Nanotechnology in a Global Context: North Carolina

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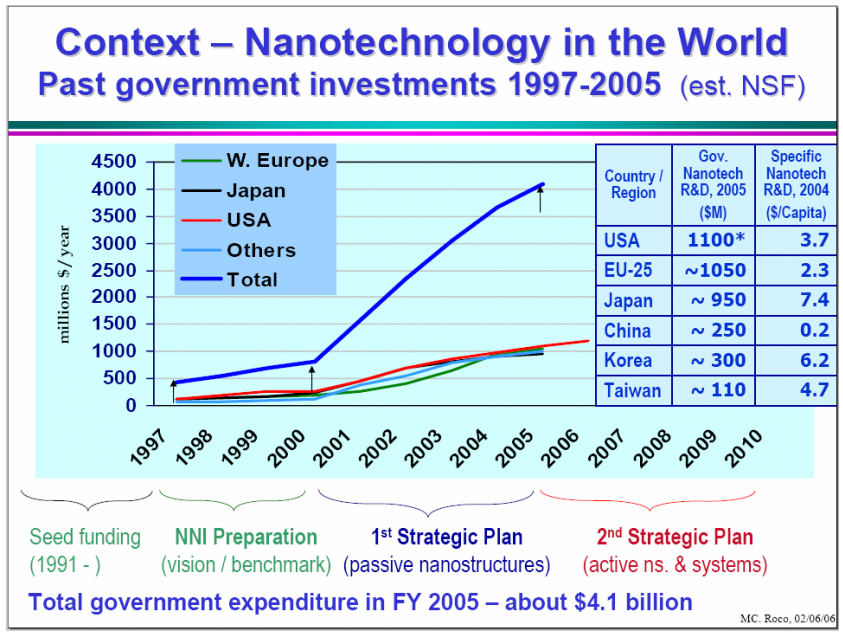
Global Diffusion of Nanotechnology

- **Governments are investing in R&D**
  - 2006: Government funding reached $6.4 billion globally
  - Developing country governments investing heavily
  - Key players:
    - Developed world: US, Japan, Germany
    - Developing world: China, Taiwan, South Korea, Russia



Country / Region	Gov. Nanotech R&D, 2005 ($M)	Specific Nanotech R&D, 2004 ($/Capita)
USA	1100*	3.7
EU-25	~1050	2.3
Japan	~ 950	7.4
China	~ 250	0.2
Korea	~ 300	6.2
Taiwan	~ 110	4.7

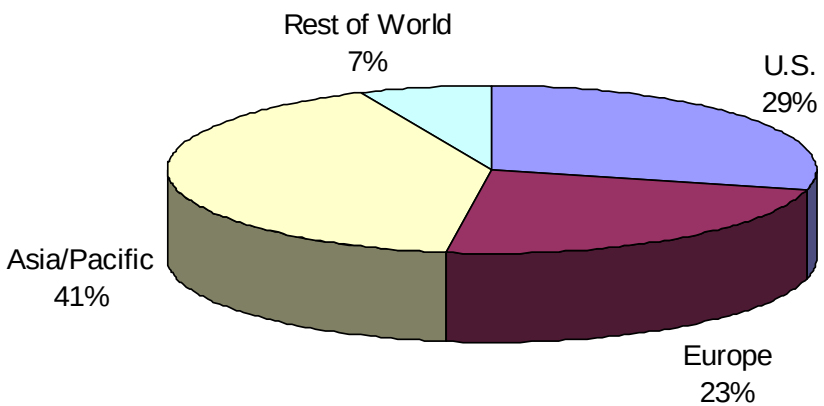
- **Huge for business**
  - 2006: Corporations invested $5.3 billion in nanotech
  - Nanotech market expected to reach $1 trillion within a decade (NSF)
  - Key areas: manufacturing/materials, electronics/IT, healthcare/life sciences

Source: Roco, M. C. (2006)

Nanotechnology in the United States

- Firms:
  - US firms capture approximately 30% of total global revenue in products incorporating emerging nanotechnology

Table 1: Emerging Nanotechnology Revenues by Region, 2004



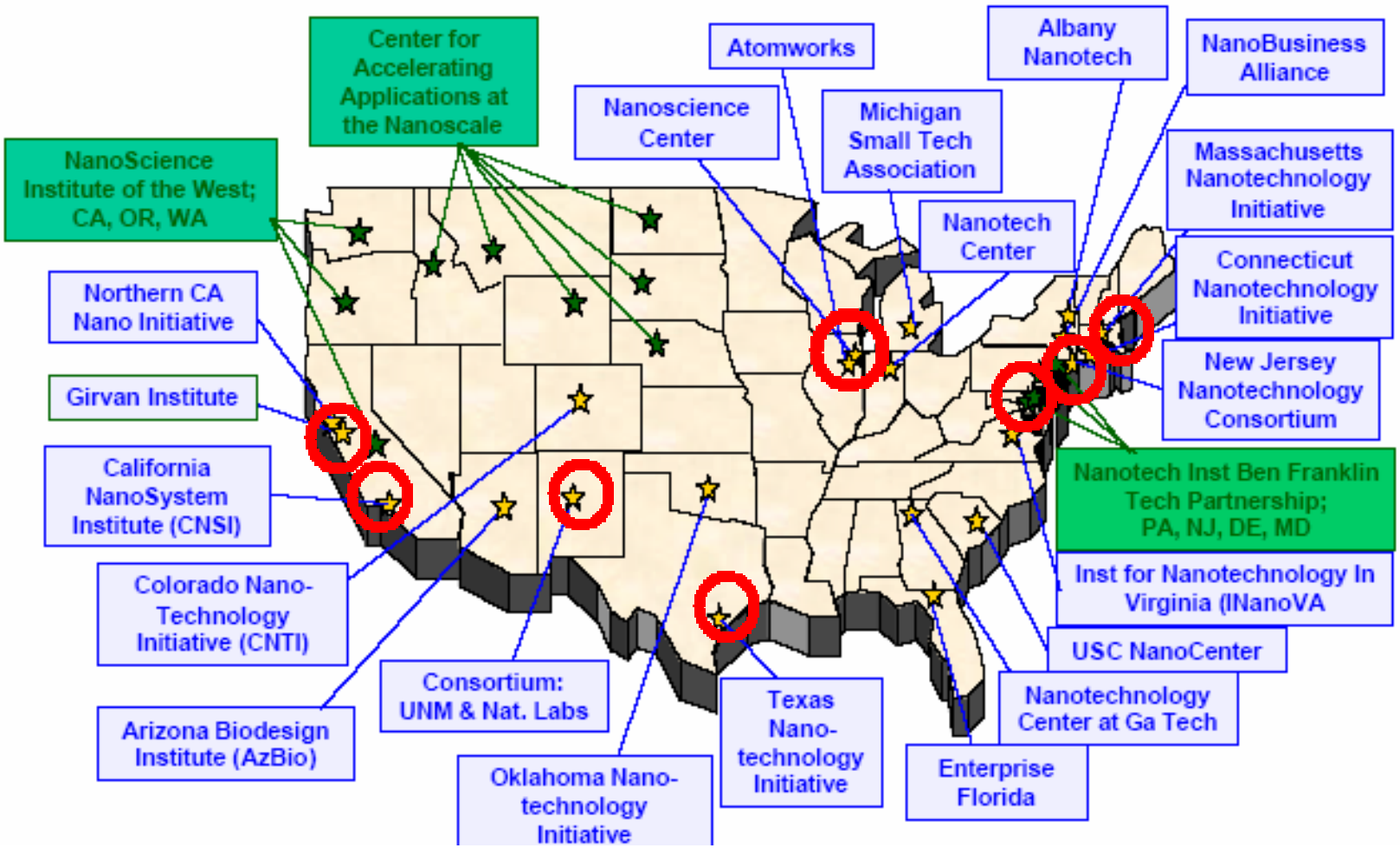
  - Strengths:
    - Healthcare/life sciences
    - Electronics/IT
  - Key firms:
    - Divisions of larger firms: GlaxoSmithKline, IBM, Kraft, BASF
    - Smaller firms: Nano-Tex, Liquidia, Altair Nanotechnologies

