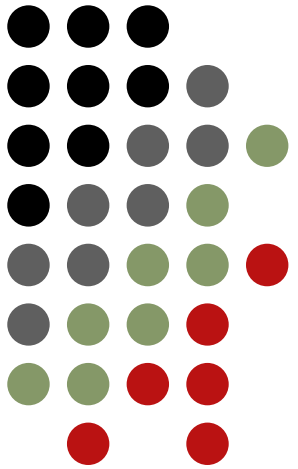
The World Is Flat: **Making Materials Matter**

National Policy Implications

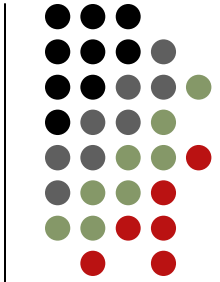


Toni Marechaux

Board on Manufacturing and Engineering Design

National Research Council

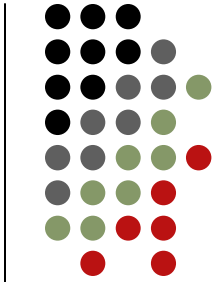
Key policy facts



- There is no US "national materials policy"
  - No industrial policy or technology policy, either
- Government programs affect materials R&D in a number of ways
  - R&D funding (amount and direction)
  - Regulations and laws
- The big picture is difficult to understand
  - Data is lacking
  - Interdependencies are not modeled

Technology insertion

Situation analysis

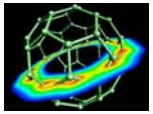


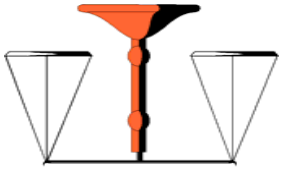
- National security is a priority
  - Drivers for both global and homeland applications
  - Warfighters and first providers are increasingly reliant on new technology
- Economic security is a priority
  - Outsourcing, offshoring, and offsets are proliferating
  - Difficult national "make/buy" decisions
    - Competition is the basis of the US economic system
    - Others factors complicate "competition" – subsidized research, currency values, labor rates, etc.
- The interdependence of national security and economic security is not well understood
  - Complexity is a particular concern

Tipping scales

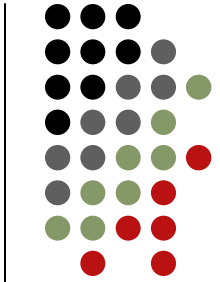
Implications of new materials

- Technology convergence leading to new concerns
- Mounting evidence of negative environmental and health impacts (e.g., nanoparticles)
- Continued flow of new nano/bio-based products into the marketplace (30-50/month)
- Existing regulatory frameworks prove inadequate in addressing risks and boosting public confidence (e.g., MSDSs)
- Continued low trust in government by the public undermines interventions



