A Value Chain Research Approach to Nanotechnology: a Framework for Competition and Collaboration

CNS Seminar Speakers Series

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Overview

- Introduction to Value Chain Research
- Part I: Value Chain Structure
  - Nano Value Chain Template
- Part II: Value Chain Mapping
  - Research Process
  - Example: Nanotechnology in North Carolina
- Part III: Value Chain Analysis
  - Example: Nanosilver
- Applying the Research Approach
  - California in the Nano Global Economy

Quick Intro to Value Chain Research

- *Purpose:*
  - Who are stakeholders, how are companies and locations linked together and why?
- *Major elements:*
  - Product supply chains and relationship among stakeholders
  - Determination of value (economic, social, environmental)
  - Power over value and other stakeholders
- *Fields:*
  - Business, management, and economics
  - Sociology and geography
- *Why:*
  - Evaluate economic, social and environmental development and competitiveness
- *Applicable to any industry or topic:*
  - Value chain research is the focus of Duke's Center on Globalization, Governance, & Competitiveness (CGGC)
    - Nanotechnology, North Carolina's industries, sustainability, environmental technologies, global health, information technology and services, textiles and apparel

Value Chain 'Research Approach'

- Can be confusing because "value chain" is used by different groups in several different contexts to mean the same or similar things

Value Chain…

- ***Structure***
  - A concept and/or visual to describe the input-output process and geography of production in the global economy
  - A supply chain are also a structure, but not as all encompassing as value chains
    - Physical transformation plus other non-production activities
- ***Research Process***
  - Steps to carry out the research; main focus on value chain mapping
- ***Mapping***
  - Identifying activities and stakeholders in the structure (who & what)
- ***Analysis***
  - Determine relationship between dynamics and stakeholders (how & why)
- ***Framework***
  - Mapping and analysis
- ***Research Approach***
  - Everything above

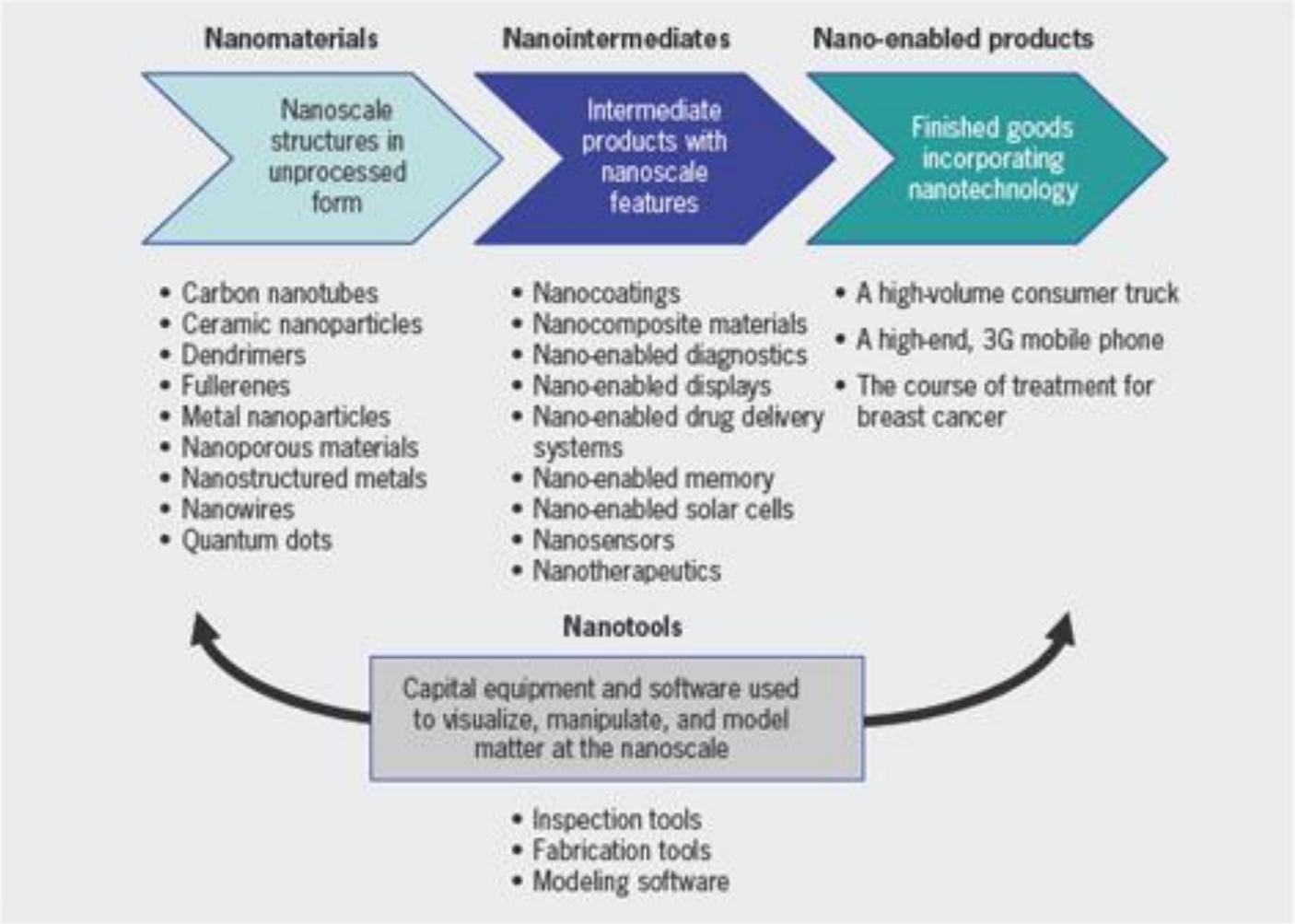
Visual Structure + Value Chain Framework + Research Process = Research Approach

