

Nanotechnologies in Food & Agriculture: Potential Applications and Implications for Governance and Public Participation

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2008 Annual Conference

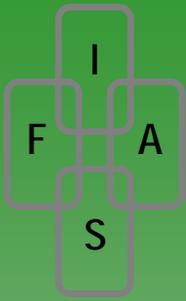
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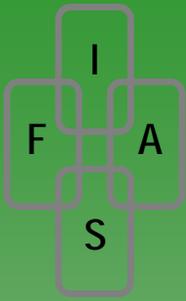
Why 'Agrifood Nanotech?'

- The use of nanotechnology to develop beneficial foods and smart packaging presents a huge commercial opportunity in agrifood sector.
- A Helmut Kaiser Consultancy report estimates the global nanotech food market will exceed \$20.4 billion by 2010.
- More than 180 applications in different stages of development and several on market today.
- More than 200 companies around the world presently engaged in agrifood nanotech R&D.
- Holds promise for more sustainable and safer methods of food & fiber production, monitoring, and management.



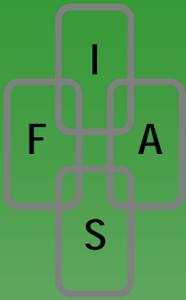
However...

- Comparatively little attention to oversight issues.
- Little information about R&D and products in public domain.
- Little information about health & safety studies in public domain.
- Potentially overlapping or missing jurisdiction for products and processes.



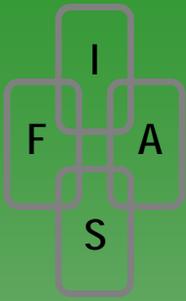
Session Goals

- **Provide background on:**
 - **National Nanotechnology Initiative (NNI)**
 - **Nanotechnology Definition**
 - **MSU Agrifood Nanotech Project**
 - **Potential Applications of Nano in Food & Agriculture (‘Agrifood’)**
 - **Key Governance & Participation Issues**
- **Explore with you the concerns & governance issues you associate with the development and introduction of agrifood nanotechnologies**



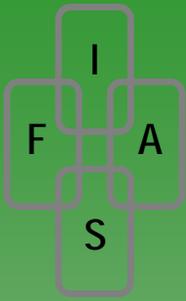
National Nanotechnology Initiative (NNI) Support for 'Societal Dimensions' Projects

- NNI created in 2001 (enacted 2003) to coordinate federal multi-agency R&D efforts in nano-science and technology.
 - 27 Departments/Agencies currently participating.
- NNI investments for 2005-06 in the vicinity of \$1.05 billion, with \$82 million devoted to 'Societal Dimensions.'
- MSU Agrifood Nanotechnology Project (2004-09) one of several 'Societal Dimensions' projects funded through NNI (NSF); the only one to examine societal issues in agrifood supply chains.
 - 'Multi-Disciplinary' -- Mechanical & Chemical Egr; Philosophy; Food Nutrition Sciences; Anthropology; Packaging; Agricultural Economics; Sociology.
 - Conducted through MSU's Institute for Food & Agricultural Standards (IFAS).



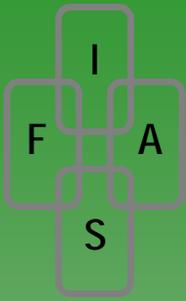
Defining Nanotechnology

- **NNI defines nanotechnology as:**
 - The understanding and control of matter at dimensions of roughly 1 to 100 nanometers, where *unique phenomena* enable novel applications. Encompassing nanoscale science, engineering and technology, nanotechnology involves imaging, measuring, modeling, & manipulating *unique qualities of matter* at this length scale.
 - Note that ‘nanotechnology’ is not a ‘thing.’