Source: Lux Research (2004)

Nanotechnology in the United States

- Financing:
  - Federal government (National Nanotechnology Initiative/NNI): $1.4 billion (2006), expanding to $1.5 billion by 2008
  - State/local government: $430 million (2006)
  - Private sector spending: $1.9 billion (2006)
- Patents/IP:
  - 43,000 patents since 1995 (more than 18,000 patents ahead of second-place China).
  - 6,801 international patents in 2006 (nearly 70% of the total)

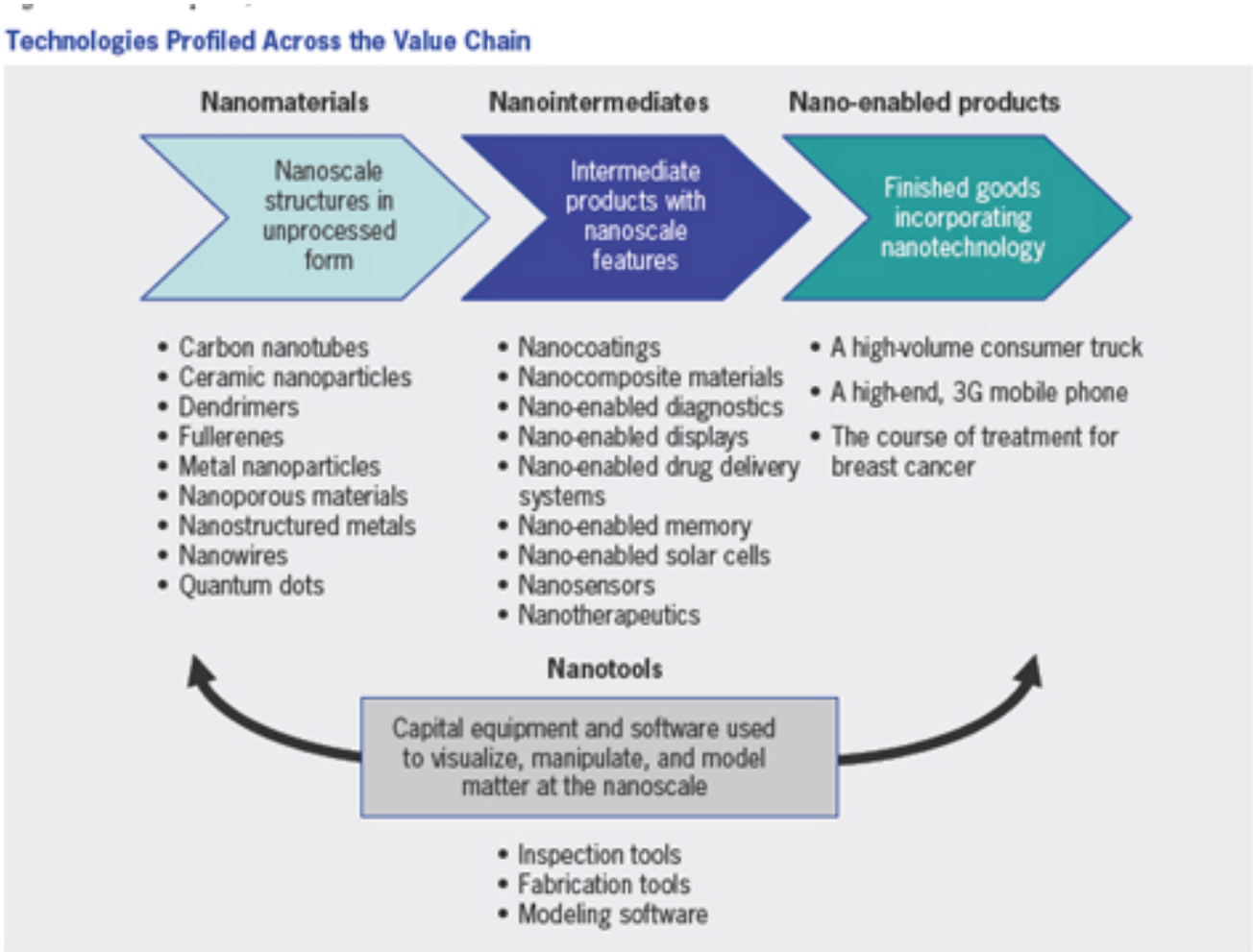
Key Nanotech Hubs



Key Questions

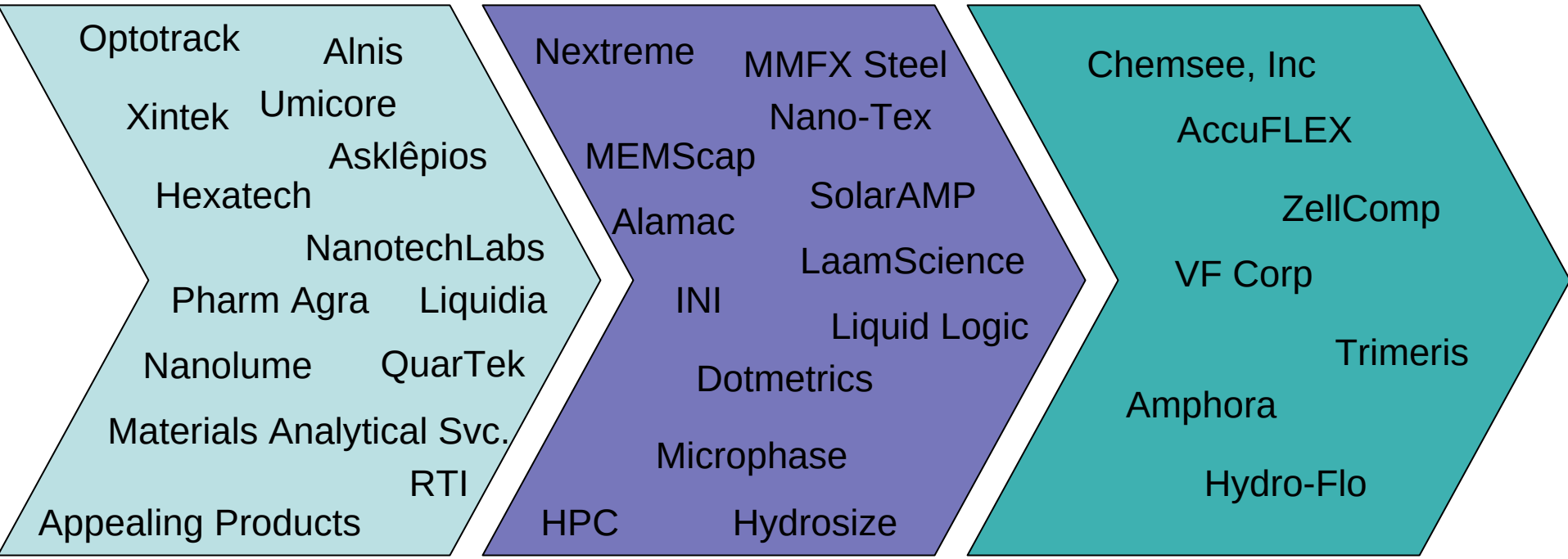
- What is the industry like here in North Carolina? *What are firms actually doing*?
- Why are these firms in North Carolina? What is the policy/regulatory context for the industry?
- How does North Carolina compare with its competitors, both at home and abroad?

