MEASURING IMPACTS AND OUTCOMES IN TECHNOLOGY ASSESSMENT RESEARCH CENTERS

A look at the NSF funded Center for Nanotechnology and Society – Arizona State University (CNS-ASU)

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BIG SOCIAL SCIENCE

Largest of two NSF funded Nano Research Center

- to investigate the societal implications of nano- & other emerging technologies.
- 2005-2016 Over 12 $Million
- @Arizona plus other research locations across the USA
    - Georgia Tech, University of Wisconsin, and other participants

to integrate academic and societal concerns to better understand how to govern new technologies, from their birth in the laboratory to their entrance into society.

- researching key issues, training a community of scholars, and engaging with publics, policy-makers, science, and industry.
- *Real Time Technology Assessment (RTTA)*
- but also to build *anticipatory governance networks* and
- to research and assess experimental methods of technology assessment.

Measuring impacts and outcomes for long term technology governance

- WHY: Anticipatory governance networks or any long term technology assessment strategy require ongoing resources
- ability to describe and justify the work on terms that funders, members of the public, and other academics can understand.
- assessment (description) helps to maintain valuable work that is being done,
- Also a chance to evaluate or gather together particular techniques or methods that have been effective in developing the capacity of communities to think about and thus potential make decisions or contribute to decision making about emerging technologies (anticipatory governance).

- CHALLENGE: Traditional metrics for center assessment (e.g., publication counts, citation analysis) demonstrate research impact within the immediate researcher community
- but fail to fully account for impacts across a broader community of publics that engaged with the Center.

- HOW: These impacts can take the form of learning and behavior (Guston 1999) and can be theorized to take place within the Center's Knowledge Value Collective (KVC,; Bozeman, 2007).

- METHOD: CNS-ASU impacts and outcomes assessment. Data was collected from a survey of Center participants (N=798) and pool of follow-up interviews (N=80) to develop causal outcomes narratives.

Tailored Design Method (Dillman, et al. 2008) emphasizing survey response as a social exchange within a community (rather than a cost/benefit economic exchange) N= 798, Response Rate 51.31%

- Questions on Concepts & Skills Development: CNS-ASU influence upon use of concepts by respondents was higher than influence upon use of skills/methods. This shows that a large part of the Center's activity related to concept work which circulated outside the immediate training community.
- Questions on identifying Impacts & Outcomes: Successively more persons are aware of the differing types of research impact, when impact type is arranged from formal to informal, from specific to general. The steady increase in number of participants aware of each new type in the successively arranged typology of outcomes/impacts (Guston 1999) gives empirical support to this understanding of impact/outcome types.
- Questions on Learning: Self-reported learning on the societal aspects of nanotechnology was highest among 'Museums and Science Educators' constituency- the Center chose early to allocate resources and strategic emphasis on working with informal science communicators. Constituencies that reported learning on the scientific and technical aspects of nanotechnology even included the 'Science and Engineering' constituency although NSE professionals showed slightly less learning than other constituencies.
- Measuring reflexivity: 'how much did you learn about the situation of other participants?' The mean self-reported learning about self and others (reflexivity) from all survey respondents was just below 'some'.

SOME PRELIMINARY RESULTS

From the survey follow-up interview participants were recruited for semi-structured interviews

N=80

These provide qualitative description of survey results or some cases contrary examples. Individual outcomes narratives were also collected.

REAL TIME TECHNOLOGY ASSESSMENT ANTICIPATORY GOVERNANCE NETWORKS

Premise: Nanotechnology innovation can be steered toward socially desirable goals by examining itself *in real-time*.

- if nanotechnology researchers are constantly assessing the outcomes of their work, they can make quicker decisions about how that work may be affecting society and can adjust their approach accordingly.
- engagement to develop public, researcher, and institutional capacity to govern emerging technologies, as well as
  - integrating public concerns into the research process

- RTTA 1: Research & Innovation Systems Analysis
  - **Textual search strategies in citation review** created a database of nanotechnology research articles containing 1.6 million citations covering over 20 years from 1990-2011. also developed a patent database that includes 116,000 nanotechnology patent applications and grants (from 71 patent offices worldwide including USPTO, EPO, WIPO, Chinese State Patent Office) and 91 countries covering the same time period.