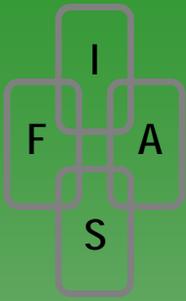
IFAS Agrifood Nanotechnology Project at Michigan State University

- Focus on ‘Societal Dimensions,’ with four primary activities:
 - **Conferences, Workshops, Seminars (to inform)**
 - Social Research, Interviews with Key Stakeholders (to inform)
 - Educational Materials geared toward societal dimensions of nanotechnologies in food and agriculture
 - **Develop models of public engagement around agrifood nanotechnologies**



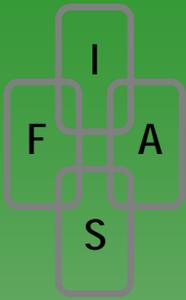
IFAS Nanotechnology Conferences & Workshops

- What Can Nano Learn from Bio?
 - Kellogg Conference Center, MSU, October 2005
- Nanotechnology Standards Workshop
 - Cowles House, MSU, September 2006
- What Is ‘Agrifood Nanotechnology?’
 - Marriott Conference Center, East Lansing, MI, April 2007

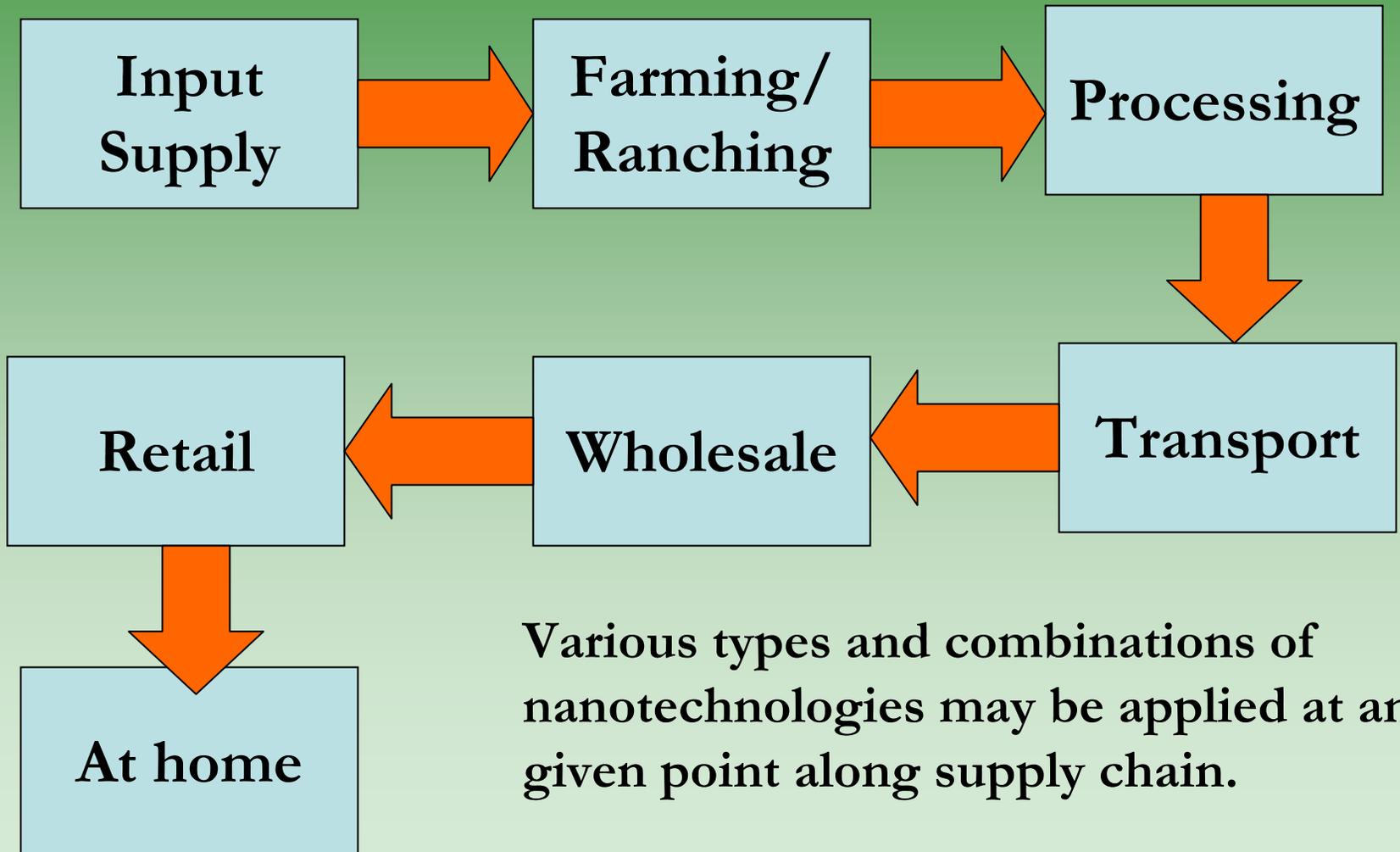


What Is 'Agrifood Nanotechnology' Workshop

- Presentations by 18 international panelists representing government, NGOs, business & industry, labor, media, and academic and technical disciplines
- Explore potential applications and their implications for agrifood 'governance' and public participation in agrifood governance systems