Part I: Value Chain Research Approach

VALUE CHAIN STRUCTURE

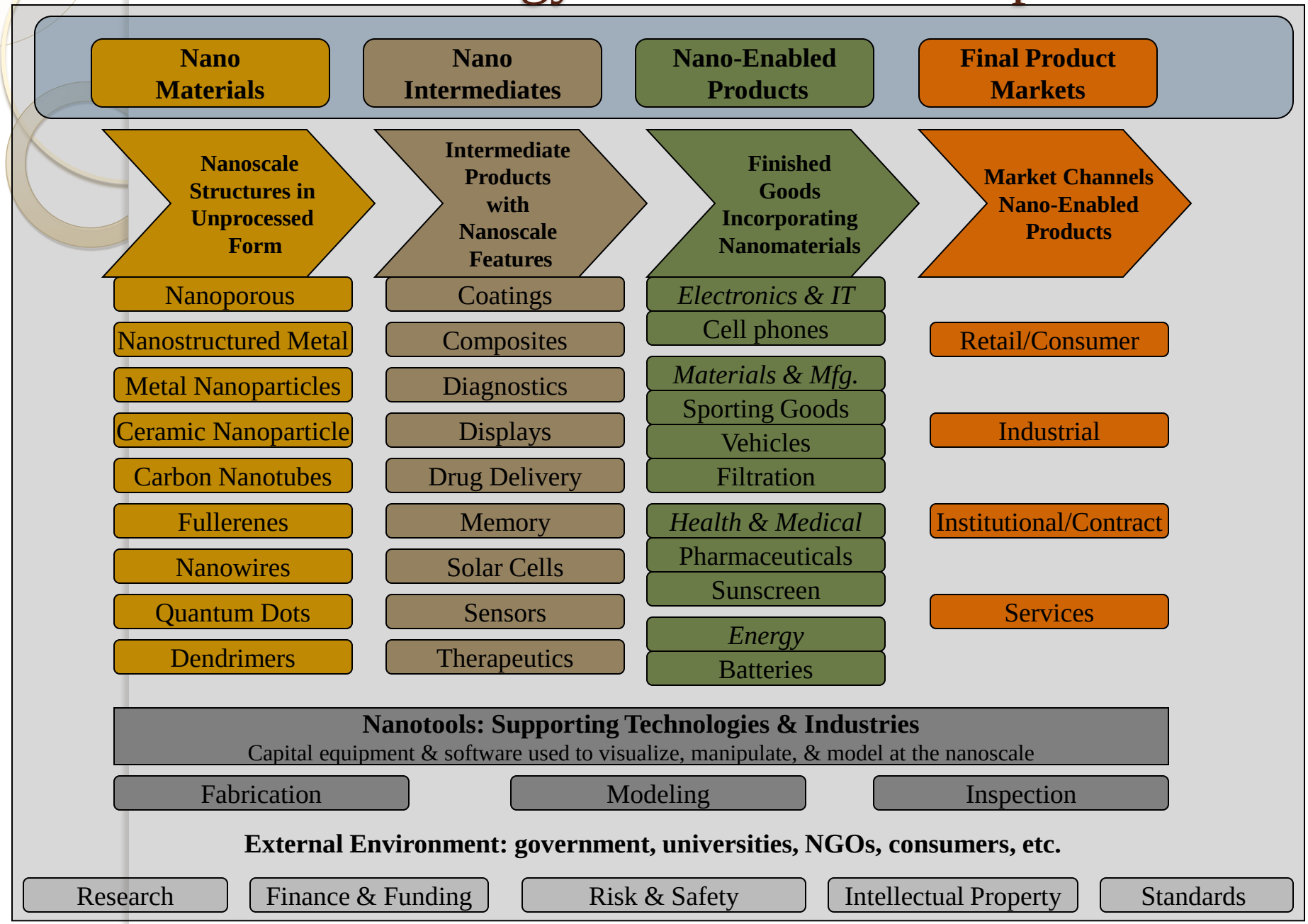
Value Chain Structure: Broad, Generic Version

Lux: Nanotechnology Value Chain



Source: Lux Research (2006). *The Nanotech Report, vol. 1,* 4th edition.