RTTA 1

- RTTA 2: Public Opinion and Values Monitoring
  - **Survey work and media tracking strategies** about changing opinions regarding nanotechnology were used to follow
    - public opinion
    - scientific researcher opinion
    - mass media influences

RTTA 2

- RTTA 3: Anticipation & Deliberation Research
  - **New methods in anticipation and deliberation** engage science researchers and publics in considering potential futures through interactive educational events. Foresight is used to develop public, researcher, and institutional capacity to govern emerging technologies. Known as **Anticipatory Governance**, this is a signature concept developed to explain the work of CNS-ASU
    - **Foresight** work differs from simple forecasting which tries to predict the most likely future. Foresight methods consider alternative but plausible futures to strengthen our capacity to deal with unplanned scenarios.
    - **Material Deliberations** is the use of alternative formats of presentation or education or even art to enable a greater diversity of public participation in thinking and decision making about common technological futures (i.e. anticipatory governance). CNS-ASU worked with the entire network of US science museums to develop new nano and society discussions

RTTA 3

The Emerge event where artists and researchers work to redesign the future

Design students considered how new technologies might create different possible urban futures

RTTA 4

- RTTA 4: Integration & Reflexivity Research
  - **Socio-Technical Integration Research (STIR)** assesses the impact of research activities on the values and choices made by nanotechnology researchers
    - Laboratory ethnographies and participant observation were used to explore researcher opinion. Social scientists and 'embedded humanists' worked in labs alongside researchers to explore their opinions and concerns about the societal aspects of their research as well as learn more about the science from the researchers.
    - This research demonstrated that a large number of scientists already are interested and think about some of the societal aspects of their work and some welcome the opportunity.
    - future research include exploring new incentive structures in science careers to enable researchers to follow their interests in the societal implications of their work.
    - Reflexivity Scientists were encouraged to reflect upon their own role within the laboratory and within the greater science and innovation research systems to better understand the impacts of new technologies in society.
    - The social scientists and 'embedded humanists' who were encouraging reflexive thinking were also required to think reflexively and place themselves in the greater context of research and innovation policy. CNS researchers were also to be 'reflexive'

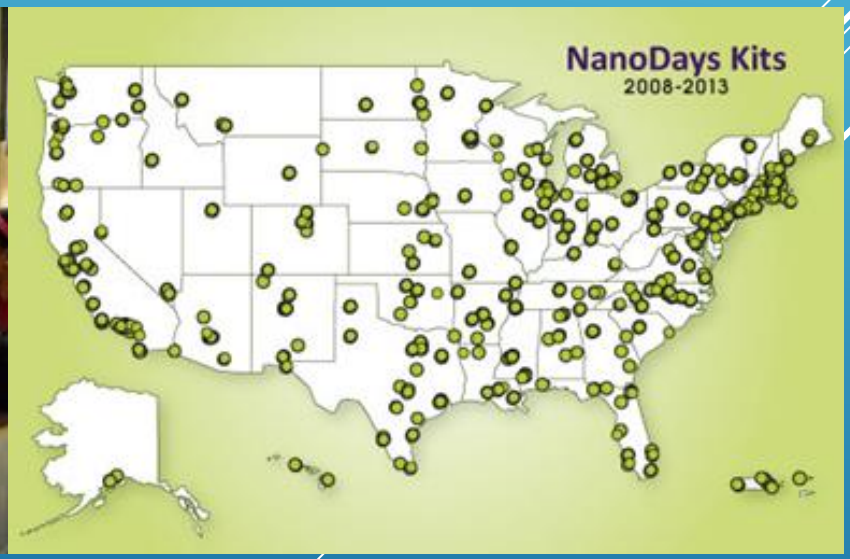
Student researchers getting new experience in a laboratory

SCIENCE MUSEUMS NISENET

- CNS researchers worked with museum educators helping to develop museum NanoDays appropriate to children, their parents, and the general public using games and displays. CNS developed a key partnering relationship with the Nanoscale Informal Science Education Network (NISENet) helping both organisations.

- A key finding of CNS-ASU outreach work was that cross-disciplinary and cross-sectoral partnering relationships take time and require a great deal of trust building. Successfully building alliances is not quick or selfish work.

Distribution of NanoDay Kits to Science Museums across the USA



- **Anticipatory Governance Networks?** Yes, there are methods for looking at these special types of impacts and outcomes
- primarily narrative and qualitative but also can be supplemented by quantitative measures
- These methods are still under development, being tested but in principle similar to what any good research centre evaluator already does intuitively

- Narrative description of outcomes is important for long term sustainability of technology governance networks
- But assessment can also be used to think through or evaluate what is working and what isn't

CONCLUSIONS

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Foresight for Responsible Research and Innovation Lab

Human Brain Project Foresight Lab