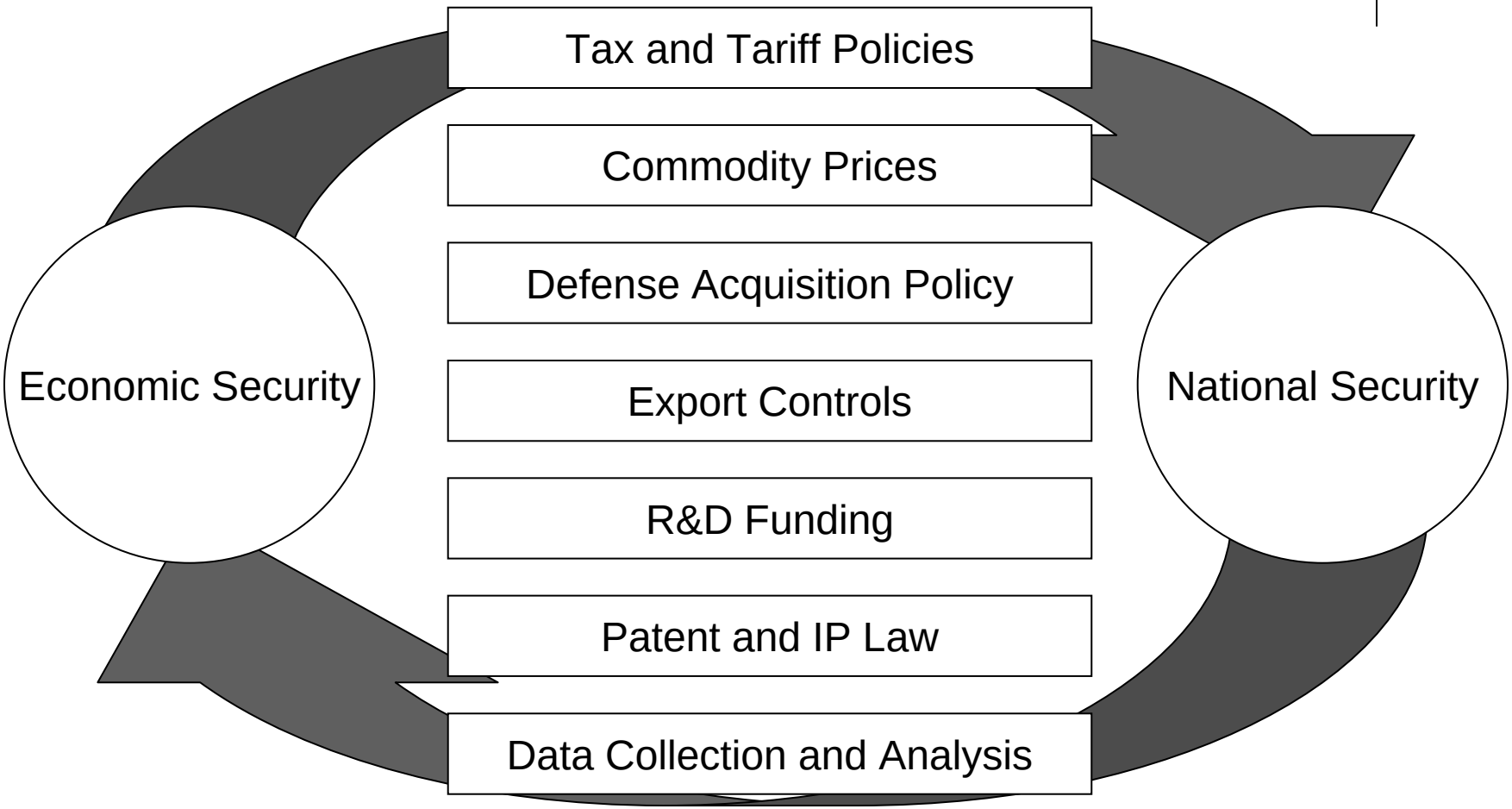


Where government plays a role

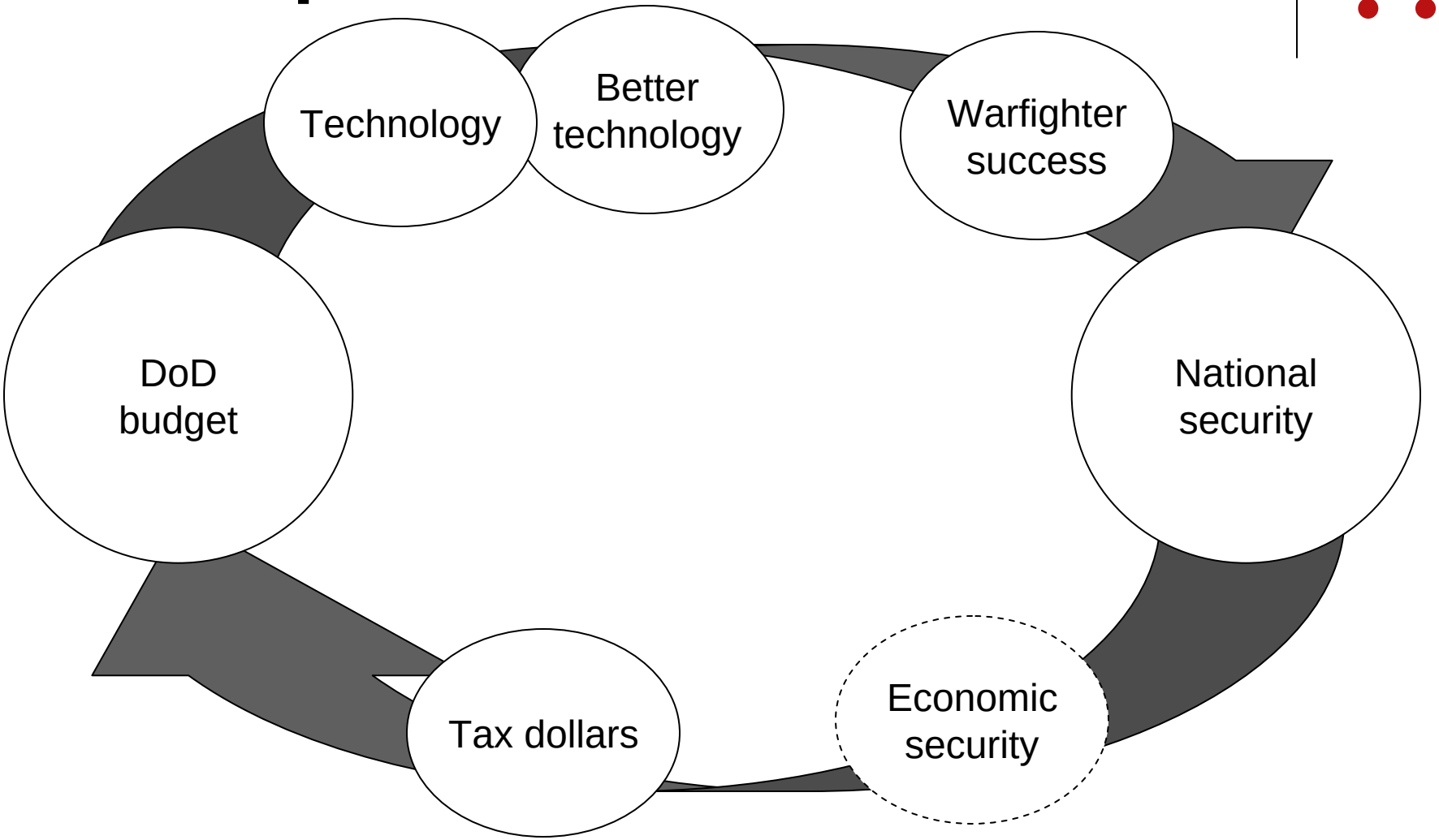


- Materials sources and transactions
  - Raw materials
  - Processed materials
  - Scrap and recycled materials
- Materials uses and technologies
  - Transportation
  - Energy
  - Construction
  - Consumer products (health care, electronics)
- Materials education and workforce
  - Collaborations
  - Transit

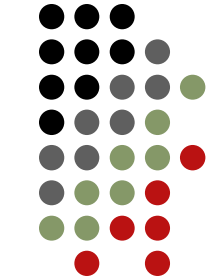
Interdependencies



Interdependencies

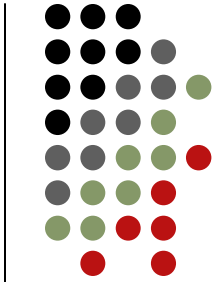


Traditional policy perceptions



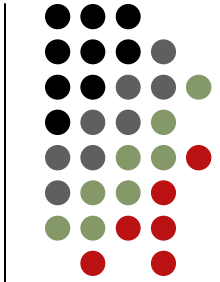
- Progress in materials research, development, and production has been the basis for economic growth and national security for centuries
- Jobs in the materials industries have been the most stable and highest paying
- Many of the largest companies in the world are materials producers and suppliers