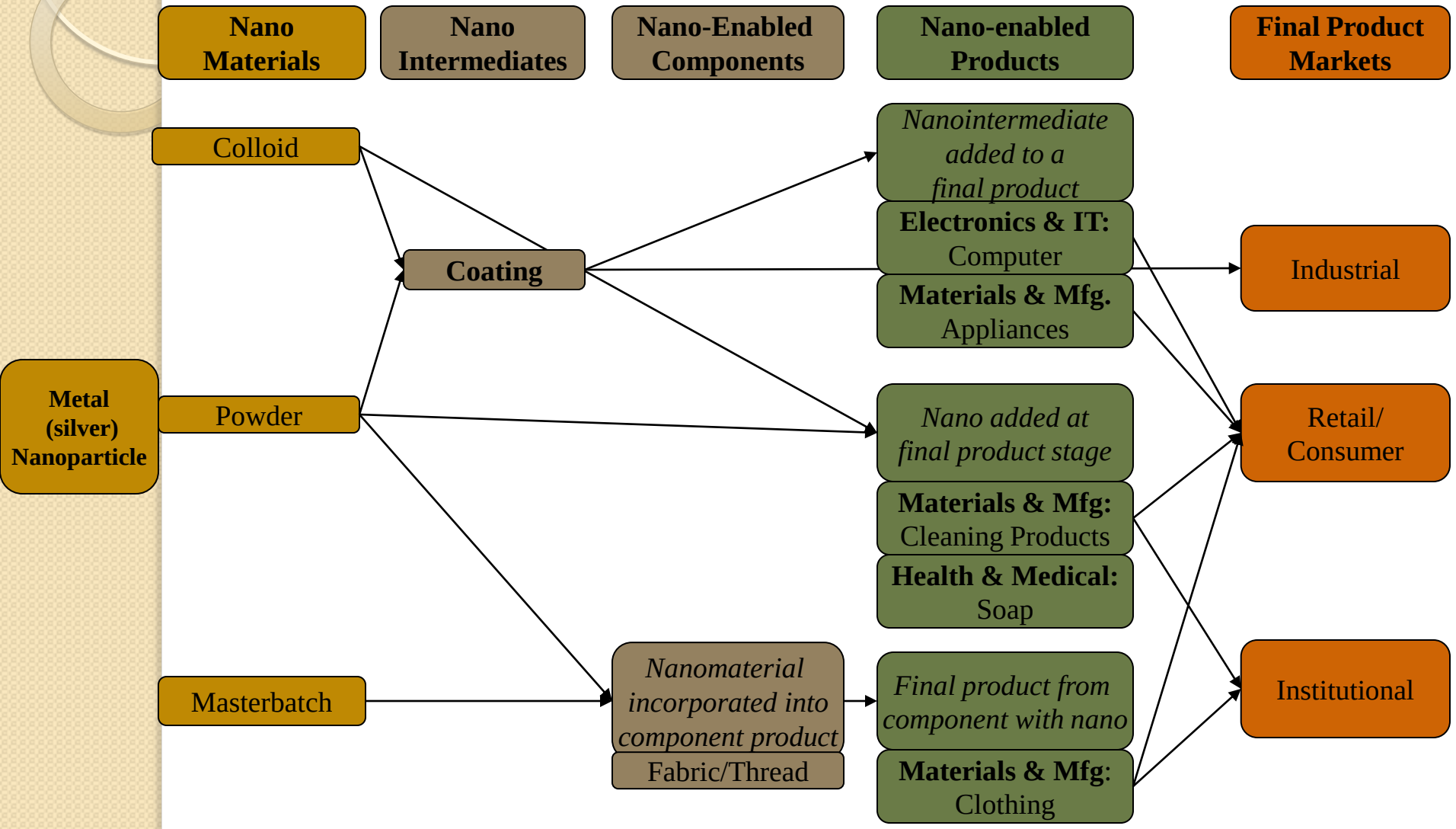
Nanotechnology Value Chain Template



Frederick, S. (2011)

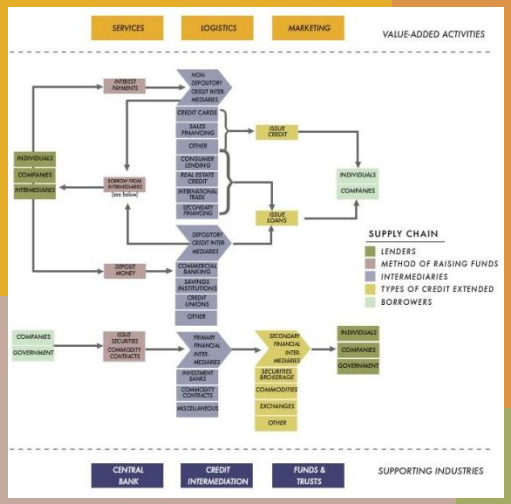
Applying the Nano Value Chain Template:

Product-Specific Value Chain: Nanosilver

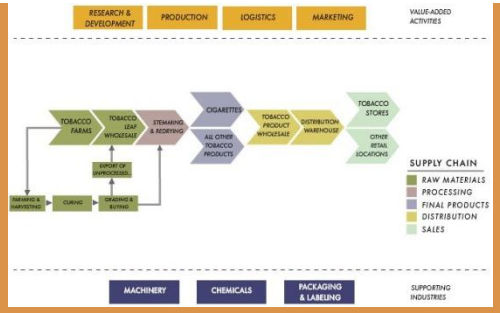


Industry-Neutral Value Chain Template:

