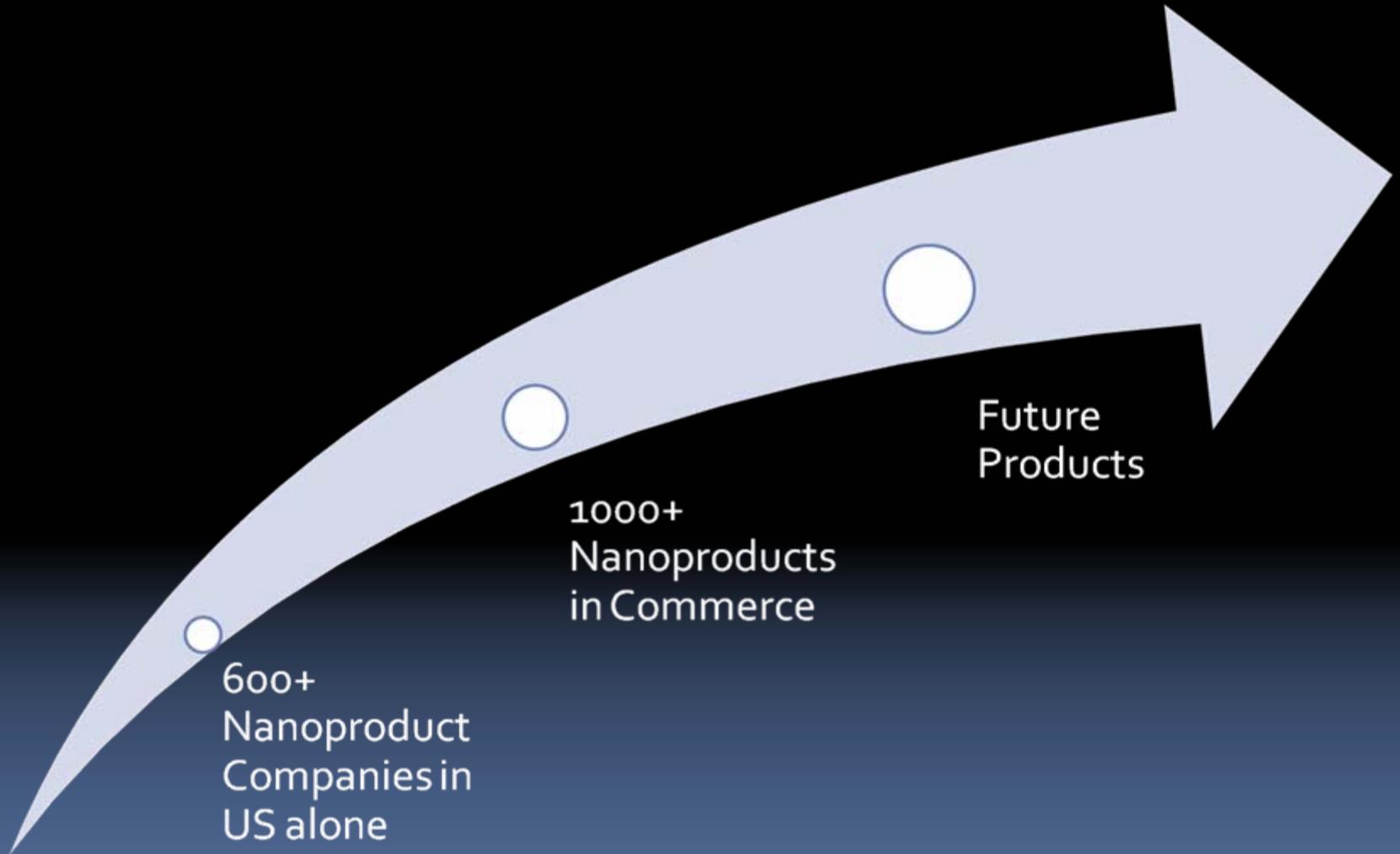


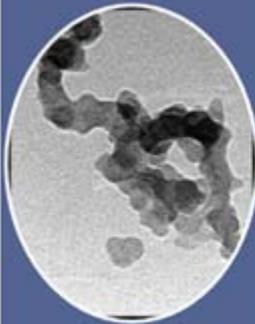
The Business of Nanotechnology

Mary Beth Miller
Unidym
March 19, 2009

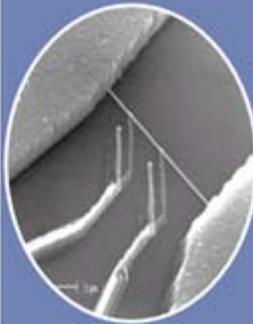
Overview



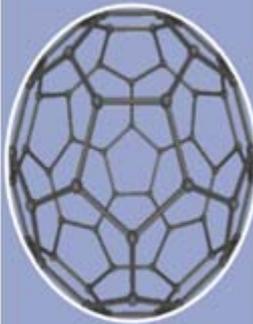
Types of Nanomaterials



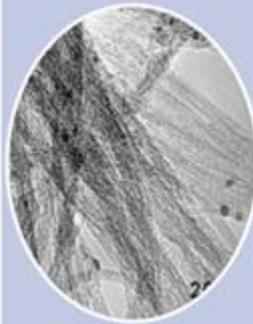
Diesel Exhaust



Ag Nanoparticles



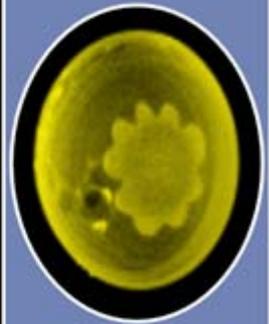
Fullerenes



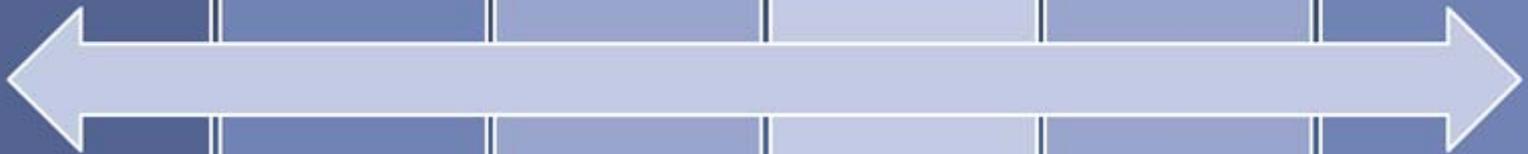
Carbon Nanotubes



Quantum Dots



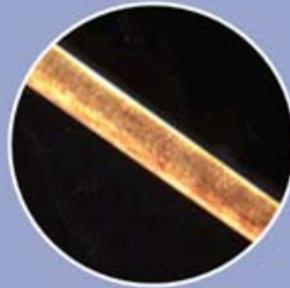
Liposomes



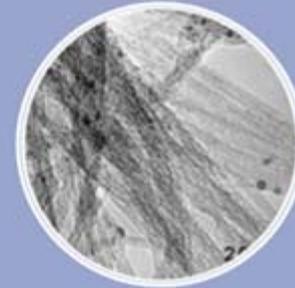
Macro v. Nano Relationship



Penny=
19,000,000
nm



Human
Hair=
100,000 nm



CNT=
1 nm D x
100 nm L



Potential for Nanotechnology

- Clean, renewable energy production and utilization
- Global clean water supply
- Human health improvement
- Preservation and healing of the environment
- Pollution Prevention
 - Electronic/material replacements
 - Less mass/less waste

Concerns with Nanotechnology

- Differing properties at nanoscale than macroscale
 - Quantum and surface mechanical changes
- Potential Interaction w/biomaterials
- Catalytic reactions

