Nanotechnology Multi-Stakeholder Risk Perception: Implications for Risk Analysis, Management, and Communication

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Main points of talk

• Responsible, ethical risk analysis, management and communication are key parts of responsible development
• Depend on good evidence about risks, and about society
• Emerging evidence from systematic research on key stakeholder groups
• Implications for multi-stakeholder dialogue
NAS 2006: “**responsible development** [of nanotechnologies] ... implies a commitment to develop and use technology to help meet the most pressing human and societal needs, while making every reasonable effort to anticipate and mitigate adverse implications or unintended consequences.”

Maximize benefits

Minimize negative consequences

- Environmental
- Social
- Economic
- Risk/harm
Who are the stakeholders?

- Scientists & Engineers
- Regulators
- Nano EH&S
- MNM Industry
- NGOs
- Publics

NNI Nanoscale Technologies
Perceptions of Nanotechnologies

- Survey and Experimental Research
- Qualitative / Deliberative Fora
Who are the relevant public(s)?

- Democratic participation:
  - Self selected (e.g., GM Nation—worried; NISEnet—interested science museum)
  - “Invited public” (UCSB and ASU deliberative research—quasi-representative)
  - Representative research sample (UCSB/UBC/Cardiff, ASU/UW-Madison, others)
  - NGOs--activated for a reason (environmental, consumer safety, \textit{local} issues)
Public perceptions of nanotechnology risks and benefits: Benefit centric, but high uncertainty and potential malleability

Based on quantitative metaanalysis of 22 studies 2002-2009 in N Am, Europe, and Japan

Trust and affect:
- Trust asymmetry prevails
- Mobility of views likely in the face of news
- But, benefit perception bigger driver than risk perception—positive regulatory actions move views
- → a particular opportunity for dialogue
- Same study shows more mobility of views when bad news follows good—benefit only communication risky!

Based on phone survey of US public n=1,100

Public has distinct views on upstream ethics, linked to environmental acceptability of nanotechnologies

- It is possible and appropriate for the pub to influence key decisions
- Everyone, even those who lack tech knowledge, is qual to have input
- It is possible to have a fruitful public debate
- The public should be consulted
- Often ben rich and harm poor
- Unethical bc manipulating substances is playing a role meant for the creator
- It is unethical to spend limited resources on devel that may not ben everyone
- Acceptable to devel if used in important applications
- Reasonable to assume appropriate for society; or wouldn't be devel
- I believe that everyone should be fully informed/given a chance to accept or oppose
- Before devel we must consider who might ben or be harmed

Based on web survey of US public n=697

- Value a role for the public
- Equity and power
- Informed consent to develop
- Institutional trust

Collins, Hanna, Satterfield & Harthorn, 2013 in progress
Examples of Qualitative / Deliberative Approaches to Nanotechnology Assessment

**UK**
- Nanotechnology Risk and Sustainability (2004/5)
- NanoJury UK (2005)
- Nanodialogues (2005/6)
- Smalltalk (2005/6)
- ‘Which’ Citizen NanoSummit (07)
- DEEPEN (2008-9)

**USA**
- Madison Area Citizens’ Consensus Conference (2005)
- CNS-UCSB Gender Deliberation (2009)

**USA/UK**
- CNS-UCSB Santa Barbara/Cardiff Workshops (2007)

**Continental Europe**
- Various (Netherlands, Switzerland, France, Germany, Portugal)

**New Zealand**
- McDarmaid Inst (2005)
“Nanotechnologies and Upstream Public Engagement: Dilemmas, Debates and Prospects?”

Comparative review of 18 nano deliberation projects in N. America and Europe

- Informed judgment, rather than intuitive, ‘fast’ thinking
- Benefit centricity quite widespread
- But also, latent ambivalence, unaffected by increased knowledge and awareness
  - Skepticism toward government & industry
  - Concern about who represents the public’s interests
  - Question the need for the product at all
- These latter are social, not technical, risk issues and predominate in US and UK deliberations (Pidgeon, Harthorn et al. 2009)

- Cautionary note: impact of public engagement often far harder to evaluate than processes themselves (Bickerstaff et al. 2010)

Group vs. individual decision making: Gendered aspects of talk in US nano deliberation

- Men speak more than women and use more intrusive interruptions in deliberations on nano
- Whites use more intrusive interruptions than people of color
- Women speak more, use more backchannels/cooperative overlaps, and use more self-disclosure when discussing health and human enhancement applications vs. energy/environment applications
- Men’s patterns of talk do not vary across applications

**Implications:** subtle and overt group dynamics play a major role in deliberative settings, largely unexamined thus far

*Source: Cranfill, Denes, Hanna, Shearer, Bryant and Harthorn, 2013. Under revision.*
“Nanotechnology Risk Perceptions and Communication: Emerging Technology, Emerging Challenges”

Upstream research issues--Conceptual & Methodological

- Nanotechnologies v. diverse
- Applications v. diverse
- Unfamiliar & intangible concept
- Few analogies for mental models or RP
- Deeper ethics and values issues
- Unpacking benefit perception
- Role & impacts of dialogue processes