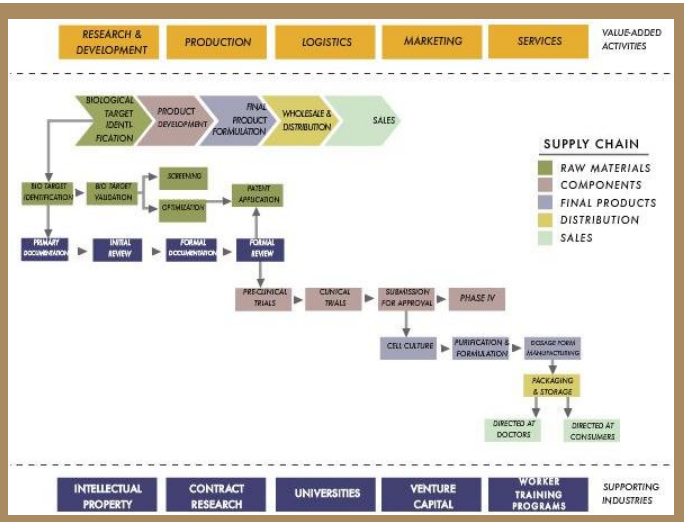
Example: NC in the Global Economy



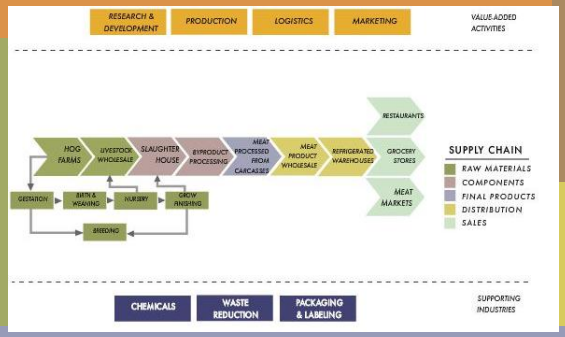
Banking



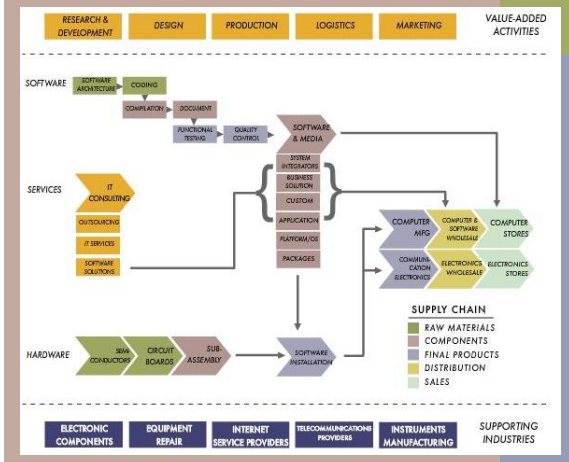
Tobacco



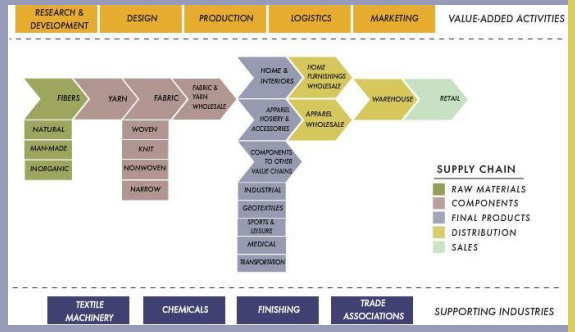
Biotechnology



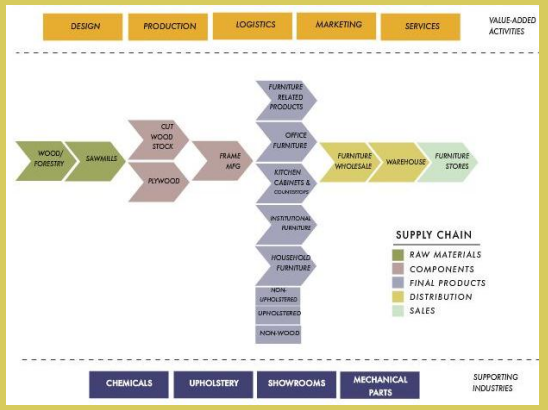
Hog Farming



Information Technology



Textiles



Furniture

Source: www.soc.duke.edu/NC_GlobalEconomy/

Part II: Value Chain Research Approach

VALUE CHAIN RESEARCH PROCESS & MAPPING

Nano Value Chain Research Process

Website Templates & Tools

- Initial development for the CNS summer internship projects
- Nano Value Chain Framework
  - Website version of Value Chain Research Process
- CNS Summer Project on CNTs
  - Students Final Projects from 2009
- NanoTechConnect
  - My working site for conducting value chain mapping and analysis