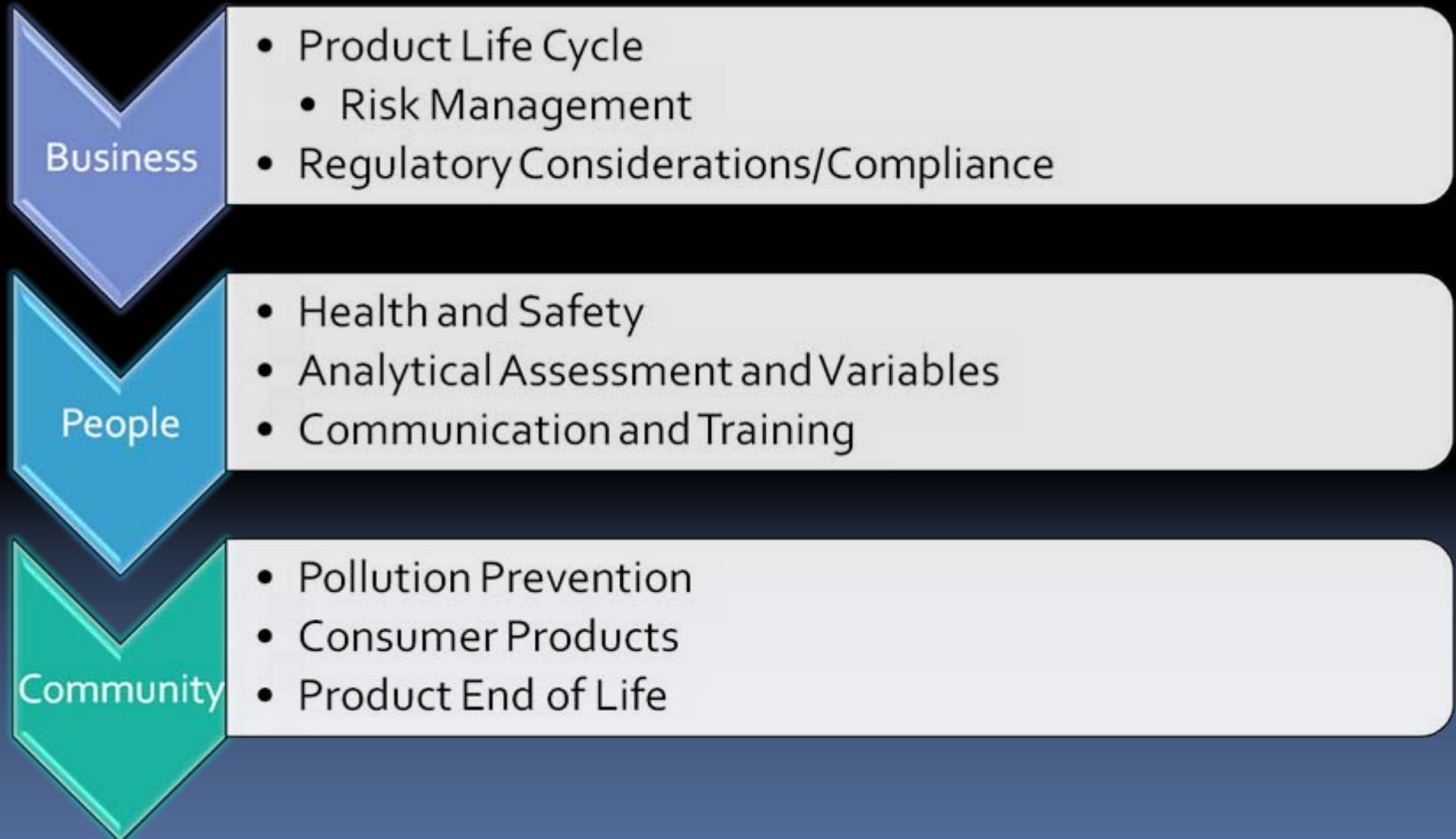
Business

- Balance between exploration of emerging technology v. potential hazards
 - Real risks are unknown
 - Perceived risks are not determined
- Meet needs for information
 - Employees
 - Community
 - Regulatory Agencies