Organizing Principle: Agrifood Supply Chain



APPLICATIONS...



Tailored chemicals

Smart Packaging
Nanofilters
Lowfat ice cream

Distributed
Intelligence
Precision Farming

Farming/

Processing

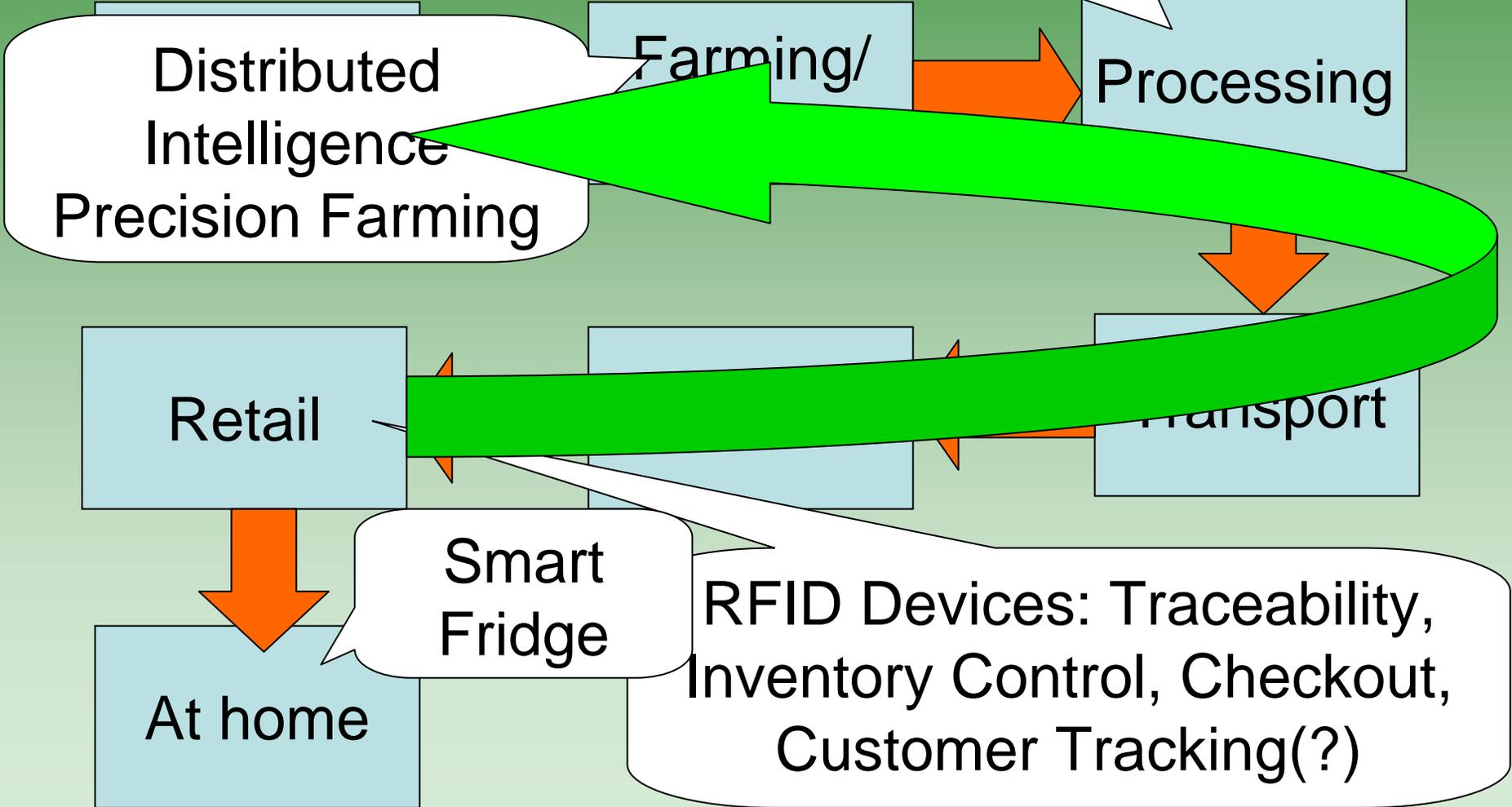
Retail

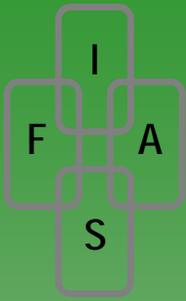
Transport

At home

Smart
Fridge

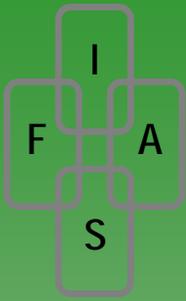
RFID Devices: Traceability,
Inventory Control, Checkout,
Customer Tracking(?)





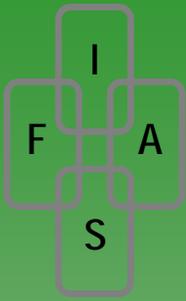
Agrifood Nanotechnology: Potential & Emerging Applications

- Randomly sampled from IFAS' database of print media coverage and its “What is Agrifood Nanotechnology” workshop presentations.
- Note “In Food” versus “Surrounding Food” Applications.



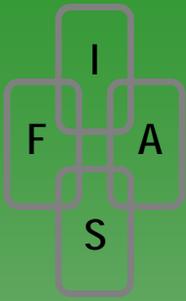
Potential & Emerging Applications ‘In Food:’ Nutritional Enhancement, Nutraceuticals

- Company develops ‘nanotech antioxidant system’
 - Means for introducing antioxidants into food and beverage products more easily
 - Increases nutrient uptake
- Food and Pharma convergence
 - Toward prescriptive disease prevention diets
 - Toward personalized nutrition
 - Convergence with genomic information
 - Toward a new ‘ethnic food’ – ‘for’ a people vs ‘of’ a people?



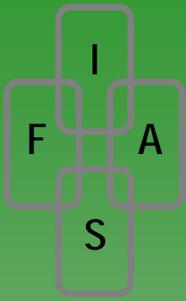
Potential & Emerging Applications: 'Surrounding Food'

- 'Smart' Dust – Sensors, Fertilizers, Pesticides; 'spot management'