Nano Value Chain Research Process

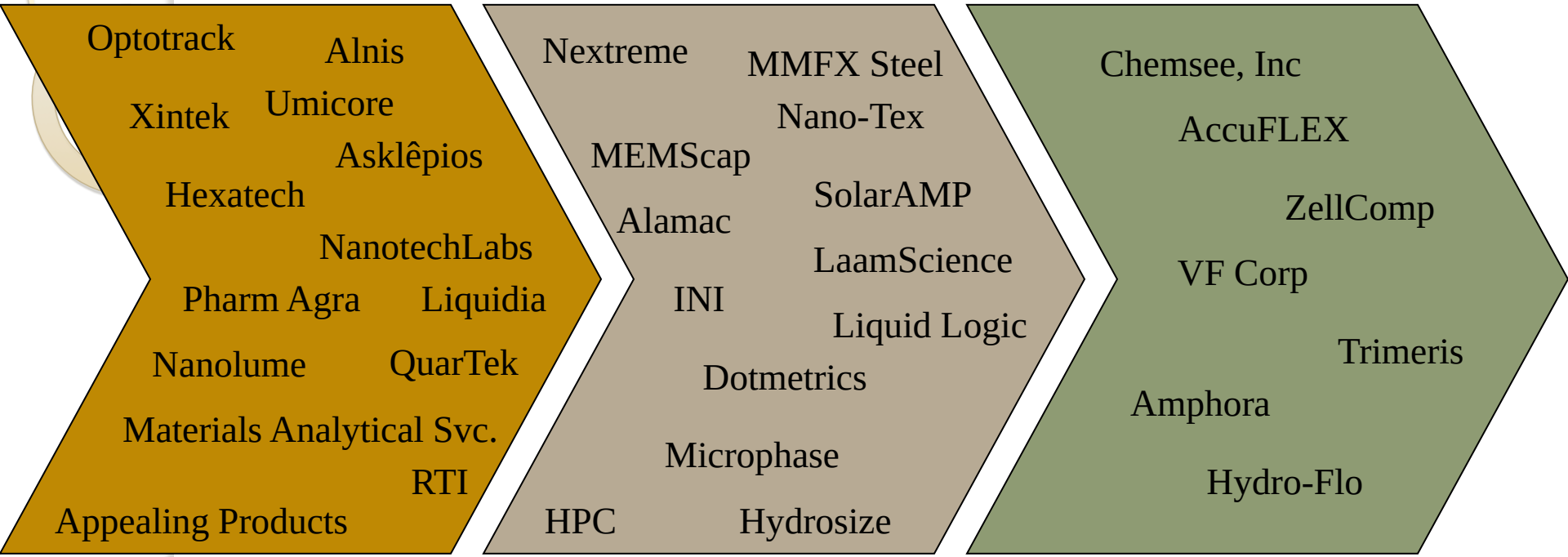
Nano Firms and Organizations Database

Started compiling the following databases last year to create a master database

- Woodrow Wilson Center:
  - NanoMetro Map: United States (2007): Companies: 955; Universities/Government: 182; Organizations: 81
  - Consumer Product Database: (2006; ongoing): International: 485 companies
  - Nanosilver Database: International (2007): 65 companies
  - Nanomedical Database: International: 19 companies
- Plunkett's: International (2010)
  - Companies and Organizations: 300 and 209
- Lux: International Scope
  - 4th Edition of Handbook (2006): 70 companies
  - 5th Edition of the Nano Handbook (2007): 121 companies
- NSTI: California: 470 locations (provides little detail)
- NanoVIP: International (2009): ~ 1,650 locations (worst to work with)
- CADTSC Call-in Databases: California (2010; 2011)
  - CNT: 24 locations
  - Nanometal, Nanometal Oxide, and Quantum Dots: 47 locations
- NanoWerks: International (2011)
  - Nanomaterials: 281 companies
  - Nanoscience & Life Science: 350 companies
  - Products, Applications, & Instruments: 1,332 companies
  - Services, Intermediaries & Other: 260 companies
- Others: Small Times Business Directory, Nanoproducts.de, State-focused databases, etc.

Example of Broad Firm-Focused Geographic Value Chain Mapping:

NC Nanotechnology Value Chain



Nanomaterials (14) **Nanointermediates (13)** **Nano-Enabled Products (7)**

Nanotech Capital Ziptronix Semiconductor Research Centice Institutec
Nanolytics 3rd Tech ProtoChips Expression Analysis Biomachines
Micell Sensory Analytics International Tech. Center Coventer Tiny Technology

Nanotools (15)

Source: Gereffi, Frederick, & Ong (2007). Nanotechnology In North Carolina Presentation

Example of Broad Geographic Product-Focused Value Chain Mapping

NC Companies' Products & Activities

Nanomaterials
Nanoparticles-4
Nanotubes-1
Quantum Dots
Fullerenes-1
Nanopowders-2
Nanoporous Materials-1

Nanointermediates
Coatings-3
Fabrics-1
Memory/Logic Chips-3
Optical-2
Nanoliter Labonchip-1
Composite Material-1
Sensors-2
Solar Cells-1

Nano-Enabled Products
Apparel-1
Pharmaceuticals-1
Filters-1
Sporting Goods-1

Nanotools

Equipment: 1	Testing: 2	Computer Software: 1

Challenges to Value Chain Mapping

- Relatively new field: Fifty years ago, value chain mapping wasn't necessary because products were made locally or one firm manufactured or controlled manufacturing for all components
  - Example: Levi's (U.S. production → Offshore → Outsource)
  - Example: Lead Firm Family Trees (CGGC-NCGE)
- It is often unclear what a firm's actual role is in the chain
  - Companies do not like disclose what they do; and in most cases they do not have to
  - Industry classifications are often vague or codes are product-based rather than activity-based
  - Nanotechnology: even more difficult because classifications are not "size dependent"—firms working with nanotechnology are classified by their industry; not as a "nano" firm

Part III: Value Chain Research Approach

VALUE CHAIN ANALYSIS

Value Chain Analysis Focus:

Environment, Health, & Safety

- Collaboration with CEIN at Duke
  - Assisted with value chain mapping
- Goal to populate an equation to provide estimates of U.S. nanomaterial production to evaluate potential exposure of five engineered nanomaterials throughout the product life cycle
- Most significant outcome was that production data was either:
  - Not available
  - Firms not willing to disclose enough information to provide reliable estimates of production

Value Chain Analysis Focus:

Innovation to Commercialization

- Competitiveness indicators are means to measure or benchmark a location or firm's footprint in the innovation to commercialization cycle.
  - Typically use economic indicators: market share, revenue, or trade
  - Not readily available for nanotechnology-specific areas.
- Potential to identify production and geographic links in the chain by combining firm value chain mapping with other existing ‘mapping’ information on funding sources, patents, and publications.
  - Several groups working on mapping above areas, but mapping firms is less popular

Value Chain Analysis Focus:

Competition & Collaboration

- Global Value Chain Framework
  - Theory: Governance
  - Who holds power in the chain? How? Why?
  - Firms, government, both?
  - If firms, is it the manufacturer or the buyer?
- Determine how and why stakeholders are collaborating and competing:
  - Along the chain
  - Within the same parts of the chain or industry
  - With the government (policy)
  - With organizations, NGOs, & educational groups