Perceptions today

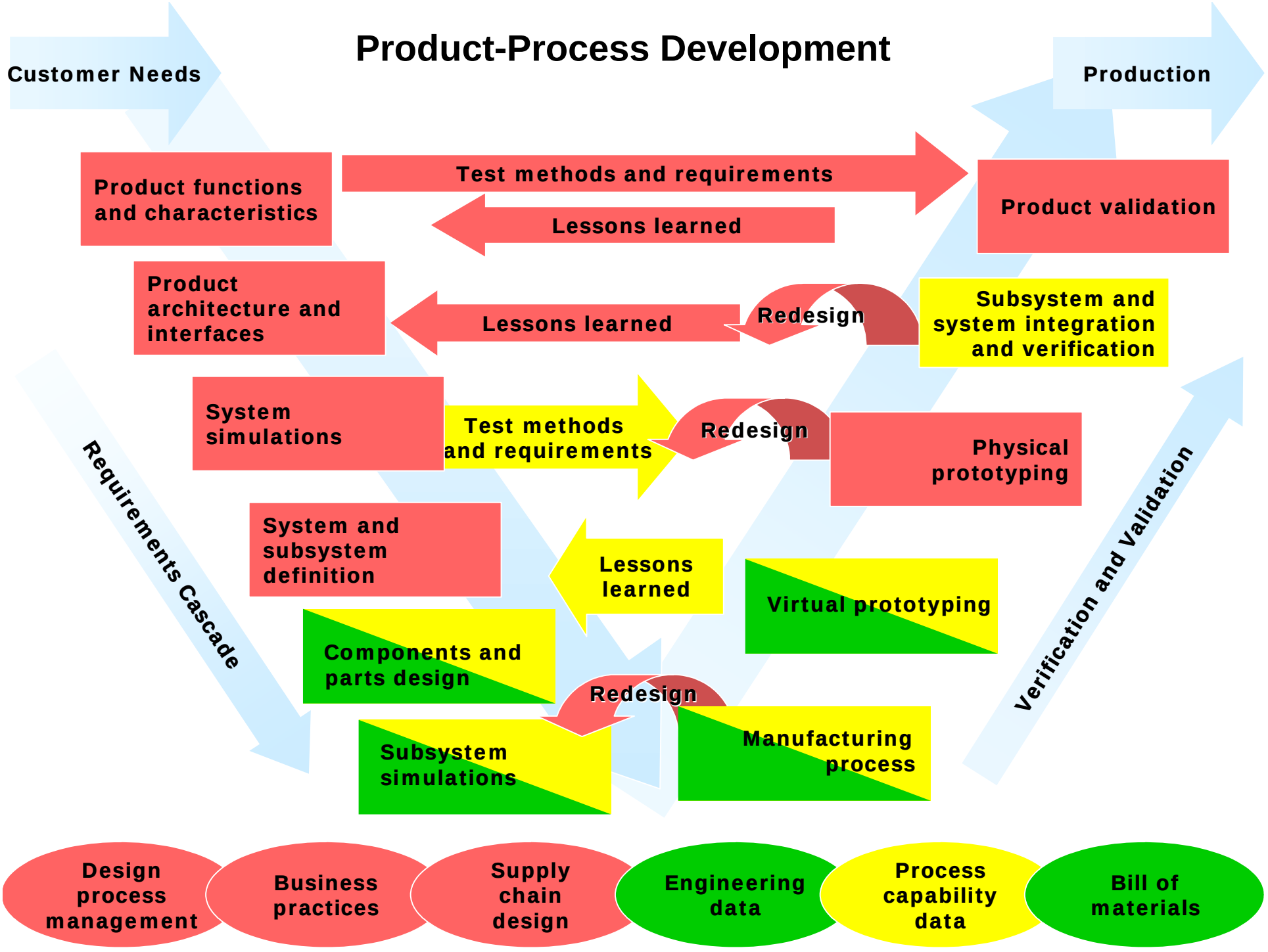


- Progress in ~~materials research and production~~ **nano-, bio- and information technology** is the basis for economic growth and national security
- Jobs in the materials industries have been the most ~~stable and highest paying~~ **polluting and unsafe; globalization will reduce wages**.
- Many of the largest companies in the world have been materials producers and suppliers; **but these aren't important to have in the U.S.**

