Anticipating developments in nanotechnology commercialization

Jan Youtie\textsuperscript{a}, Philip Shapira\textsuperscript{b,c}, Luciano Kay\textsuperscript{c}

\textsuperscript{a}Enterprise Innovation Institute, Georgia Institute of Technology
Atlanta, GA 30332-0640, USA

\textsuperscript{b}Manchester Institute of Innovation Research, Manchester Business
School, University of Manchester, UK

\textsuperscript{c}School of Public Policy, Georgia Institute of Technology, Atlanta, GA
30332-0345, USA

Nano Research Day, September 3, 2010, School of Public Policy, Atlanta, Georgia
Shift from Discovery to Application

Ratio of corporate nanotechnology patent applications to corporate nanotechnology publications by year

with corporate activity in all patent offices

with corporate activity in WIPO
Anticipating nanotechnology commercialization: Some questions which need better answers

- How is the shift from discovery to application in nanotechnology taking place?
- Where is this shift taking place? Who is involved with this shift?
- What type of applications will be developed?
- How do companies address uncertainty in nanotechnology commercialization?
- How can we feed insight about nanotechnology commercialization into the processes of anticipatory governance?
Starting Point

- Georgia Tech Global Nano Databases (Porter et al, 2008)
  - WOS, SCI
  - IISC PatStat
- Focus on WIPO patents for modeling (5 or more nano patents)

<table>
<thead>
<tr>
<th></th>
<th>Publications</th>
<th>Patents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Source</td>
<td>ISI-WoS</td>
<td>Patstat</td>
</tr>
<tr>
<td>Unit of analysis</td>
<td>Publication record</td>
<td>Patent record</td>
</tr>
<tr>
<td># Records</td>
<td>648,195</td>
<td>92,463</td>
</tr>
<tr>
<td># Organizations (all type)</td>
<td>51,192 (author affiliations)</td>
<td>14,739 (assignees)</td>
</tr>
</tbody>
</table>

Notes: a. data sources cover only part of 2008 for patents (until July 2008); b. before data clean up; c. before data clean up, includes authors’ affiliations in publications, patent assignees in patents, and all type of unique organizations in the establishments database.

Source: Based on Georgia Tech global nanotechnology databases.
“Multi-player” rather than “global”


Note: X and Y axis are log scales; labels are shown for only some country examples; bubble color does not represent any measure; partial year 2008 is annualized.
Source: authors’ analysis.
Locations of Research Not Necessarily the Same as Commercialization

Nano Publications
1990-2006

Nano Corporate Entry
as of 2009
Nanotechnology Patenting Strategies of US Multi-National Enterprises (MNEs)

- 25 largest US MNEs active in patenting in nanotechnology
  - (13% of all USPTO, EPO, WIPO Patents)
- Non-US share declining
  - 1997-2001 = 1187 patents; 17% co-invented abroad; 10% totally invented abroad
  - 2002-2006 = 2555 patents; 13% co-invented abroad; 8% totally invented abroad
- US home advantages still evident.
- Significant for non-US patenting: host country scientific strength, firm experience and technological capabilities, and technological diversity in patenting.
- Not significant for non-US patenting: Market size and GDP/capita

International Nano Patent Strategies: Small Businesses are Increasingly Emerging

- Analysis of WIPO PTC nano-related applications 1997-2006 of 300+ US owned SMEs
- Increased geo-graphic breadth of patent protection; regional/international (co-) invention patterns observed

Next Question: What drives the growth of US SME international patenting?