Risk communication

- Anticipatory dialogue (=upstream engagement)

Source: Pidgeon, Harthorn & Satterfield 2011 Risk Analysis: 1694-1700
Summary: Public perceptions of benefits & risks of nanotechnologies are contingent on:

- Toxicology—risk signal effects strong in experimental studies; but also:
- Publics’ ongoing low familiarity/unformed views—benefit centricity anchored in positive views of ‘new tech’
- High uncertainty linked w/ need for information
- Media coverage low & mixed message; changing media environment
- Inequality/social justice--gender, race, other social differences; vulnerability
- Trust in or betrayal by government and industry
- Application-specific views—e.g., nano food unacceptable even if all contextual features are positive (Conti et al. 2011)
- Environmental values--resilience, environmental justice
- New tech = job loss? (Scheufele et al. 2007)
Perceptions of Nanotechnologies

183 Organizations in database
88 “nano engaged” organizations

Nanotechnology issues?
- Consumer safety
- Environmental protection
- Other issues: development and human health

Specific nano-materials?
- No, nanotechnology, generally
- Nanosilver
- Titanium dioxide

Goals?
- Increased EHS research
- Product labeling
- Government oversight
- Public participation

Tactics?
- Issue reports, public statements, press releases
- Lawsuits and legal petitions
- Industry collaboration, forums

Engeman & Harthorn 2013 Research in Progress
Perceptions of Nanotechnologies

- Mixed interview/survey methods
- Qualitative/engagement dialogue

* MNM = manufactured nanomaterials
Nano Industry EHS and Risk Perception

29% of respondents uncertain re: risks of 6 types of ENMs. Combined ‘don’t know’ plus moderate-high risk per type = 64% (metal oxides) - 83% (quantum dots)

Engeman et al. JNR (2012) 14:749-760

2010 phone and web survey of 78 MNM companies in 14 countries
1. It is reasonable to assume that industries working with nanomaterials will adapt or alter their safe-handling practices when new hazards are discovered.

2. Businesses are better informed about their own workplace safety needs than are government agencies.

3. Industries working with nanomaterials can be trusted to regulate the safe-handling of these materials.

4. Voluntary reporting approaches for risk management are effective for protecting human health and the environment.

5. Employees are ultimately responsible for their own safety at work.
1. In my company, we worry that nanotechnologies may encounter unwarranted public backlash such as that which accompanied genetically modified foods in Europe (59% agree).

2. Insurers in my industry are increasingly concerned about nano-specific risks (34% agree; 40% don’t know; 30% disagree).

3. Direct involvement of citizens in policy decisions about research and development of new technologies is beneficial (55% disagree).

Source: Engeman et al. 2010 int’l survey results.
Perceptions of Nanotechnologies

- Survey and Experimental Research
- Qualitative approaches

Photo credit UCSB CNSI
Scientists’ and Regulators’ ENM Risk vs. Benefit Perceptions—Benefits outweigh the risks, but notable group differences

**Source:** Beaudrie, Satterfield, Kandlikar, & Harthorn 2013 under review
Scientists’ and Regulators’ MNM Risk and Benefit Perceptions—Application context effects & group differences

Web-survey of 424 nano experts on their views of MNM risk and regulation

NSE – Nanosci and engineers
NTOX – Nano EHS researchers
NREG – Nano regulators, risk assessors in govt

Occupational Settings a,b,c
Air or Water emissions - Production b
Children’s Toys b
Industrial Waste Products b
Environmental Releases from Consumer Products NS
Food Ingredients NS
Cosmetics b
Cleaning Products b
Fuel Additives b
Vitamins & Supplements NS
Clothing b
Drug delivery NS
Environmental Remediation NS
Computer Chips a,b

a - NSE & NTOX
b - NSE & NREG
p < .05
c - NTOX & NREG

Almost no risk
Slight risk
Moderate risk
High risk

Experts’ risk perceptions differ by gender

- Children’s Toys *
- Air or Water emissions - Production *
- Environmental Releases from Consumer Products *
- Occupational Settings *
- Food Ingredients *
- Cosmetics *
- Vitamins & Supplements *
- Fuel Additives *
- Drug delivery *
- Industrial Waste Products *
- Cleaning Products *
- Clothing
- Environmental Remediation
- Computer Chips *

* p<0.05

Experts workshop: Nanotech Risk Screening Using a Structured Decision Making Approach

May 24-25 at UBC, Vancouver, Canada

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Structured Decision Making (SDM) approach

- Appropriate when decisions are characterized by:
  - Complexity and uncertainty
  - Difficult judgments – weighing the science, consequences of alternatives, priorities, risk tolerances
  - High stakes, limited resources

- Engages experts and decision makers in productive decision-oriented analysis and dialogue