Nanotech Value Chain



Source: Lux Research (2006)

North Carolina Nanotechnology Value Chain



Nanomaterials (14)

Nanointermediates (13)

Nano-Enabled Products (7)

Nanotech Capital | Ziptronix | Semiconductor Research | Institutec

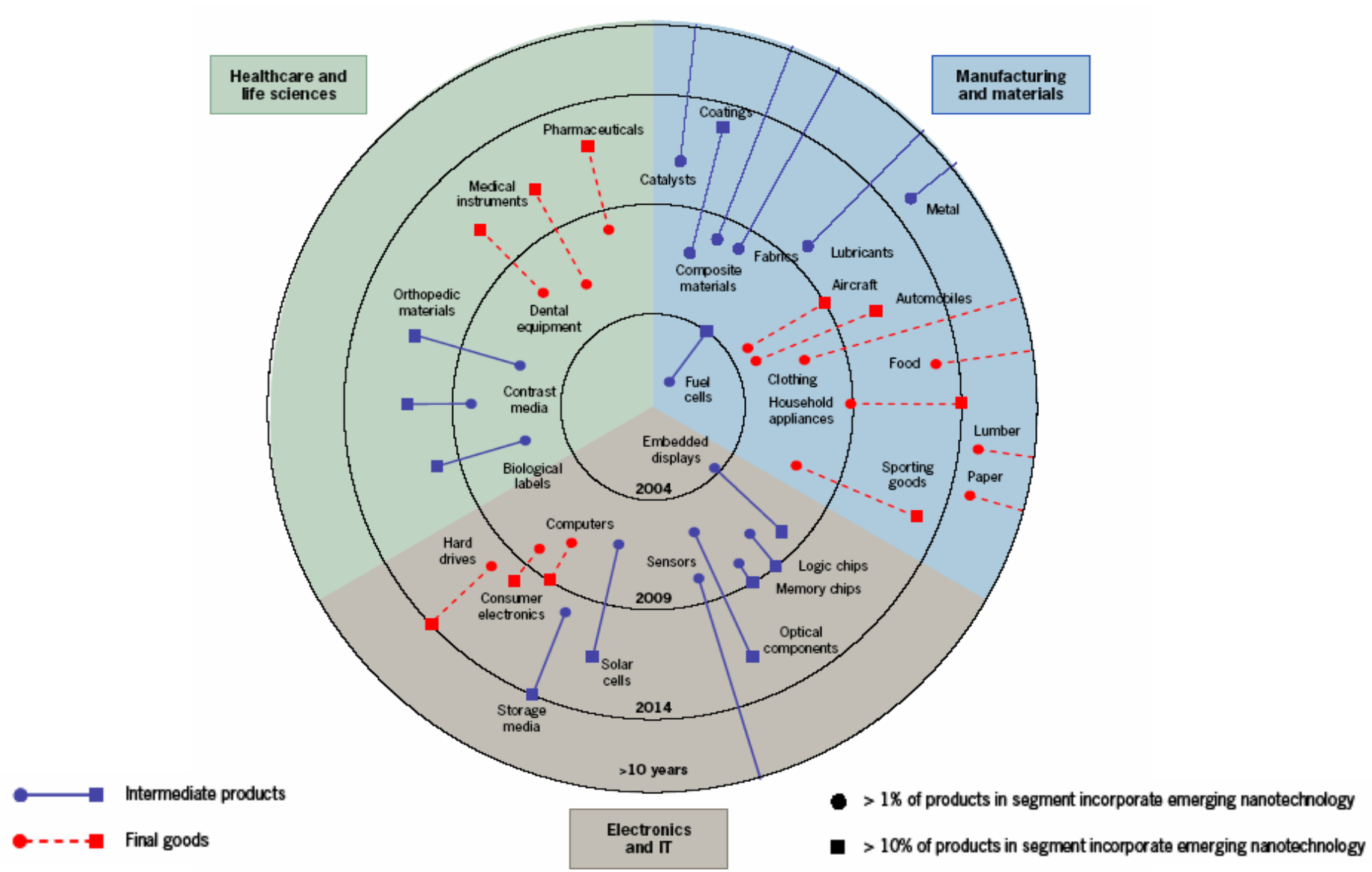
Nanolytics | ProtoChips | Expression Analysis | Biomachines

Micell | 3rdTech | International Tech. Center

Sensory Analytics | Tiny Technology | Centice | Coventer

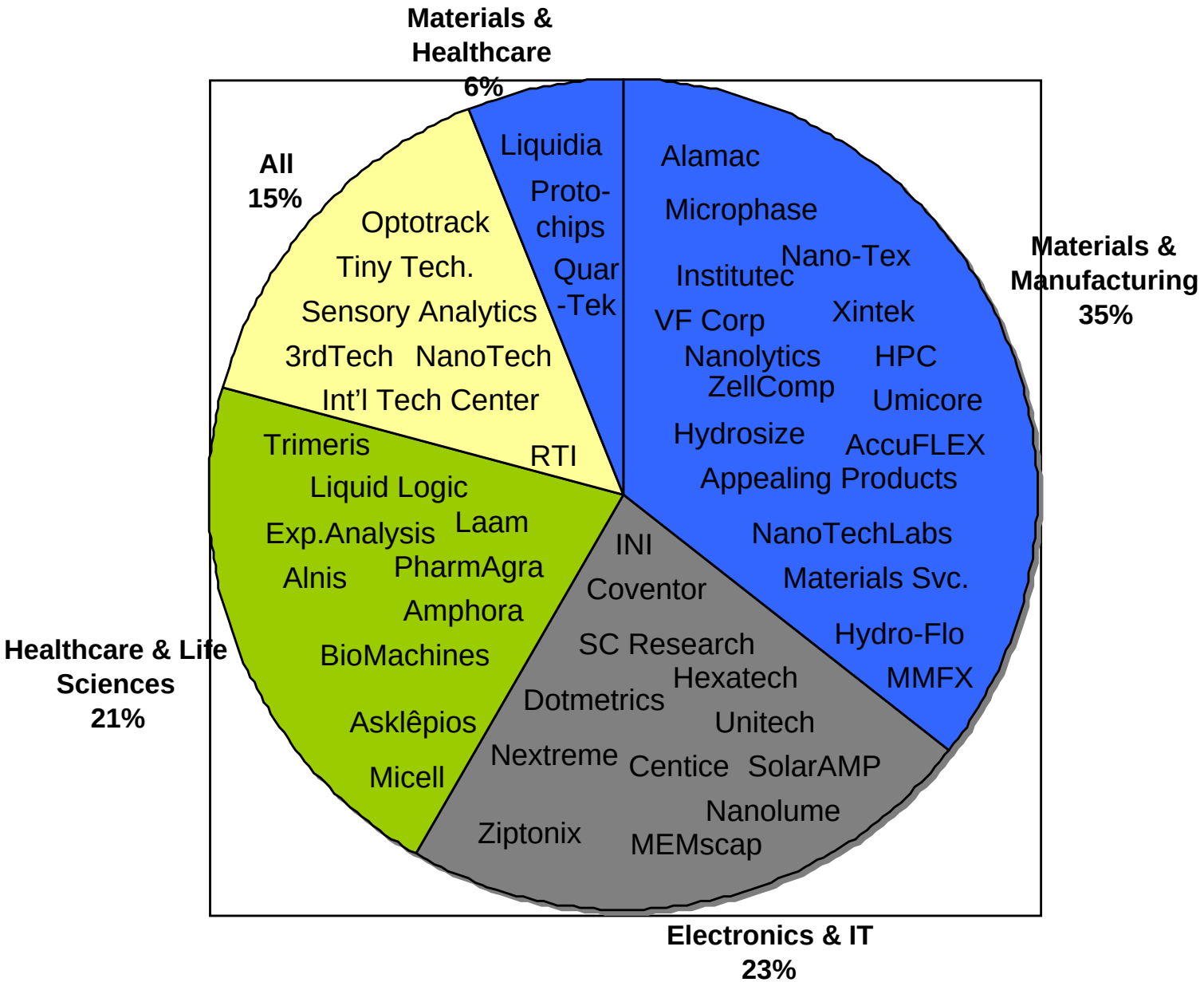
Nanotools (15)