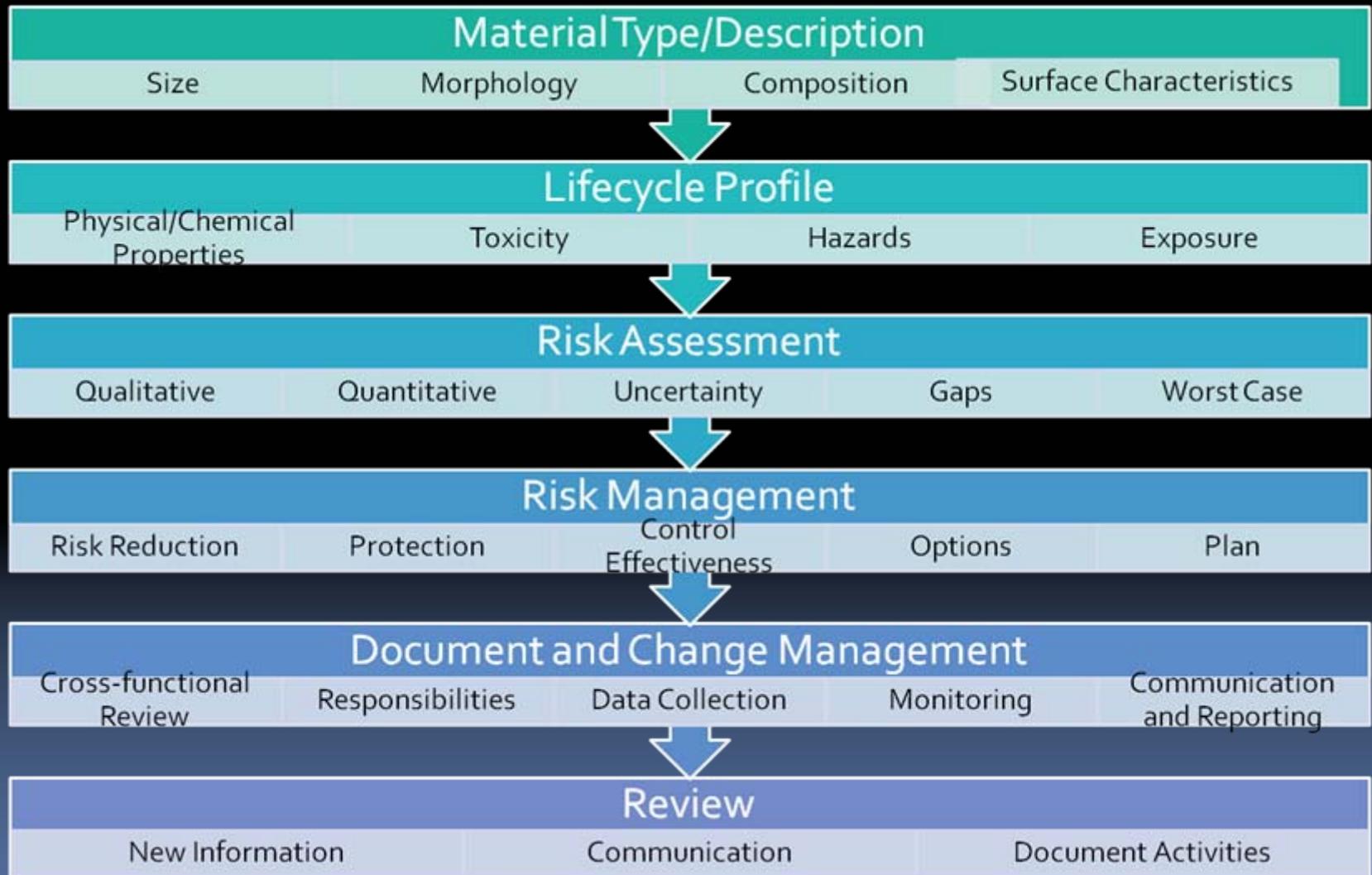
Industry Relationships



Industry Perspective



Product Life Cycle



Risk Assessment and Management

Assessment

Quantitative

Qualitative

Worst Case

Gaps

Uncertainty

Management

Risk
Reduction

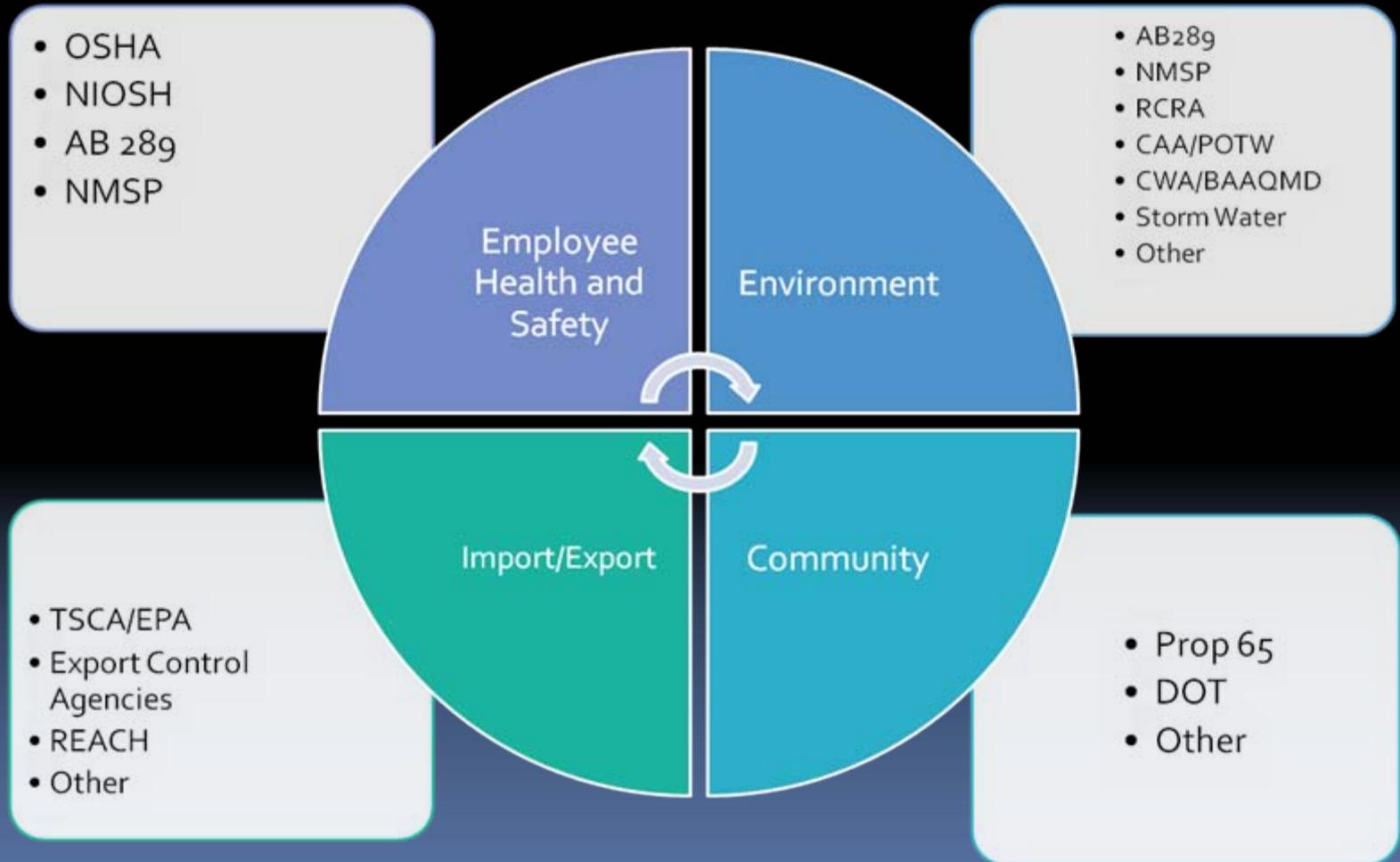
Protection

Controls

Options

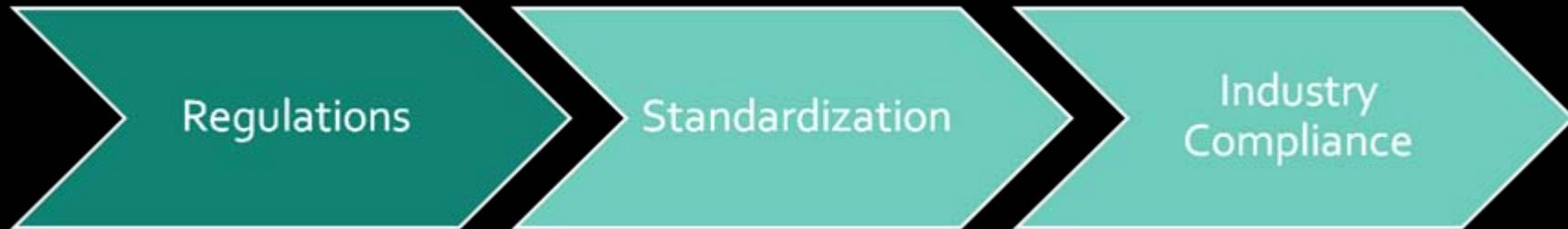