Competition & Collaboration

Nanotechnology Opportunities

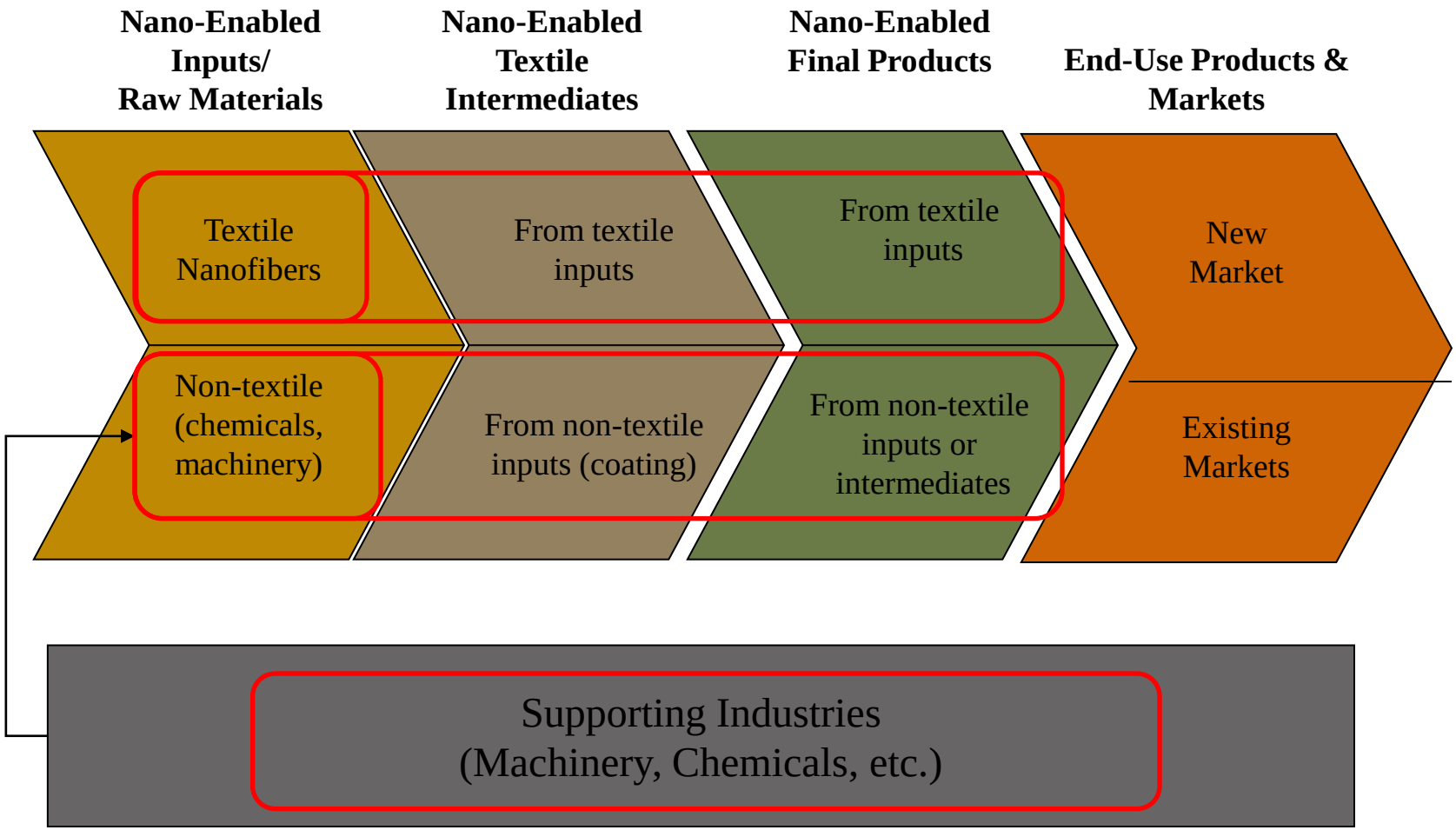
- **Competition**
  - Geographic: Outsourcing: nano-enabled products, components, intermediates, & materials are not isolated from the current trends in supply chains. Manufacturers and buyers need to have an incentive to manufacture in the U.S. because supply chains have already moved to other countries
  - New products and materials replacing existing products
    - How determine which is better or cost effective? Intermediate marketing
- **Collaboration**
  - Parts of the supply chain where relationships did not exist in the past are emerging, and firms are performing more specialized roles, leading to more and new links in the chain
  - Similar products used in multiple markets; Targeted intermediate marketing
  - Shift from buyer-driven to a new kind of producer-driven…opportunity to put power into the hands of manufacturers; largely in intermediates
- The third 'C': **Confusing**
  - Nanotechnology opens up an incredible amount of room for collaboration—part of the issue is figuring out who potential collaborators may be.
  - Collaboration with new groups leads to new competitors

Textile-Apparel Value Chain

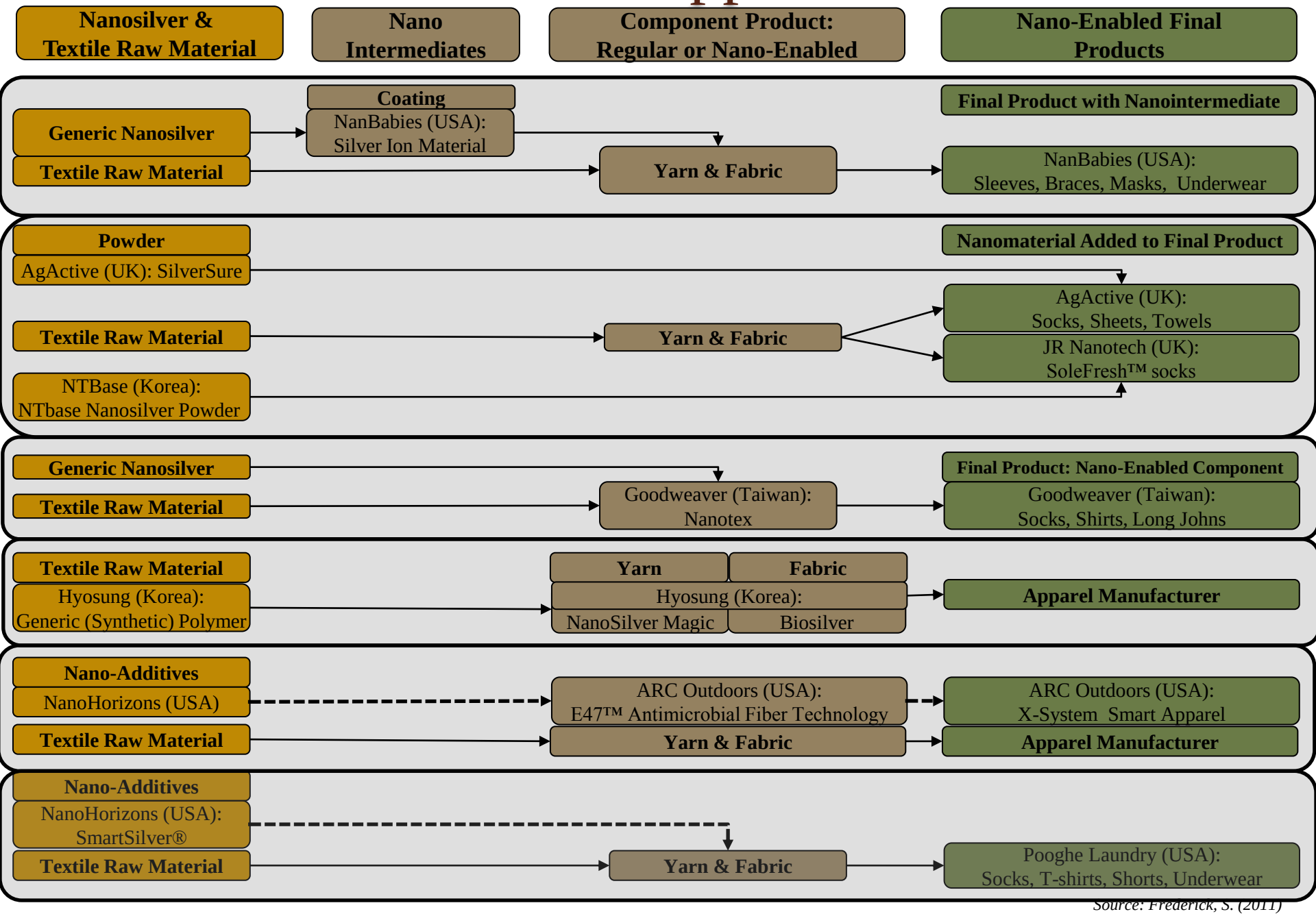
Supporting Industries
(Machinery, Chemicals, Packaging, Labels, etc.)