Time Horizons for Major Nanotech Industries



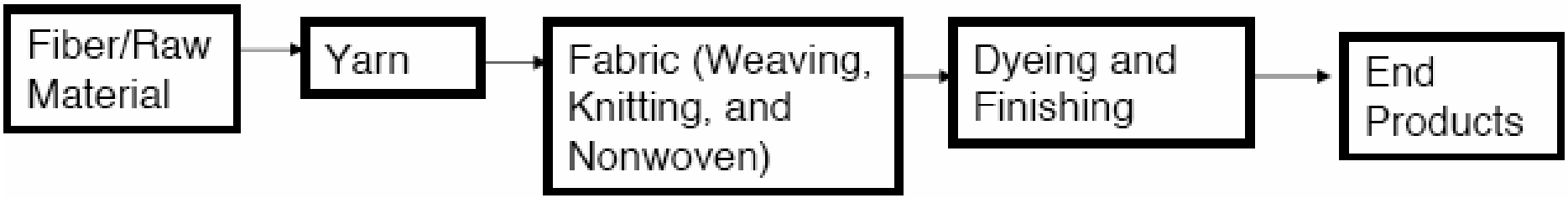
Source: October 2004 Lux Research Report "Sizing Nanotechnology's Value Chain"

North Carolina Nanotech Firms and Industries



Nanotechnology and North Carolina's Textile and Apparel Value Chain

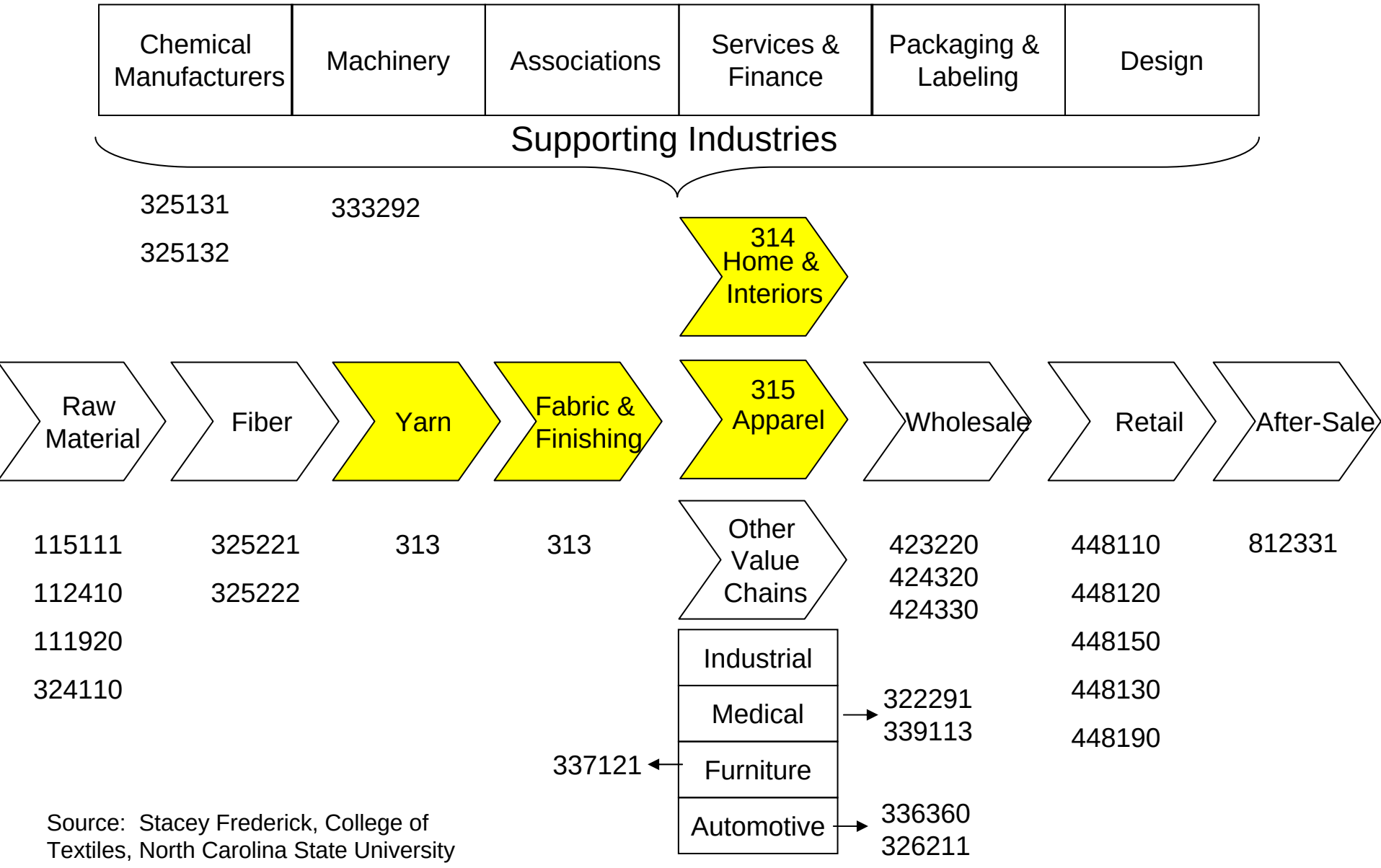
A Basic Textile Value Chain: North Carolina in 2006



Fiber/Raw Material	Yarn	Fabric (Weaving, Knitting, and Nonwoven)	Dyeing and Finishing	End Products
1. 60 Companies	1. 138 Companies	1. 227 Companies	1. 297 Companies	1. 497 Companies
2. 5,448 Employees	2. 22,273 Employees	2. 29,581 Employees	2. 18,291 Employees	2. 48,689 Employees
3. Sales - $1,569,245,515	3. Sales - $7,321,372,108	3. Sales - $6,016,127,707	3. Sales - $4,113,025,495	3. Sales - $13,191,097,861
NAICS: 115111 325221 325222	**NAICS:** 313111 313113 314991 314992	**NAICS:** 313210 313221 326150 313230 313241 313249	**NAICS**: 313112 313311 313312 313320 323113 323119 314999 325132 325199 325998	**NAICS:** 314110 314121 314129 314911 314912 337121 337122 337910 333411 339113 all 315