Plan

Stakeholders



Regulation Development

Hierarchical



Collaborative



Advantages of Collaborative Approach

- Regulations meet needs of stakeholders
- Opportunity to provide innovative approach
- Voluntary Risk Assessment and Management

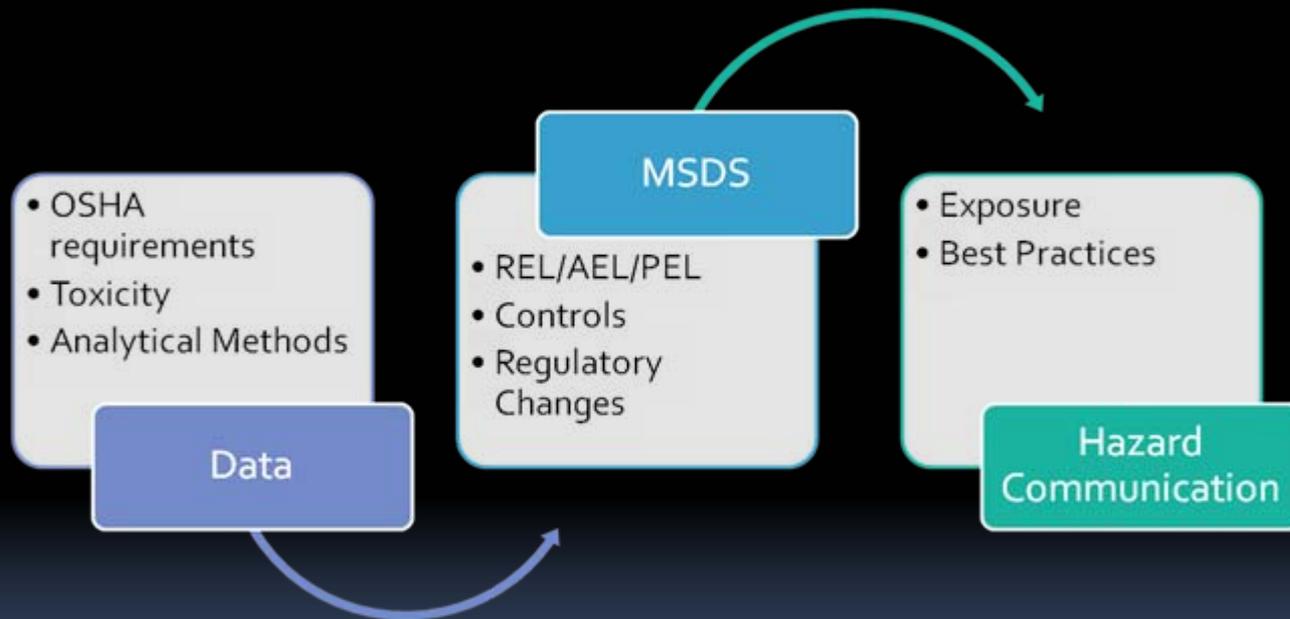
Health and Safety

- Managing Employee Risk
 - Lack of evidence or regulatory framework should not prevent employers from protecting their employees
 - Hazard Assessment
 - Engineering Controls
 - Effectiveness
- Medical Surveillance
 - Applicable Analytical Methodologies
 - Risk to employee for non-specific test
 - Economics
- Exposure Controls
 - Effectiveness
- Good Work Practices