- 'Nano-Nose' – e.g., monitor food spoilage, CAFO air quality, etc.
- Nano-microbial thin films – sense, signal microbial & chemical changes to food, increase shelf life
- Conductive 'Nano-Inks' – direct printing of electronic circuits onto food packaging, monitoring
- Nano-catalyst ceramics – prolong life of deep-fryer oils, reduces waste & cuts costs
- Nano-metal coatings of hollow microspheres – recoverable & reusable in waste water filtration of animal and post-consumer wastes, food processing effluent.
- Nano-RFID – livestock ID, track/trace; retail monitoring upstream product control
 - Concerns over data ownership/control; privacy/proprietary information; downstream concentration of power



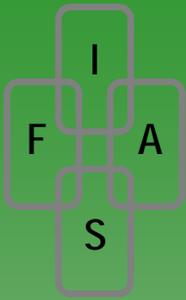
Emerging Issues in Agrifood Nanotechnology Applications

- “Agrifood Nanotechnology” (singular) is at best an oversimplification and potentially confusing from governance/participation perspectives.
- Any given nanotechnology may have additional applications across multiple sectors, thereby blurring traditional distinctions among sector-specific technologies.
 - e.g., Nano-engineered distributed sensors in conjunction w/nano pesticides & fertilizers will likely require new cooperative arrangements among EPA, FCC, FDA, USDA, NOAA and other agencies to cover regulatory ambiguity



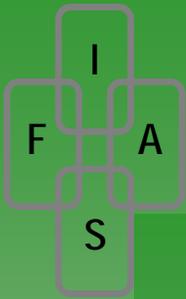
Lessons from the Debate over Agrifood Biotechnology and GMOs