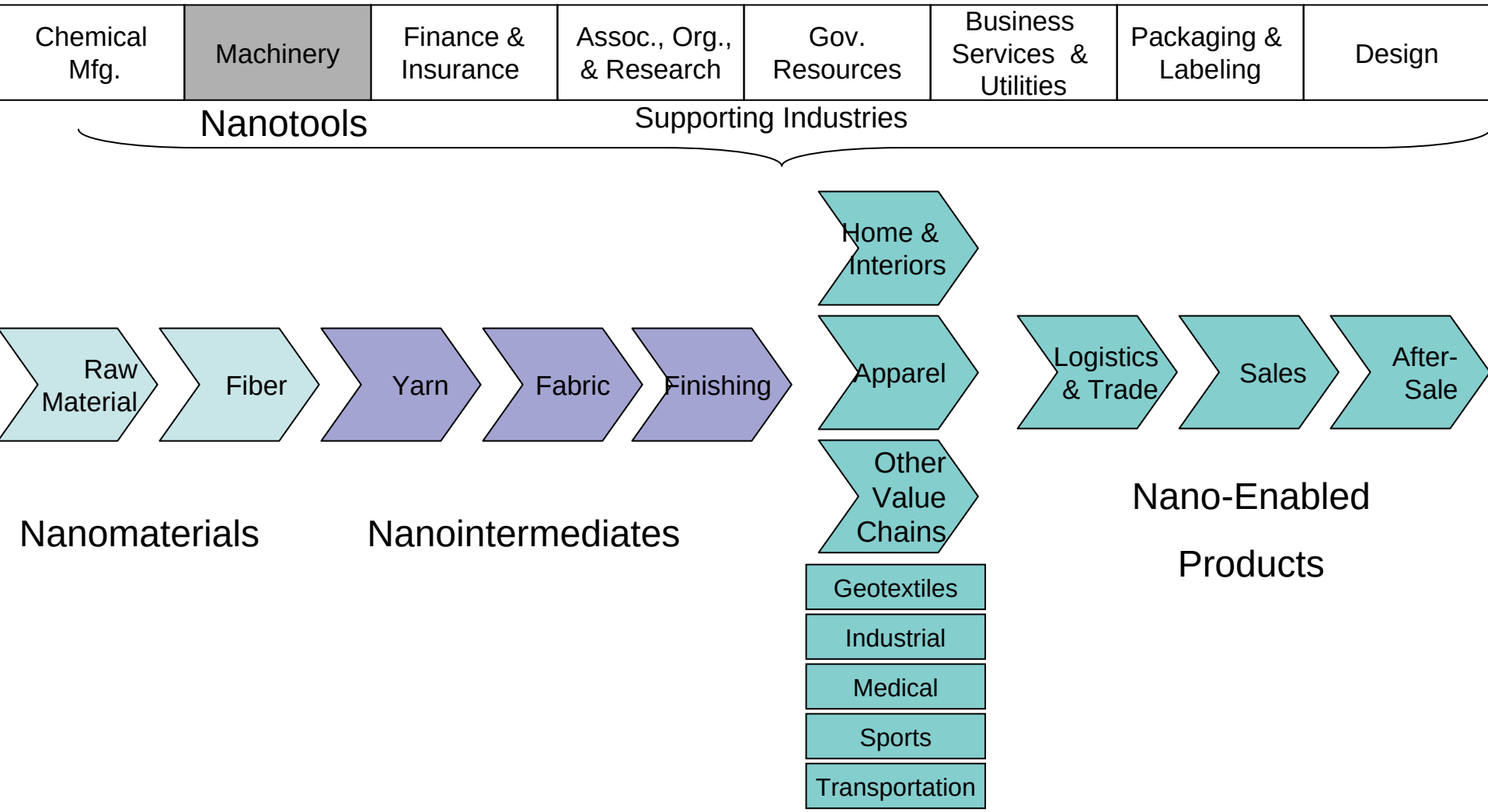
Source: Stacey Frederick, College of Textiles, North Carolina State University

A More Complete Value Chain



Source: Stacey Frederick, College of Textiles, North Carolina State University

Nanotechnology & the Textile Value Chain



Source: Stacey Frederick, College of Textiles, North Carolina State University

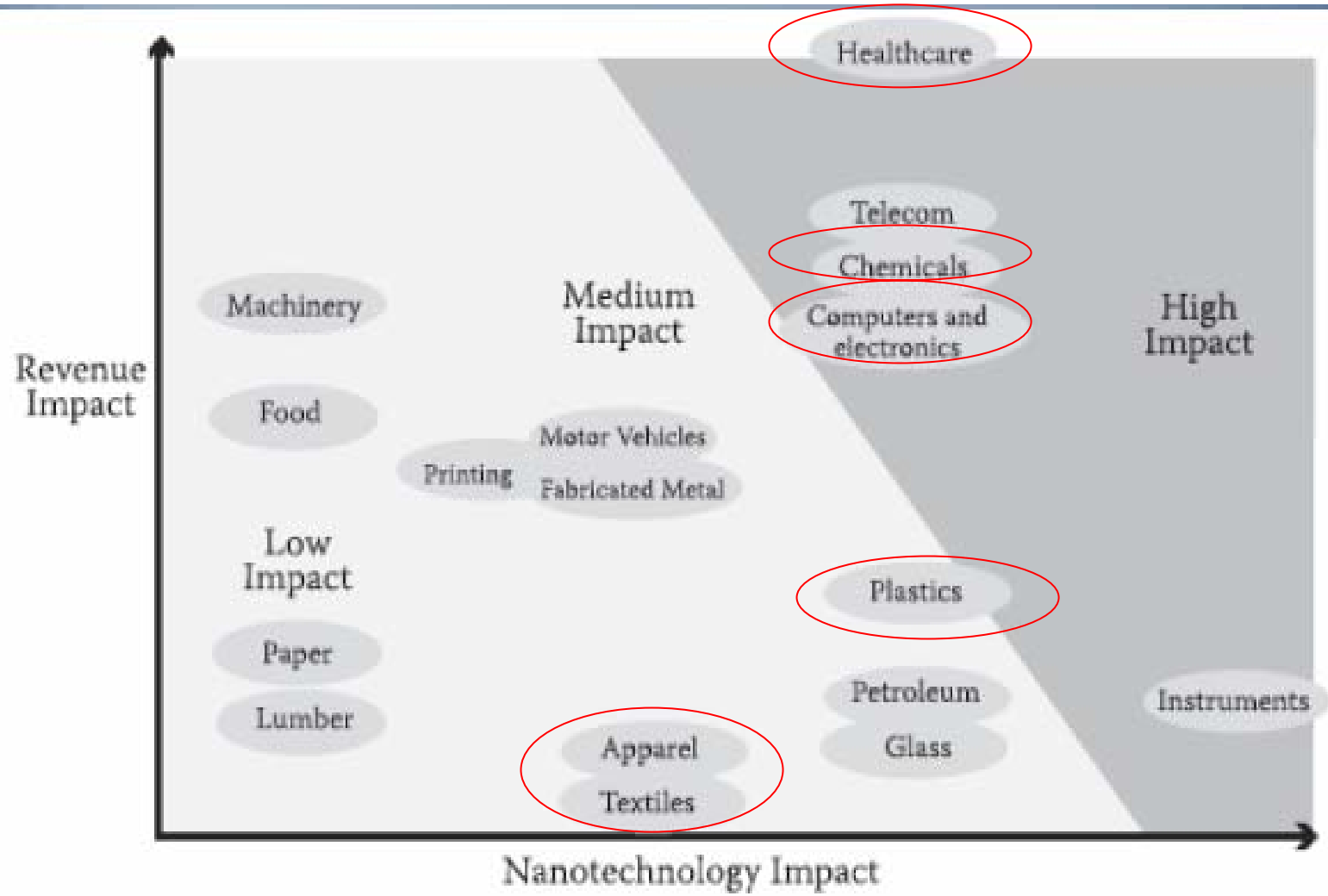
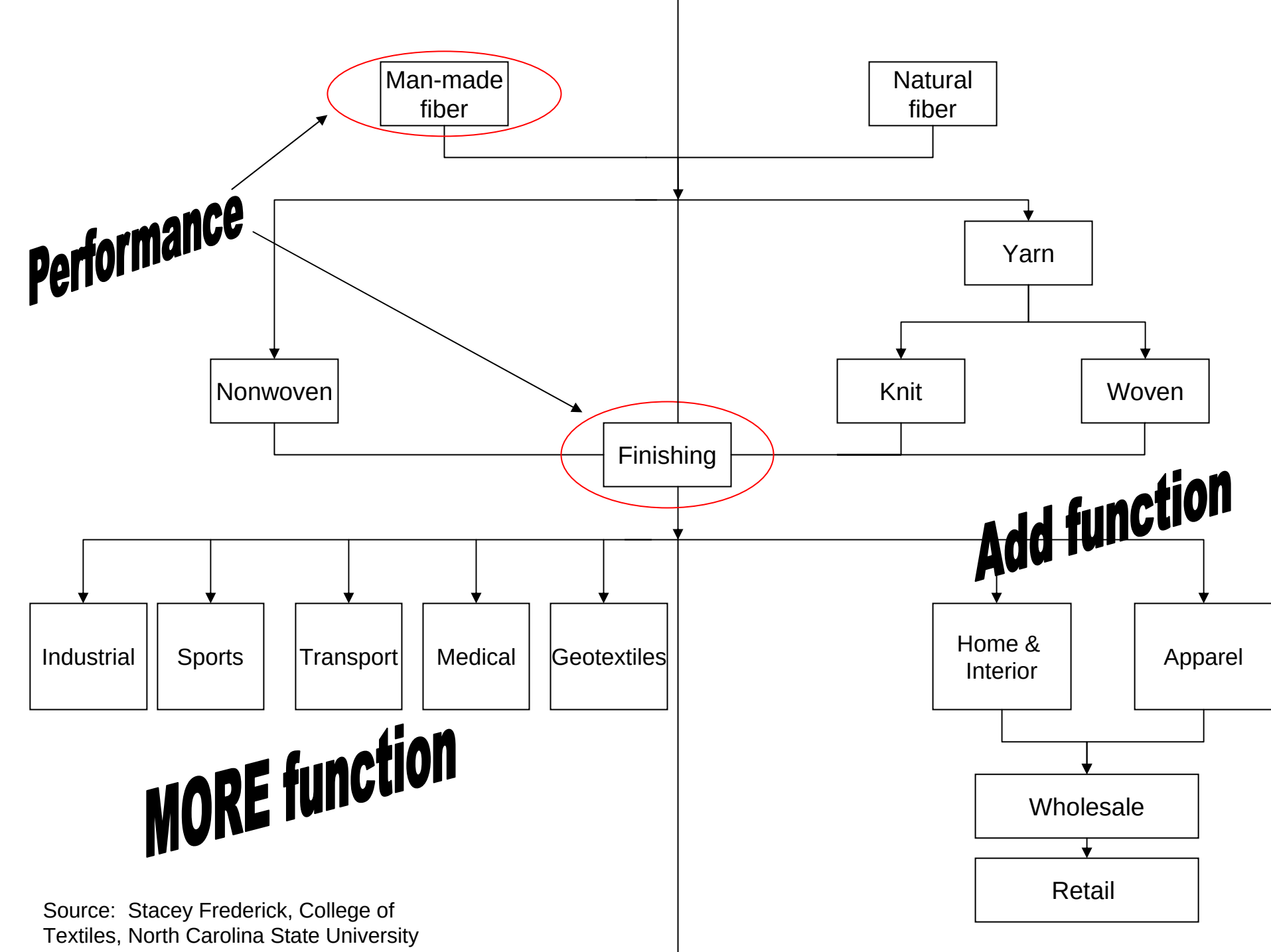