Supporting Environment
Institutional Context: Government, Service Providers, Industry Organizations, etc.

Nano-Enabled Textile Value Chain



Nanosilver-Textile-Apparel Value Chain



Source: Frederick, S. (2011)

Applying the Value Chain Approach

CALIFORNIA IN THE NANO GLOBAL ECONOMY

California in the Nano Global Economy

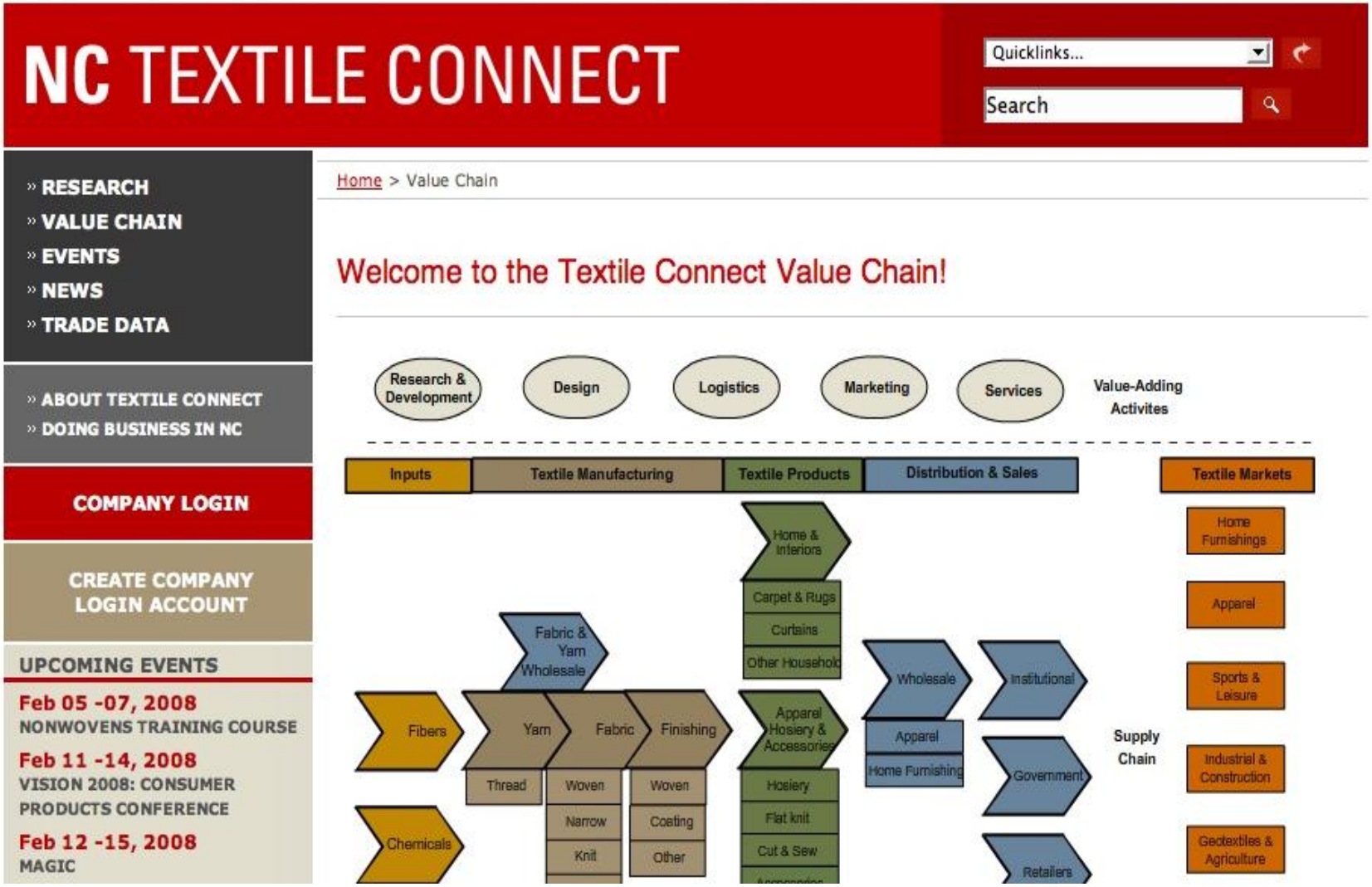
- Project:
  - Use the value chain approach to examine California's footprint in nanotechnology and its emerging research networks and resources
  - Highlight California's position in the national and global value chain and showcase how visual analytic tools can be used to do this
  - Will combine aspects of two existing web-based economic development websites