- Social experience with agricultural biotech to inform development of agrifood nanotech
- Diverse Speakers, Participants
 - Consumer groups
 - Industry
 - Labor
 - Regulatory agencies
 - Academics from technical, legal, and social sciences



Key Issues Identified

- Agrifood-biotech experience different than pharma-biotech
- Food is socially very sensitive
 - Same basic technology, however...
 - “You can shoot it in my veins but don’t **make** me eat it.”
 - Power, Control, Access, and ‘Voice’
- **Public perception “reactive engagement”**
 - Little to no participation in technical applications, product development, **standards** promulgation
- Book published in 2008 (Elsevier)... contact me for details.



Key Lessons, Next Steps

- Perceived failure to engage diverse stakeholders and other potentially affected groups in dialogue during standards development

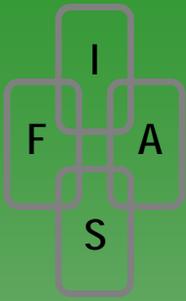


- Early dialogue among diverse interests should precede development of standards for nanotechnologies



- From dialogue, chart 'Issues Landscape' as roadmap to guide actions of all parties





Second International IFAS Workshop on Nanotechnology

An Issues Landscape for Nanotechnology Standards

Contact me for details –
hardcopy/electronic access

AN ISSUES LANDSCAPE FOR NANOTECHNOLOGY STANDARDS: Report of a Workshop

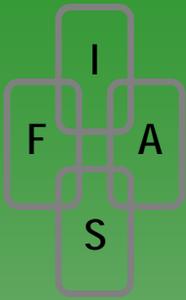
Cowles House, 11-12 September 2006



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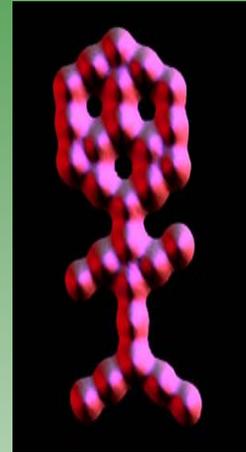
March 2007

Why Standards?



Technical Compatibility

- Standards generally considered convenient, neutral, and benign means for handling technical compatibility



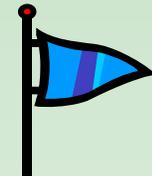
Social Power

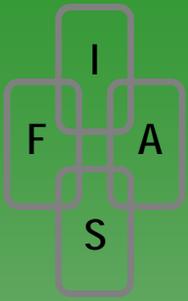
- Social power reflected in ability to set rules others must follow
- Standards represent form of codified power reflecting interests of groups with greatest access to and influence within standards setting processes

Whose Standards?

While many people and institutions recognize and broadly support role of standards in general, controversy often ensues as they confront the question:

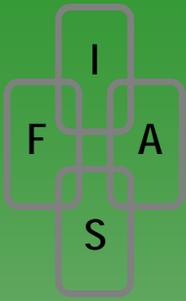
‘Whose Standards?’





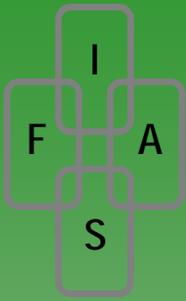
IFAS Nanotechnology Standards Workshop Participants and Goal

- 40 panelists representing government, NGOs, business & industry, labor, media, trades associations, standards-setting bodies, and academic and technical disciplines.
- Goal was **not** to necessarily establish *consensus*, but rather to chart the diverse ‘issues landscape’ across which the standards deliberations of organizations confronting emerging nanotechnologies must necessarily proceed.



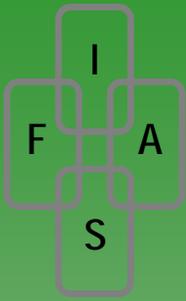
Five Critical Standards Themes

- Timing
- Product vs. Process
- Operational Integration
- International Harmonization
- Participation and Transparency



Timing and Standards-Setting

“Standards will need to be developed (early) for... nanotechnology research, production, products, and waste disposal.”