Figure 5.1: Nanotechnology's Probable Business Impact in 2007
Source: Larta, 2003



Source: Stacey Frederick, College of Textiles, North Carolina State University

North Carolina Nanotechnology & Textiles

- **Nanomaterials:**
  - Nanofibers
    - Improved filtration & barrier properties
    - Medical applications
    - Synthetics that simulate natural fibers
- **Nanointermediates**:
  - Carbon nanotube yarn
  - *LaamScience*: light-activated antimicrobial coatings
  - *Nano-tex*: patent for nano-layer coatings
  - *Alamac Knits*: fabrics with nano-layer coatings
- **Nano-enabled products**:
  - *VF Corp*: apparel with nano-layer coatings
  - *AccuFlex*: composite shaft golf clubs

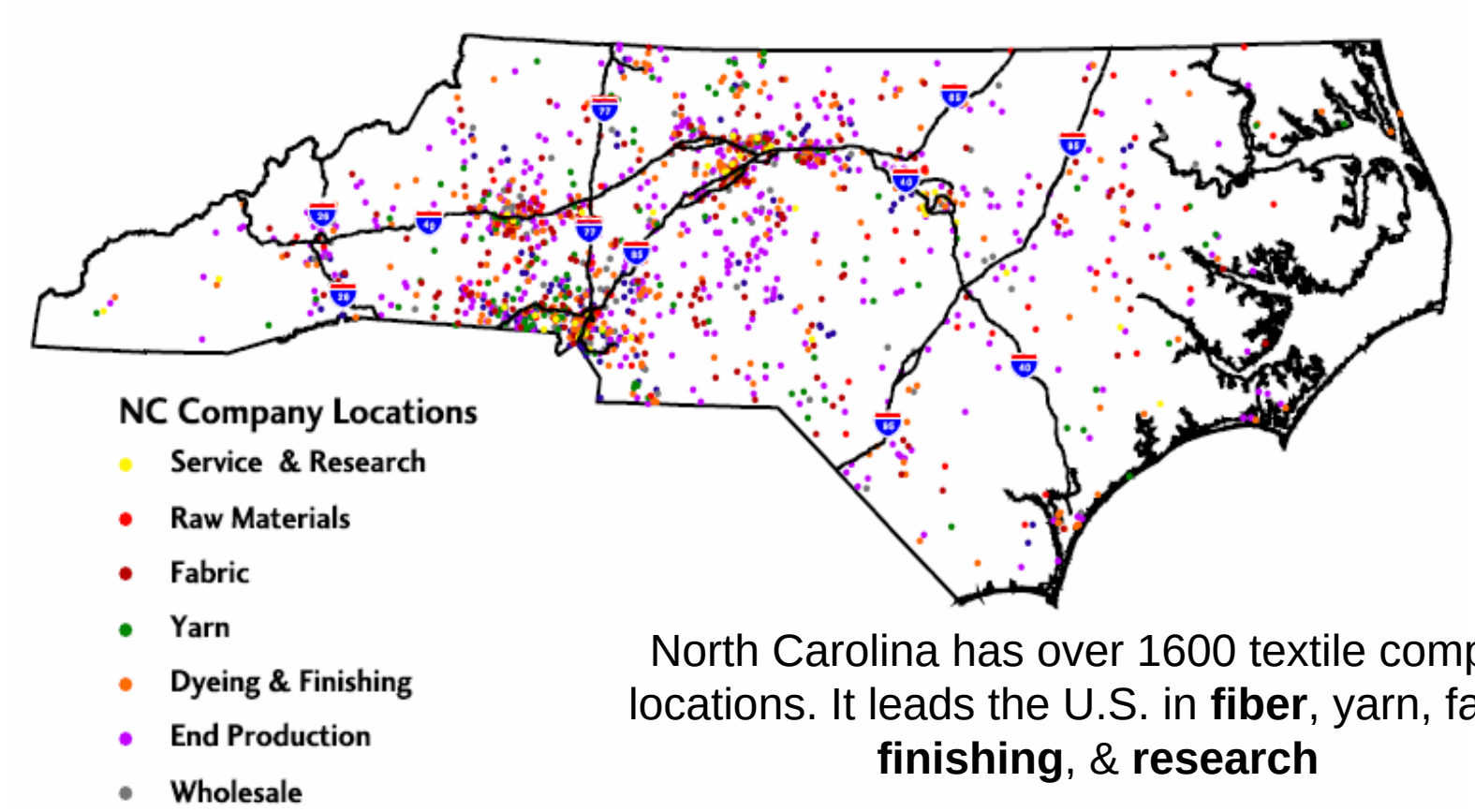
North Carolina's Nanotechnology Future

- Where will nanotechnology clusters form?
- *Nanotechnology is not an industry, but an enabling technology with a high degree of cross industry relevance*
- Therefore areas with…

