STIR
SocioTechnical Integration Research

NSF

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?

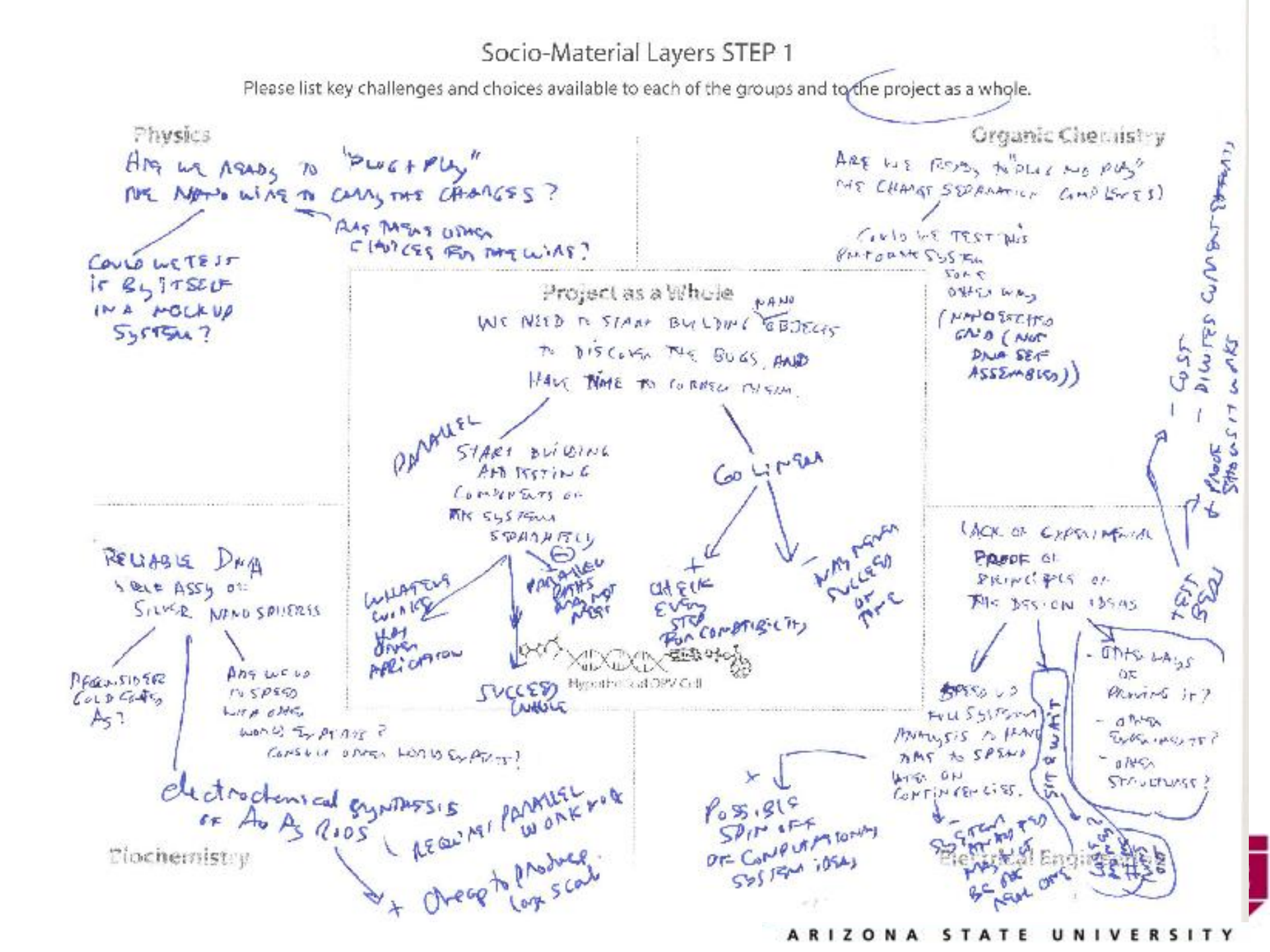
Public Value Mapping

- 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

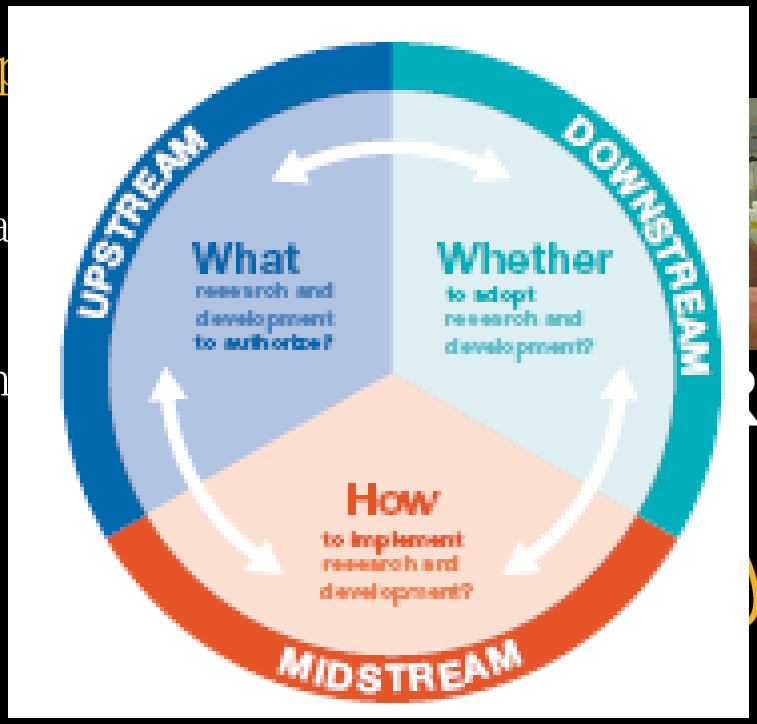
Socio-Material Layers STEP 1

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



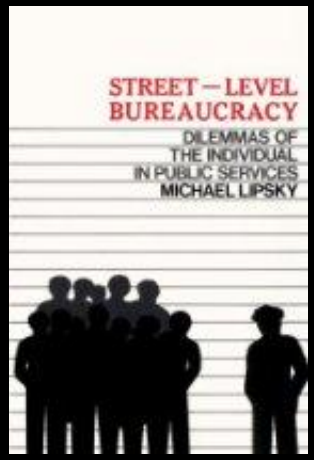
Integration: STIR Project

- Three year NSF project ($540,000)
  - Investigate conditions for "Midstream Modulation" (Fisher et al. 2006)
- 20 laboratories on three continents
  - North America, Western Europ
    - Expand R&D practitioners' perception of decision goals a 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”

LEGISLATURE
= Congress

AGENCY
= NSF

LABORATORY
= NSF awardees

“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

Level	Discourse	Number	Source
Congress	Reports	189	LoC
NSF	RFPs	96	NSF
Laboratory	Abstracts	735	awardsearch

data collection

Other selection criteria:

Time: 106-110th congresses (2000 to 2008)

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

results analysis

search terms (n=84)

Access	Developing	Hispanic	Renewable
Advanced Science	Discovery	Homeland	Renewable Energy
Afford	Disease	Infection	Rural
African American	Disseminate	Integrate	Security
Armed Forces	DOD	Justice	Servicemen
Atmosphere	Domestic	Knowledge	Smallpox
Attack	Durable	Leadership	Social
Basic Research	Economic Competition	Legal	Socioeconomic
Basic Science	Education	Low-cost	Soldier
Brain	Efficiency	Market	Supply and/or Demand
Business	Emergency	Medical	Surveillance