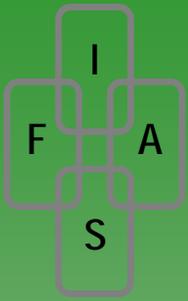


Product ('in food') Versus Process (‘surrounding food’) Standards

“Addressing issues of risk will require thinking about standards in a manner that is much broader than risk assessment itself.”

e.g., ‘Nano-bread’

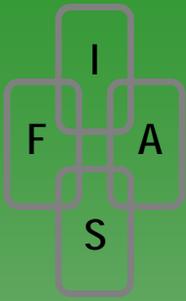
“Decisions regarding whether to employ product or process standards may vary by sector of economic activity...”



Integration of Operational Standards

“Integration of diverse standards... is likely to pose new challenges for governmental regulation and non-governmental standards.”

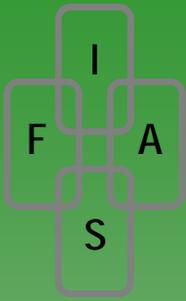
“Global integration will require cooperation among competing institutions.”



International Harmonization

“Developing countries must have a say in international nanotechnology standards development...”

- Potential conflicts over Access, Ownership, Control
- e.g., Standards ‘Makers’ vs. Standards ‘Takers’



Participation and Transparency: Social Access, 'Voice' & Power

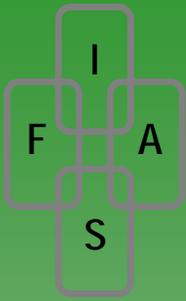
“Be sensitive to culturally appropriate forms of participation.”

“Protect minority perspectives from ‘tyranny of the masses,’ consider social justice dimensions.”

“Decision-makers... must remain open to being educated by participants about the social contexts of their concerns...”

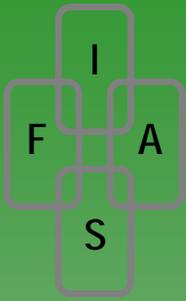
Key Lesson: Participation is as much about *educating policy-makers and technologists* about the social contexts of technological innovation as it is educating lay publics about the science & technology underlying those innovations.

- e.g., AFDO Collaboration with IFAS on USDA engagement proposal (pending)



NNI & Public Engagement

- Public Participation and Nanotechnology Workshop, Arlington, VA, May 2006
 - 175 participants from government, industry, media, NGO, academia – various disciplinary perspectives
 - Two broad approaches
 - Traditional: ‘Centralized,’ top-down, public education, reactive, ‘rational choice’
 - Town Halls, Public Meetings, Museums, etc.
 - Non-traditional: ‘Decentralized,’ Bottom-up, decision-maker learning, risk perception/cultural rationality, social context & action
 - Ethnography (e.g., Risk Perception Mapping), Extension