1) An existing manufacturing base
2) An established emphasis on technology innovation
3) University support
4) Local support

…are one step ahead of the crowd

Importance of Existing Manufacturing Base: Textiles & Apparel



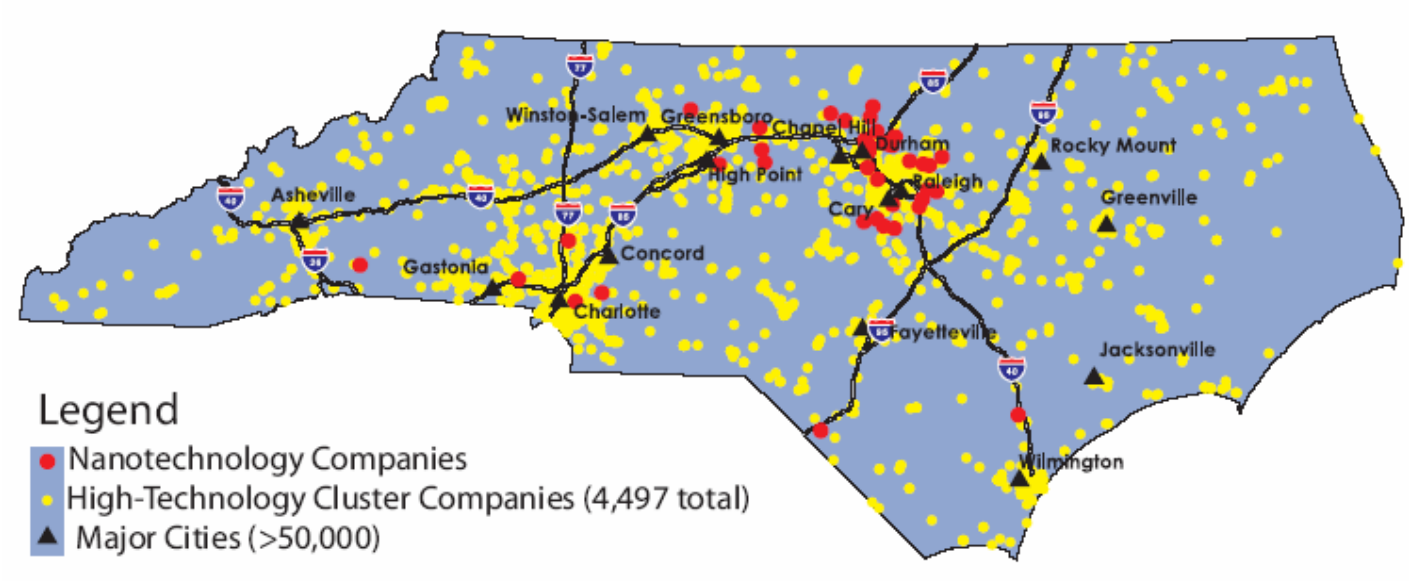
North Carolina has over 1600 textile complex locations. It leads the U.S. in **fiber**, yarn, fabric, **finishing**, & **research**

- Existing cluster
- Existing emphasis on technology
- Supportive environment

Source: N.C. Department of Commerce

Importance of Innovation: Existing Technology Firms

Nanotechnology Companies and High-Technology Companies

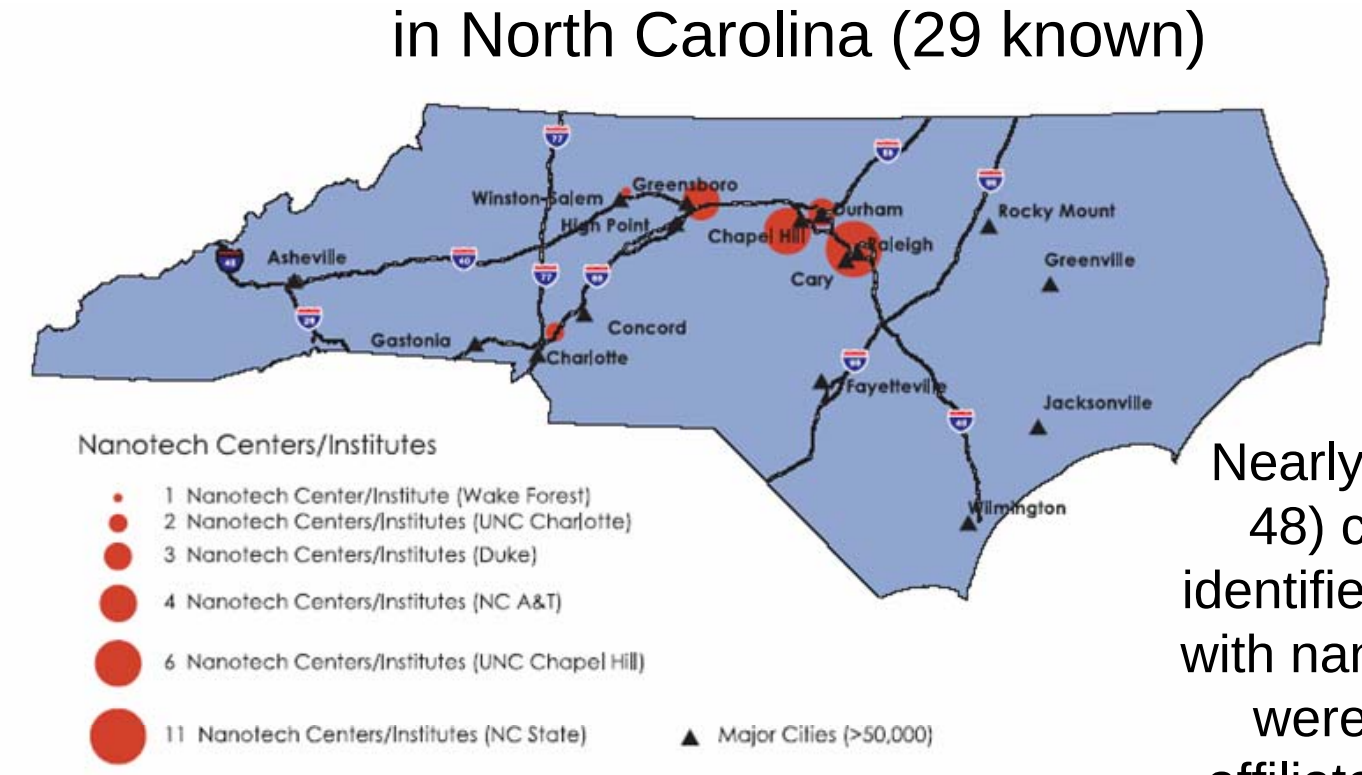


What about Charlotte?