Cancer	EPA	MEMS	Technology Transfer
Clean Air	Equal	Military	Terror
Climate Change	Ethics	Minority	Toxic
Commerce	First Principles	Modeling	Training
Community	Flu	Native American	Under Represented
Company	Forefront	Oversight	Understand
Consumer	Gender	Product	Virus
Decentralized	Global Warming	Progressive	Waste
Defense	Greenhouse Gas	Proper Disposal	Weapon
Demand	High Performance	Reliable	Wound

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)

	Security & Defense	Equity & Economy	Energy & Environment
Defense	.981		
Military	.975		
DOD	.974		
Armed Forces	.890		
Attack	.756		
Weapon	.751		
Wound	.683		
Terror	.648		
Soldier	.630		
Community		.889	
Native American		.849	
Education		.839	
Minority		.824	
Hispanic		.808	
Social		.802	
Leadership		.775	
African American		.759	
Disseminate		.713	
Rural		.695	
Business		.661	
Market		.611	
Commerce		.592	
Efficiency			.631
Renewable Energy			.603
Renewable			.576
Clean Air			.531
Total Variance	32.98	10.05	8.64
Cumulative Variance	32.98	43.03	51.67

results analysis

Factor 1	Factor 2	Factor 3
Defense	Community	Efficiency
Military	Native	Renewable
DOD	American	Energy
Armed Forces	Education	Renewable
Attack	Minority	Clean Air
Weapon	Hispanic	
Wound	Social	
Terror	Leadership	
Soldier	African	
	American	
	Disseminate	
	Rural	
	Business	
	Market	
	Commerce	

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).

Equity/Economy

"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

Fisher & Mahajan (2006)

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

questions?

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