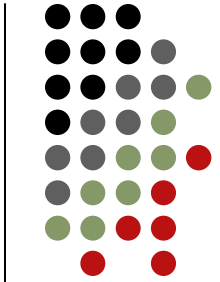
Possible actions



- More "upstream" education
  - General public, public figures, and vocal scientists
  - Tie potential costs to potential benefits
- More funding for research on environmental and health implications
- Global agreements on responsible research, development, and use of new technologies
- Standards for labeling for consumer products, foods, etc.
- Better tools for understanding drivers

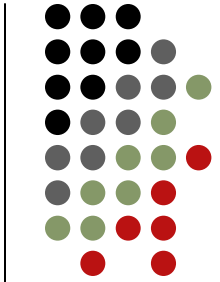

Product-Process Development
Customer Needs
Production
Product functions and characteristics
Test methods and requirements
Product validation
Lessons learned
Product architecture and interfaces
Lessons learned
Redesign
Subsystem and system integration and verification
System simulations
Test methods and requirements
Redesign
Physical prototyping
Requirements Cascade
System and subsystem definition
Lessons learned
Virtual prototyping
Components and parts design
Redesign
Subsystem simulations
Manufacturing process
Verification and Validation
Design process management
Business practices
Supply chain design
Engineering data
Process capability data
Bill of materials

What's missing



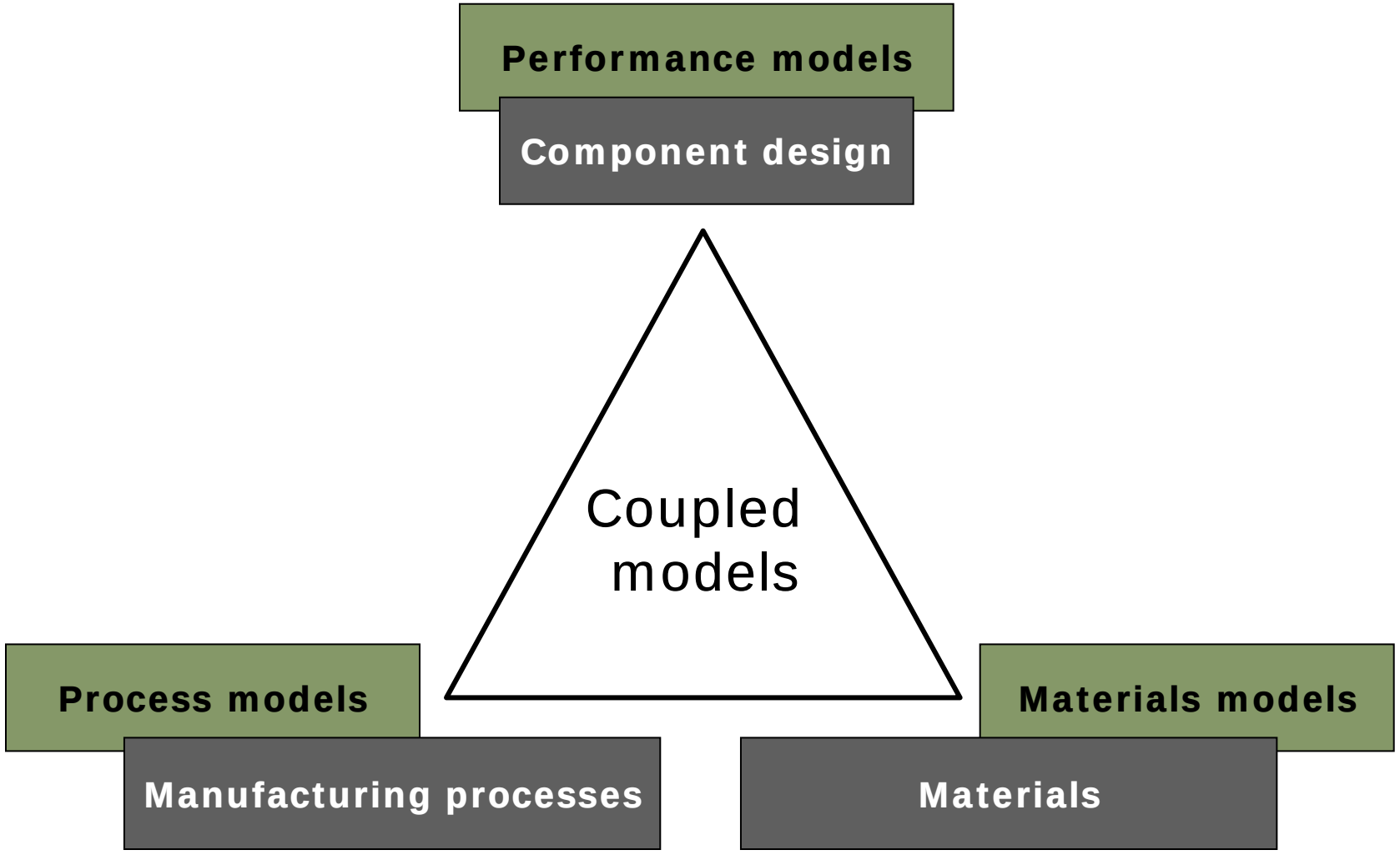
- Tools to facilitate systems-level decision making
- Tools to evaluate and prioritize design alternatives early in the design process
- Tools that incorporate life-cycle costs and environmental impact
- Tools to validate component effectiveness

