  - User-centered research & design course
  - To create new products/scenarios
- **Critical Corps**
  - Critical theory
  - To engage critically nano products & scenarios
- **National Citizens' Technology Forum**
  - Six inter-linked citizens' panels
  - To deliberate on nano issue of their framing

RTTA 4: Reflexivity Assessment and Evaluation

How does CNS-ASU know that it is being effective?

How have NSE researchers' views changed over time?

What has CNS-ASU contributed to institutional change?

- **Reflexivity Assessment**
  - Intensive interviews w/ nano researchers
  - To understand change in Identity, Knowledge, and Practice
- **Boundary Organizations**
  - Comparative case studies
  - To assess ability of CNS-ASU to bridge "ways of knowing" nano

Performance and Outcomes

Large, multi-year datasets & tools
- Publications
- Patents
- Public opinion
- Expert opinion
- Media
- STIR field data
- Policy documents
- Urban design elements

Generative, influential vision & methods
- Anticipatory governance
- Real-time technology assessment

New techniques and methods for
- Anticipating futures
- Engaging publics
- Integrating across “two cultures”
- Training students

Important scholarly and reference works
- *Encyclopedia of Nanoscience and Society*
- *Yearbook of Nanotechnology in Society* series

Human capital
- New scholars
- Enlightened citizens
- Informed decision-makers
- Reflexive scientists and engineers

Demonstrations of public engagement at scale
- National Citizens’ Technology Forum
- FutureScape City Tours

Extended networks of individuals and institutions
- Scores of institutions in public and private sectors
- More than 100 international visitors
- Thousands of participants

In-depth study of critical, long-term societal issues
- Human Identity, Enhancement & Biology
- Equity, Equality and Responsibility
- Nano and the City

Scholarly impact
- 100-150 peer-reviewed publications
- 1000-2000 citations

The Strategic Vision

Anticipatory Governance

1. Foresight
   - All governance requires a disposition toward future
2. Engagement
   - Normatively, strategically, pragmatically
3. Integration
   - Scientists, industry know things we don't, and vice versa
4. Ensemble-ization
   - Because none of these works in isolation

Integration:

Engagement

Multiple Examples:

- Policy forums and workshops
- Testimony & hearings
- Private sector workshops
- Citizens forums (6 deliberative sites)
- Scenario development - Wiki interactions
- Nano & religion workshop
- Science Cafés ~50 per at AZ SC
- NISE Net interactions – NanoDays
- Nano Winter Schools
- STIR – engagement with scientists in labs
- Phoenix communities
- International projects (Innovation Co-Lab)

Science Cafe

Reflections

CNS-ASU Mission

- Research
- Train
- Engage
- Partner

- CNS-ASU: A new national and international resource *informing* and *stimulating* scientific and policy dialogue about nanotechnology emergence
- Innovative approaches (for the US), incl. datamining, scenarios, wikis, citizen panels, science engagement, policy, business and community engagement
- Has caught attention of some scientists (but, of course, not the majority), policymakers (national, local)
- Resources: $1.2m / year
  - Enough to establish a model, but not to replicate?
- Limited to one technology (albeit a general purpose technology)

Comparisons

OTA Model (1970s-1980s)

- Focused on Washington
- Draws on informed experts and interest groups
- Multiple technology scope
- Embedded in policy cycle
- Established techniques
- Target group: policy decision makers
- Top-down forms of influence ⇨ stakeholders
- Reports, testimony, informal interactions
- Tried and tested
- *Mode 1?*

CNS Model (2000s-2010s)

- Distributed structure
- Seeks to inform stakeholders and publics and foster reflexivity
- In-depth focus on an emerging technology
- Embedded in technology cycle & innovation system
- Able to experiment with new methods
- Target group: decision-makers + scientists, engineers + business + NGOs + public(s)
- Multiple dissemination modes
- Bottoms-up forms of influence ⇨ stakeholders
- Experimental
- *Mode 2?*

Roles and requirements: contrasts

	Focused (OTA)	Distributed (CNS-ASU)
Roles	Issue framing Decision-making Policy cycle Tested methods Foresight	Issue framing Decision-context Development cycle Experimental methods Foresight & anticipation
Requirements	Strong legislature Bi-partisan support Synthesis expertise	Sponsorship of multiple sites Network capabilities Engagement expertise
Shared features	TA personnel capabilities Independence/interdependence Credibility Transparent & open processes Multiple sources of information, expertise	

*Ideal worlds of TA?

Anticipate technological impacts, avoid major problems, maximize benefits, open decision-making

- Re-establish parliamentary TA capabilities *in* Congress
- Expand new TA capabilities *for* the broader governance of science and technology

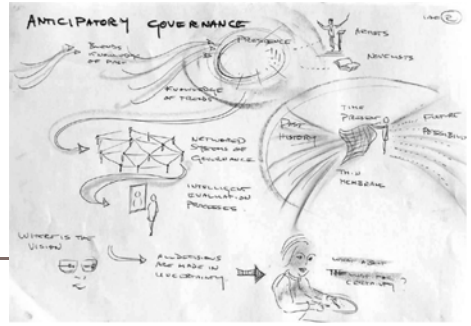
⇨ To build a **distributed and networked** system
  - Building on concepts of **strategic intelligence**
  - Outside of Congress, but inside the science and innovation system
  - Combining research, training, education and engagement with **real-time technology assessment**
  - Caution: system bandwidth – so focus on key new **strategic challenges** in new technology – with flexibility to surface new challenges

Not just about establishing TA organizations …

but of embedding real-time TA processes for anticipatory governance in the science and innovation system

*for the USA

*Real worlds of TA?



- Multi-level and diverse (fragmented?) US approach continues
  - TA capabilities unlikely to soon be re-established in the US Congress
  - Current expert agencies continue in Washington, DC
  - Distributed network remains partial and experimental
- Issues:
  - Can distributed RTTA be expanded?
  - How can it outlive NSF center-level funding?
  - Will further expansion embed the anticipatory governance of science and technology?
  - Are there additional ways to embed anticipatory governance?

*for the USA

Insights for HSE?*

- **Going beyond conventional expertise**
  - Engagement (rather than consultation)
  - Involvement of publics
- **Diversifying methods**
  - Beyond quantitative analyses
  - Scenarios, wikis, innovation labs
  - “Visioneering” and impact/options assessment
- **Integration**
  - Multiple methods around common themes
- **Networking and orchestration**
  - Multiple sites working together – developing specialties and integrating
- **Anticipatory orientation**
  - Beyond foresight to anticipation and reflection

*Caution – the US and RU NIS systems and frameworks are rather different!

More information

- Web sites:
  - http://cns.asu.edu/
  - http://www.nanopolicy.gatech.edu

- Acknowledgements: The Center for Nanotechnology in Society (CNS-ASU) is supported by the National Science Foundation (NSF Awards 0531194 and 0937591). The findings and observations contained herein are those of the author and not necessarily those of NSF.