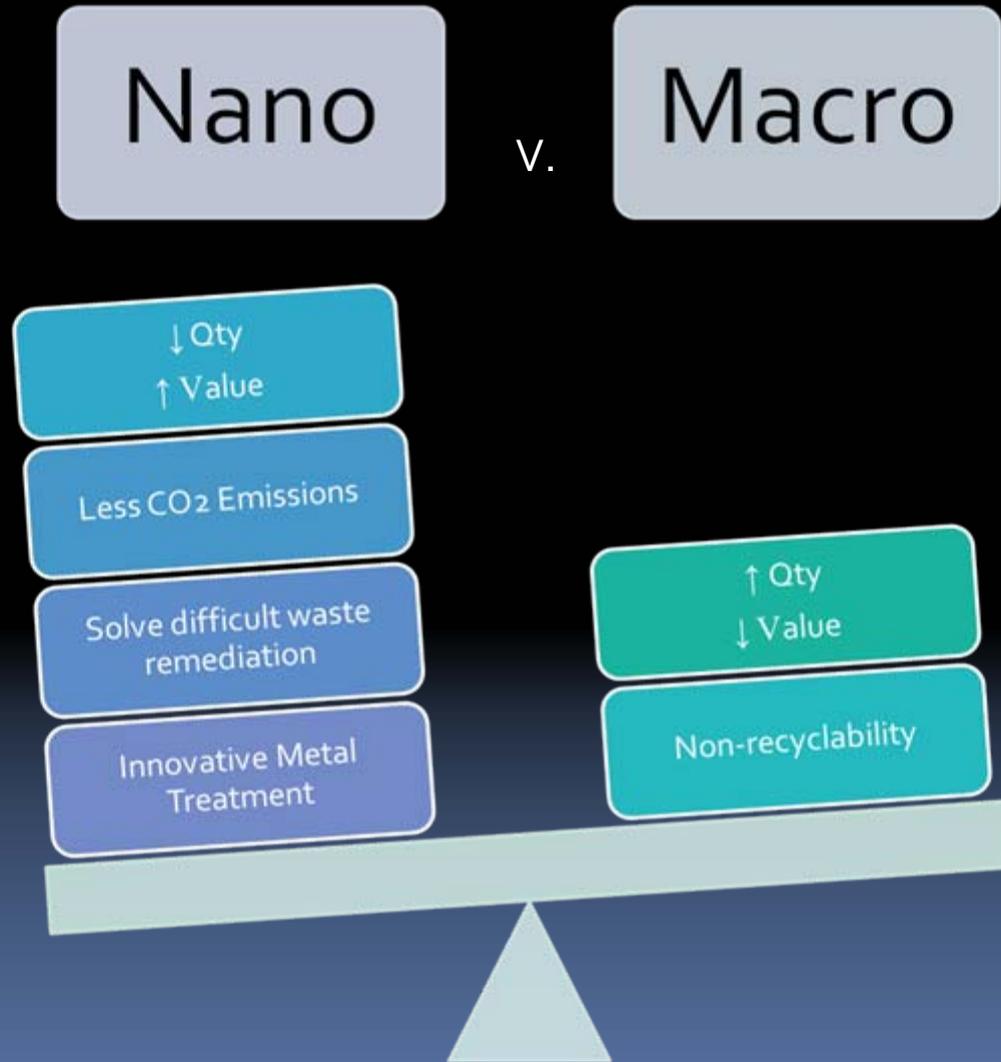
Analytical/Assessment Variables

- Varied Physical and Chemical Composition
 - Size
 - Shape
 - Composition (functional groups)
 - Surface Characteristics
 - Degree of Agglomeration
- Test selection
- Data collection
- What level is actionable?

Communication and Training



Pollution Prevention



Nanomaterial Fate and Transport

- Consumer Products
- Nanomaterial End of Life

Consumer Products

- Consumer Use and Safety
 - Current safety criteria
- How can consumer dispose of product?
 - Landfill
 - Incinerator
 - Recycle

Nanomaterial End of Life

- Existing Regulations
 - RCRA
 - CERCLA
 - CWA-NPDES
 - Household Waste
- Current Toxicity Characteristic Tests
 - TCLP
 - Fish Bioassay

Path Forward

- Industry
 - Adopt self-regulating approach
 - Voluntary Risk Assessment
 - Incorporate conservative EHS protocol
- Regulatory Community
 - Adopt Risk driven regulations
- Research
 - Health and Safety
 - Fate and Transport
 - Eco-toxicity