More missing links

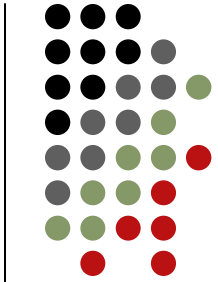


- Data that is
  - accessible and peer-reviewed for new materials
- Tools that are
  - interoperable and composable, and span multiple fields
- Best practices that
  - define ownership rights to models, simulations, and data

Models for Linking Design, Manufacturing, and Materials



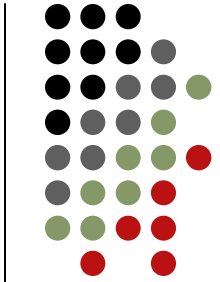
Moving forward



Where could the US lead (or not lag)?

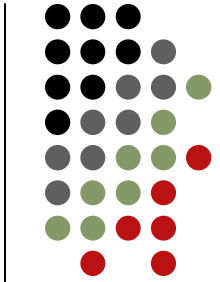
- Comprehensive models and methods
- Materials databases
- Implementation and infrastructure

Ultimate goals



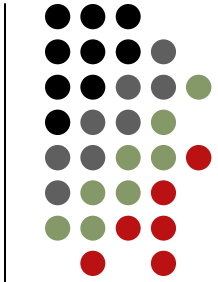
- The reward for use of new materials will be clear
- The risk will be mitigated

The National Academies



- What are the National Academies?
  - Not a government agency
  - Established by Congress to ‘advise the nation’ on science, technology and health policy issues
  - Academies consist of
    - National Academy of Sciences (NAS)
    - National Academy of Engineering (NAE)
    - Institute of Medicine (IOM)
    - National Research Council (NRC)

Recent reports



- Accelerating Technology Transition: Bridging the Valley of Death for Materials and Processes in Defense Systems (2004)
- Capturing the Full Power of Biomaterials for Military Medicine (2004)
- Retooling Manufacturing: Bridging Design, Materials, and Production (2004)
- New Directions in Manufacturing (2003)
- Materials Research for 21st Century Defense Needs (2002)
- Modeling and Simulation for Manufacturing and Defense System Acquisition: Pathways for Success (2002)
- Equipping Tomorrow's Military Force: Integration of Commercial and Military Manufacturing (2002)

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