From Lab to Legislature

Public Value Mapping of Nanotechnology Policy in the Making

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Talk Outline

• Rationale and Framework
• Methods and Results
• Discussion and Follow-up Research
R&D Policy Discourse: Platform or Protection?

• Nanotechnology R&D policy discourse often invokes specific societal goals and values to justify investments
  “Enabling the blind to see and the deaf to hear” (Bond 2004)

• Does such discourse function primarily as a mechanism for promoting initial investments?
  Nano hype” (Berube 2005)
  Green nano (Schwartz 2009)

• Or might it function as a substantive platform that can inform and guide R&D efforts?
  “Enhancing [society and science] linkages in ways that can add to the value and capability of each sector” (Guston & Sarewitz 2001)
Guiding Research Question

• Too early to assess emerging technological trajectories in terms of policy discourses
• Not too early to investigate whether a coherent set of policy discourses underlies the R&D processes that shape these trajectories
• Can we identify a core set of discursive goals and rationales that
  - is reproduced over time?
  - extends throughout a continuous chain of R&D institutions?
  - is evident across multiple levels of R&D actors?
Public Value Mapping

• An underlying public value structure
  - Stable and coherent set of public value articulations for nanotechnology R&D
  - Suggestive of a collective commitment to specified public values that can be documented

• Science and innovation policy applications
  - Evaluation (“retrospective PVM”)
    • Which public values by which to evaluate R&D outcomes
  - Integration (“prospective PVM”)
    • Which public values might viably inform ongoing R&D efforts
      - Ongoing adjustments and alignments
      - Mid-course corrections
Socio-Material Layers STEP 1

Please list key challenges and choices available to each of the groups and to the project as a whole.

Physics
Are we ready to "plug + play"
Are we willing to carry the changes?
Could we test it by itself in a mockup system?

Reliable Data
Will assays or silver miniscale work?

Biochemistry
Electrochemical synthesis of AD, AD synthesis is required, parallel work now in cold storage.

Organic Chemistry
Are we ready to "plug + play"
Are we ready to separate samples?
Could we test it?

Biomedical Systems
From one way

Project as a Whole
We need to start building objects to discuss the bugs. When do we have time to organize them?

Parallel
Start building and testing components of the system.

CoLine
Amass success of P3

Bio Linear
Start building and testing components of the system.

Succeed

Back off

Hypothetical DEV Cell

Failure

Electrical Engineering

A R I Z O N A  S T A T E  U N I V E R S I T Y
Integration: STIR Project

• Three year NSF project ($540,000)
  - Investigate conditions for “Midstream Modulation” (Fisher et al. 2006)

• 20 laboratories on three continents
  - North America, Western Europe
    • Expand R&D practitioners’ perception of decision goals and alternatives
    • Feedback results into research setting in real-time

http://cns.asu.edu/stir/
Policy implementation

- A nested chain of principles and agents
- Laboratory practitioners as discretionary public servants or “Lab-Level Bureaucrats”

Insofar as possible, integrating research on societal, ethical, and environmental concerns with nanotechnology research and development (P. Law 108-153)

So that societal research influences the direction of ongoing nanotechnology research and development (HSC 2003)
research question
data collection
content analysis
results analysis
(factor analysis)
results interpretation
research question

Is there an underlying values structure in the policy discourse of nanoscale science and engineering?
research question

data collection

content analysis

results analysis
(factor analysis)

results interpretation
## data collection

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<th>Level</th>
<th>Discourse</th>
<th>Number</th>
<th>Source</th>
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<tr>
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</table>
data collection

Other selection criteria:


Lab level data was limited to NIRT, NER and NSEC programs
research question

data collection

content analysis

results analysis
(factor analysis)

results interpretation
content analysis

methodology considerations included:

1. A need to develop qualitative and quantitative approaches to PVM

2. massive amount of text

3. repeatability

4. don’t forget research question and dataset

method of choice: standard computer aided content analysis with statistical results analysis
research question

data collection

content analysis

results analysis
(factor analysis)

results interpretation
### search terms (n=84)

<table>
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<td>Emergency</td>
<td>Market</td>
<td>Supply and/or Demand</td>
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</table>
results analysis

method = factor analysis...

data reduction tool

common, low to moderately technical

ideal when working with constructs

(i.e. public values)

A common use of factor analysis is to define dimensions underlying existing measurement instruments which can correspond to constructs. (Green and Salkind 2008)
research question

data collection

content analysis

results analysis
(factor analysis)

results interpretation
results interpretation

3 clear factors:
security/defense (33%)
equity/economy (10%)
environment/energy (9%)
results interpretation

Component selection criteria:

Loading of .5 or higher within the factor

Loading of .4 or lower in other significant factors

Conceptually relevant

(consistent with convention in bibliometrics)
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<td>32.98</td>
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## Results Analysis

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Discussion

• The three primary value clusters that emerged
  - Encompass prominent social and public values
  - Are emphasized in government and scholarly literature on nanotechnology that was generated outside of the specific agency chains
  - Suggest close relations between each of the three paired sub-clusters
Security/Defense

• Advances in nanoscience and nanotechnology promise to have major implications for health, wealth, and peace” (Roco and Bainbridge 2001).

• It has been observed that military warfare, in general, is undergoing a dramatic revolution, a central characteristic of which is exploitation of emerging technologies (Krepinevich 1994).

• Why the most pervasive? Commentators have observed that nanotechnology has been characterized as going beyond other emerging technologies to the point of having the capability to “revolutionize warfare” (Lovy 2004).
“The Act [P. Law 108–153]mandates the establishment of a center and research into the societal and ethical consequences of nanotechnology. As a business proposition we must identify legitimate ethical and societal issues and address them as soon as possible.”

Philip J Bond (2003)
Undersecretary for Technology at the US Department of Commerce

US nanotechnology legislation embodies potentially contradictory mandates for both
- “rapid development” of nanotechnology
- “responsible development” of nanotechnology

Energy/Environment

• NSE has the potential “to increase the efficiency of lighting, enhance the performance of electronic devices, decrease waste and pollution during manufacturing...and provide more cost-effective solar energy conversion” (NSTC 2004)

• “Green Nano”

• Nanotechnology has potential to make significant impacts on “energy” and “environment” (NSTC 2007)
Discussion

• The research demonstrates
  - That mixed qualitative/quantitative approaches to value statements can provide a credible and robust basis for policy analysis

• The results have potential policy applications for
  - Evaluation
  - Integration

• The research does not reveal
  - Changes over time
  - Differences in emphasis of values across policy levels
  - *De facto* role of discourse as a platform for R&D efforts
Follow-up / Ongoing Research

• Differences among policy levels in public value articulation and inflection
  - “Unpacking” value clusters
    • Qualitative research
  - Changes over time in values articulation
    • Dynamic factor analysis
  - Theoretical paper on the role of discourse in
    • Policy implementation
    • Lab-level bureaucracy