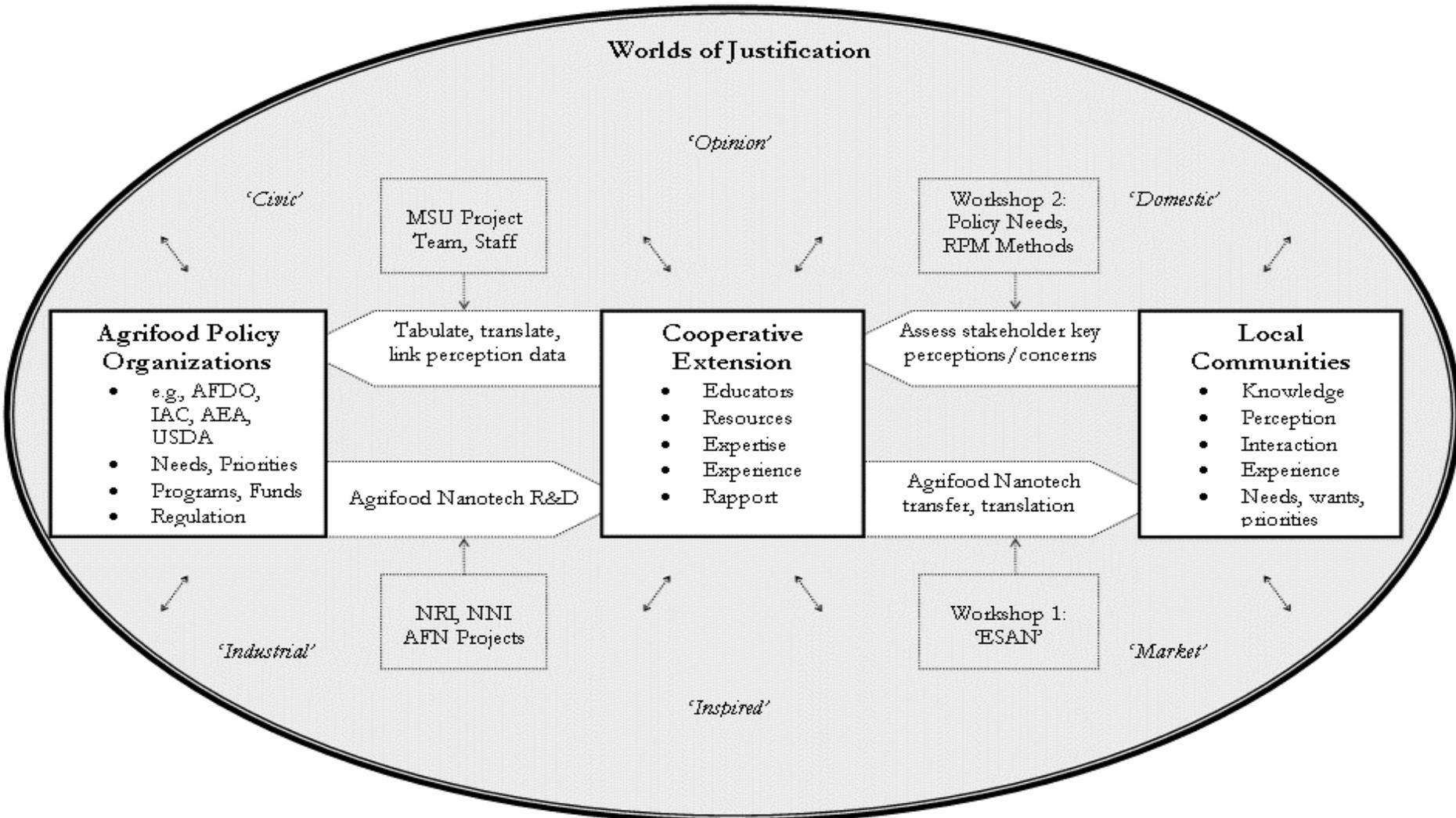


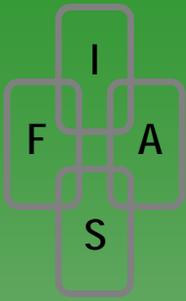
Cultural Context and ‘Local Knowledge’ in Public Engagement: Lessons for Nano

- RPM & LLRW in Michigan
 - Amish cultural dislocation and ‘known’ vs ‘unknown’
 - Demographic vs. behavioral categories, social response
 - Milksheds, Physical vs. social distance/networks
- Culture and Fish Consumption Advisories
 - ‘Mushrat’ & ‘Kukko’
- Buckminster Fuller, ‘Buckyballs,’ and Dymaxion Houses...
- ‘Informal’ Nano-Engagement: Of Cosmetologists and Appliance Salespersons and...



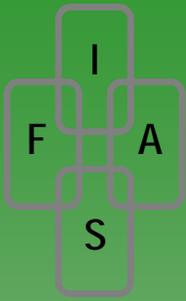
An Iterative, Extension Approach to Public Engagement for Agrifood Nanotechnologies





Pending Project's Broad Goals

- Use Extension to complement public understanding of agrifood nanoscience & tech with greater scientific understanding of the public.
- Inform/enhance socially responsive policies for agrifood nanotechnologies at national, state, and populations-specific levels (i.e., fit projects/technologies to people rather than vice versa).
- Transform agrifood nanotechnology from a purely technical endeavor which is then 'transferred' to the general public to a *socio-technical* or 'co-productive' process in which local knowledge is systematically documented & transferred upstream to inform agrifood nano policies.
- Heed the sociological lessons of what can happen when people don't come first – unnecessary financial cost, significant social disruption, and occasionally social rejection of emerging technologies.



Your Thoughts and Comments are Always Welcome

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