Source: Board of Science and Technology: *A Roadmap for Nanotechnology in North Carolina's 21st Century Economy, 2005*

Importance of Universities/Research Centers

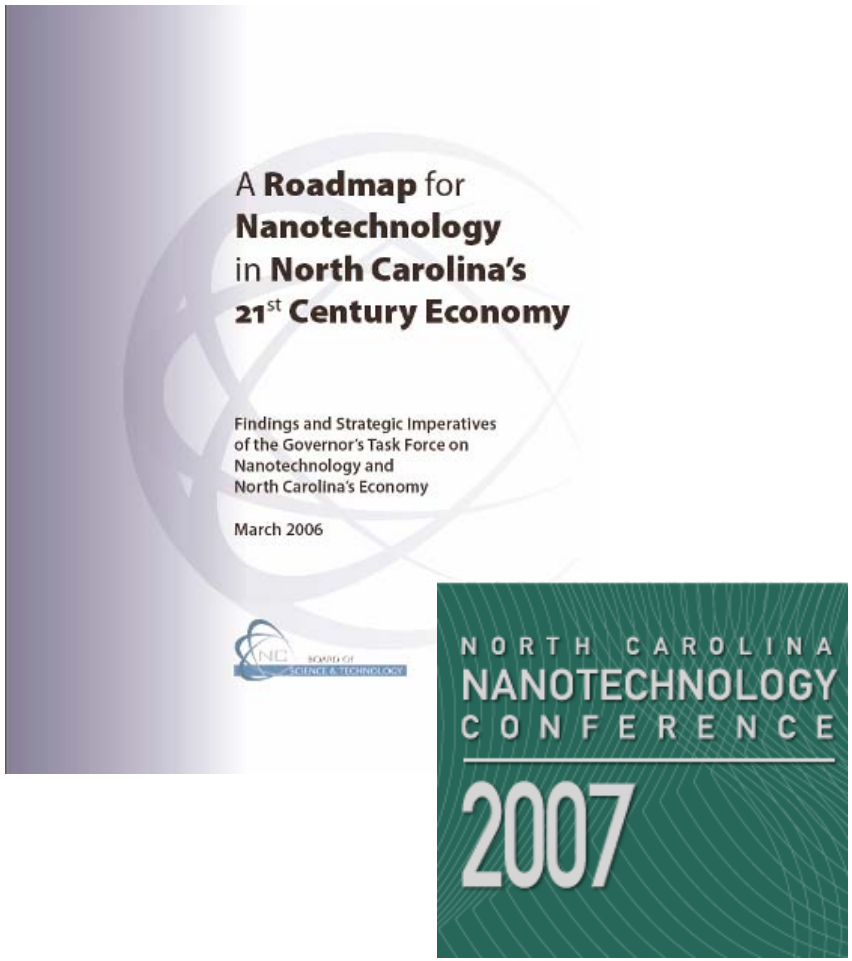
University Centers/Institutes Focusing on Nanotechnology in North Carolina (29 known)



Nearly 50% (23 of 48) companies identified as working with nanotechnology were originally affiliated with local universities

Source: Board of Science and Technology: *A Roadmap for Nanotechnology in North Carolina's 21st Century Economy, 2005*

Importance of State/Local Support



Policy Framework: Outlined in Roadmap

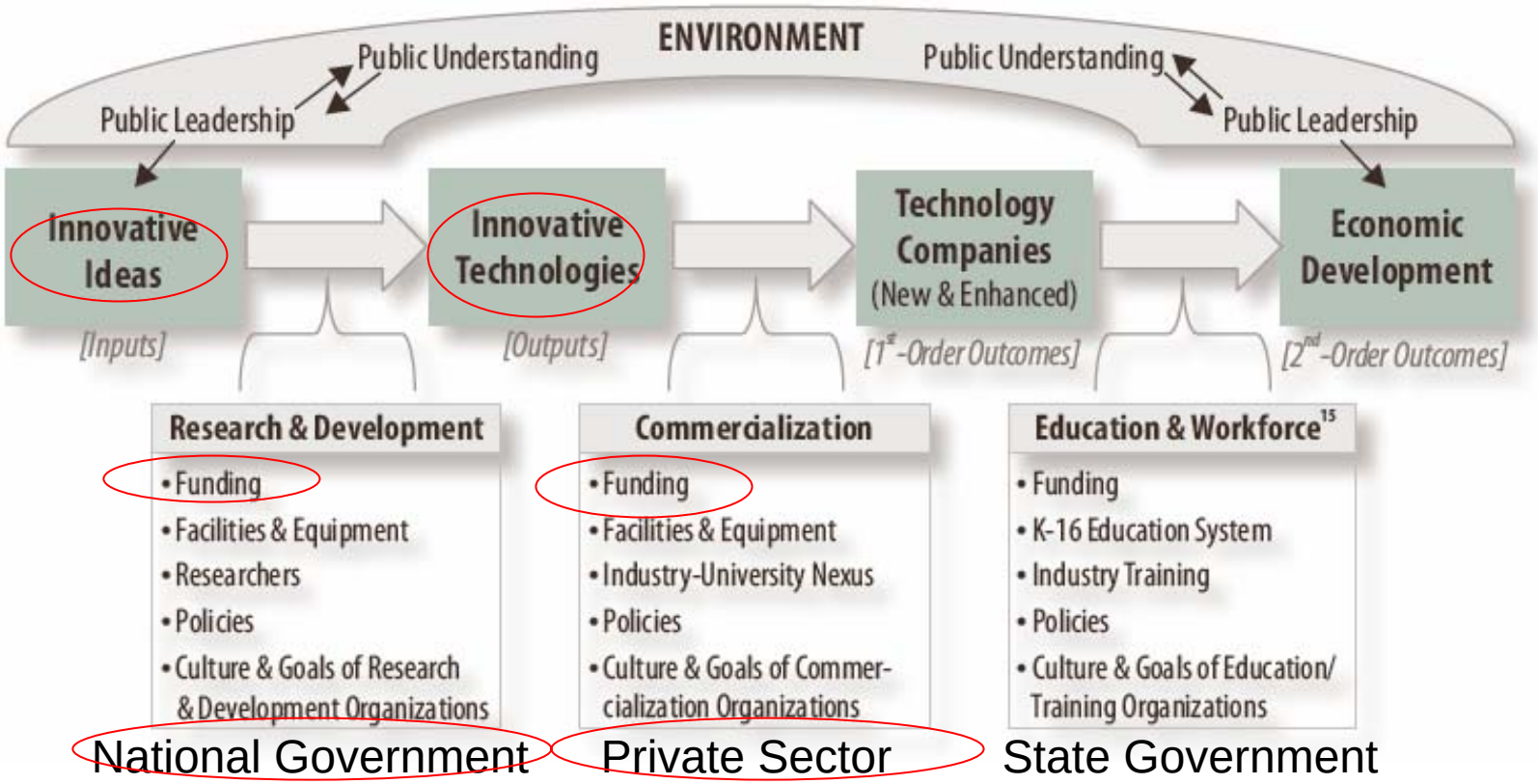
Strong in University R&D

RTP Leads U.S. in Innovation Capacity

Weak in Private Sector R&D

Stronger in Inputs

Weaker in Outputs



Roughly 86% of nanotech program awards to N.C. universities have come from federal agencies

Source: Board of Science and Technology: *A Roadmap for Nanotechnology in North Carolina's 21st Century Economy, 2005*

Future Directions for Research

- Step 1: Descriptive Mapping of North Carolina Nanotechnology Industry
  - Key questions:
    - What are NC nano firms doing? What fields of nano are they working in?
    - Where do they fit in the nano value chain?
    - Where are they located geographically?
  - Secondary research, using web searching other literature, and contacts to conduct a value chain analysis of the NC industry and to map NC firms across the value chain

Future Directions for Research

- Step 2: Firm Interviews and Surveys
  - Key questions:
    - Why have you chosen to locate in NC? What advantages/disadvantages does that give you?
    - What are your strategies for growth/expansion? What areas do you see for future innovation/commercialization?
    - What impact do policy and regulation have on your firm?
    - What are the key opportunities & challenges for the industry going forward?
  - Primary research, using contact information from a variety of sources to set up interviews with key business leaders in the industry

Future Directions for Research

- Step 3: NC Competitive Analysis
  - Key questions:
    - How does NC's firm profile compare with that of other US states? With that of other countries?
    - On which dimensions does NC have particular strengths? Innovation? Entrepreneurship? Capital?
    - How can NC build on these strengths to strengthen the local industry? Who are the key stakeholders?
  - Combination of primary research (interviews with policymakers, industry analysts) and secondary research (secondary literature and other materials)

Thank you for your attention!