Source: Beaudrie, Kandlikar, Long, Gregory, Wilson & Satterfield 2013
Experts workshop: Nanotech Risk Screening Using a Structured Decision Making Approach

Project

- **Phase I - Ideation (UBC Expert Workshop)**
  - Framework Confirmation & Testing
  - Initial Concept
- **Phase II - Proof of Concept**
  - Structural and Logical Framework
  - Prototype NRST web tool
  - Peer Verification
- **Phase III - Deployment and Integration**
  - Web + database implementation
  - Integration and Deployment

NRST = Nanomaterial Risk Screening Tool; mockup at nanoscreen.org

Report available at: www.cns.ucsb.edu

Source: Beaudrie, Kandlikar, Long, Gregory, Wilson & Satterfield 2013
A Multi-Stakeholder Perspective on the Use of Alternative Test Strategies for Nanomaterial Safety Assessment

Andre E. Nel, Elina Nasser, Hilary Godwin, David Avery, Tina Bahadori, Lynn Bergeson, Elizabeth Bery, James C. Bonner, Darrell Boverhof, Janet Carter, Vince Castranova, J. R. DeShazo, Saber M. Hussain, Agnes B. Kane, Frederick Klaessig, Eileen Kuempel, Mark LaFranchi, Robert Landsiedel, Timothy Malloy, Mary Beth Miller, Jeffery Morris, Kenneth Moss, Gunter Oberdorster, Kent Pinkerton, Richard C. Pleus, Jo Anne Shatkin, Russell Thomas, Thabet Tolaymat, Amy Wang, and Jeffrey Wong

ABSTRACT There has been a conceptual shift in toxicological studies from describing what happens to explaining how the adverse outcome occurs, thereby enabling a deeper and improved understanding of how biomolecular and mechanistic profiling can inform hazard identification and improve risk assessment. Compared to traditional toxicology methods, which have a heavy reliance on animals, new approaches to generate toxicological data are becoming available for the safety assessment of chemicals, including high-throughput and high-content screening (HTS, HCS). With the emergence of nanotechnology, the exponential increase in the total number of engineered nanomaterials (ENMs) in research, development, and commercialization requires a robust scientific approach to screen ENM safety in humans and the environment rapidly and efficiently. Spurred by the developments in chemical testing, a promising new toxicological paradigm for ENMs is to use alternative test strategies (ATS), which reduce reliance on animal testing through the use of in vitro and in silico methods such as HTS, HCS, and computational modeling. Furthermore, this allows for the comparative analysis of large numbers of ENMs simultaneously and for hazard assessment at various stages of the product development process and overall life cycle. Using carbon nanotubes as a case study, a workshop bringing together national and international leaders from government, industry, and academia was convened at the University of California, Los Angeles, to discuss the utility of ATS for decision-making analyses of ENMs. After lively discussions, a short list of generally shared viewpoints on this topic was generated, including a general view that ATS approaches for ENMs can significantly benefit chemical safety analysis.
Main points/issues/questions

1) *All* stakeholders have perceptions of benefit and risk that affect their views of problems, processes, and solutions. Systematic mixed methods research comparing these complex, contingent & dynamic views is important for risk analysis & communication and responsible development.

2) Technical risk data alone won’t effect decisions—judgments will be involved, by different stakeholders, with varying biases, values, and stances, and differing levels of power and interest; better outcomes if address.

3) (Some) scientists and industry are ambivalent about public; (some) publics are ambivalent about technology, industry & government—upstream/midstream dialogue and incorporation of *social risk issues* likely important.

4) Novel multi-stakeholder collaborations using cutting edge methods merit full attention.

5) Where is there *meaningful* change from engagement and participation? (e.g., UK Royal Society 2004, Responsible Nano Forum 2009).

6) Do nanotechnologies pose novel challenges for risk assessment, management & communication?
• Research participants in all these different communities
• Lead collaborators: Terre Satterfield at University of British Columbia and Nick Pidgeon at Cardiff Univ, UK
• Colleagues, collaborators, students, and postdocs in the CNS-UCSB and UC CEIN, in particular: Milind Kandlikar & Christian Beaudrie (UBC), Paul Slovic & Robin Gregory (Decision Research), Shannon Hanna (NIST), Mary Collins (UMD), Patricia Holden & Cassandra Engeman (UCSB), and Hilary Godwin & Andre Nel (UCLA).
• NSF cooperative agreements #SES 0531184 and #SES 0938099 to the Center for Nanotechnology in Society at UCSB. And NSF & EPA cooperative agreement #DBI 0830117 to the UC CEIN. Views expressed here are those of the author and do not necessarily reflect the views of the NSF or EPA.
Democratizing Technologies: Assessing the roles of NGOs in shaping technological futures


- To what extent, and in what areas, are NGOs attempting to fill the governance roles traditionally provided by nation states – and with what results?

- When are the agendas and policies advocated by NGOs adopted by states or in international agreements? When do industries or companies respond to NGO-advocated standards?

- How are new media changing the landscape for NGO engagement, participation, recruitment and dissemination?