Proportion of U.S. SMEs* with WIPO PCT filings (relative to U.S. Large)

- 1997: 5%
- 1998: 15%
- 1999: 20%
- 2000: 25%
- 2001: 30%
- 2002: 35%
- 2003: 20%
- 2004: 15%
- 2005: 20%
- 2006: 25%

* SBA standard definition, less than 500 employees

Authors: Andrea Fernández-Ribas with research assistance Ronak Kamdar. Support obtained through CNS-ASU and the Kauffman Foundation and Georgia Research Alliance.
Opportunities for SMEs and Large companies are in contrasting applications

<table>
<thead>
<tr>
<th>Use of nanotechnology (classes of technologies—IPC codes)**</th>
<th>Firm size*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>SME</td>
</tr>
<tr>
<td>Nano-raw material (e.g. carbon nanotubes, proteins)</td>
<td>21%</td>
</tr>
<tr>
<td>Nano-intermediate (e.g. semiconductors, films)</td>
<td>76%</td>
</tr>
<tr>
<td>Nano-products (e.g. solar cells, cosmetics, drugs)</td>
<td>11%</td>
</tr>
</tbody>
</table>

* United States, Fortune 1000 vs. Non-Fortune 1000; all nano-patents since 1990.
** Technologies classified according to definition in Alencar et al. (2007), multi-classification possible. Covers 57% of all nano-patent records
## Pilot Cases

### Contrasts in Positioning of “Nano”

<table>
<thead>
<tr>
<th>Company</th>
<th>Segment</th>
<th>Strategy</th>
<th>R&amp;D/Linkages</th>
<th>Marketing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3M Co.</td>
<td>Industrial</td>
<td>Multi-segment, Multi-product</td>
<td>Global R&amp;D, Multi-university links</td>
<td>“Nano” = USP</td>
</tr>
<tr>
<td></td>
<td>materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nantero, Inc.</td>
<td>Industrial</td>
<td>Single-segment</td>
<td>Central R&amp;D, Multi-university</td>
<td>“Nano” = USP</td>
</tr>
<tr>
<td></td>
<td>materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SurModics, Inc.</td>
<td>Medical</td>
<td>Single-segment, Multi-product</td>
<td>Central R&amp;D, University link</td>
<td>“Nano” = USP</td>
</tr>
<tr>
<td></td>
<td>markets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>markets</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>International Cosmeceuticals, Inc.</td>
<td>Consumer products</td>
<td>Single-segment, Intermediate user</td>
<td>No R&amp;D, University link</td>
<td>“Nano” downplayed</td>
</tr>
</tbody>
</table>

Source: multiple data sources online, as of 2008 otherwise indicated (e.g. Reference USA, BusinessWeek, Yahoo Finance)
Nanotechnology commercialization summary
“Knowns” and “Unknowns”

“Knowns” (or better “knowns”)
- Corporate entry into nanotechnology through research publications and patenting
- Geographical concentration of corporate entrants in nanotechnology
- First generation consumer-oriented products
- Linkages with public research and universities
- Nano varies as a marketing brand / certification

“Unknowns” (or mostly “unknowns”)
- Corporate strategy (in the face of uncertainty)
- Influence of contrasting regulatory environments
- Fit in the global supply chain v. inventive activity
- International boundaries, consumer values and demand
- Employment and labor market implications
- Implications for anticipatory governance
## Planned Corporate Panel

### Selection Criteria
- United States, Europe, Asia
- MNEs and SMEs
- Markets: (1) consumer, (2) medical, (3) industrial

### Sources
- Publications and patents
- PEN DB of nano products
- Company websites
- NSF award search
- Press releases (company website or other sources)
- Public companies: SEC filings
- Media coverage
- Primary data collection

### Measures
- Applications
- Customers
- Relationships with universities
- R&D organization
- Global value chain
- Funding sources
- Corporate responsibility
- Strategy
Plans for coming year

Methods
- Finalize and implement methodology for selection of US panel
- Refine web-scraping technique for scale up
- Locate improved patent information source

Proposed papers
- National Innovation Systems and the Globalization of Nanotechnology Innovation
- Nanotechnology’s Transition from Discovery to Commercialization in Small & Medium-Sized Enterprises: An Exploration of Web-scraping Evidence