California in the Nano Economy

- Why: Lack of resources that:
  - Present accurate or reliable information on nanotech firms
  - Present data based on a supply chain rather than by industry
  - Tie firms and competitiveness factors to each other; patents, publications, funding
- Benefits
  - Can be expanded to other geographic areas
  - Avenue to explore new visualization techniques with information management
  - Can have a place for all CNS working groups

Value Chain Organization for Website

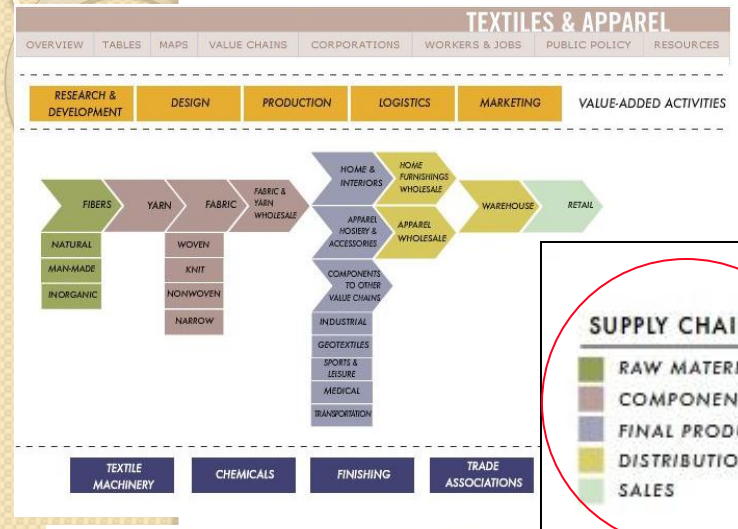
www.nctextileconnect.com



NC in the Global Economy

www.soc.duke.edu/NC_GlobalEconomy/index.shtml

Geospatial Value Chain Mapping

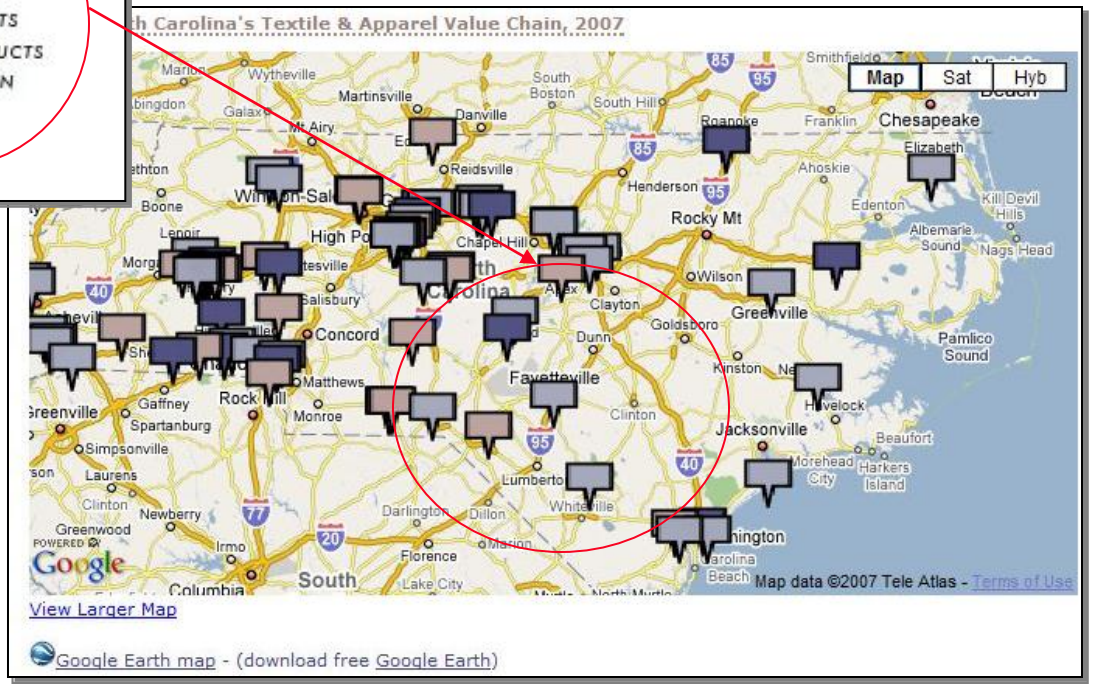


Actors in each stage of the textile value chain are represented in North Carolina, from fi
distribution and sales. North Carolina has a significant presence in several segments of t
woven and nonwoven fabric, and sock manufacturing. Many of the biggest players in the
headquartered or have plants located in North Carolina including Parkdale Mills and Unifi in yarn, International Textile Group and Freudenberg in fabric, and Hanesbrands and Kayser-Roth in hosiery. North Carolina also has a strong supportive environment for the textile industry including: the College of Textiles and the Institute of Textile Technology located at NC State University, the Hosiery Technology Center and the Applied Textile Technology Center as part of the community college network, and several national professional organizations such as AATCC, [TC]2, INDA, and Cotton Inc.

Map - North Carolina's Textile & Apparel Value Chain, 2007

View Larger Map

Google Earth map - (download free Google Earth)



View Larger Map

Google Earth map - (download free Google Earth)

Source: www.soc.duke.edu/NC_GlobalEconomy/textiles/value.php

Questions?

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