Method and Platform for Identifying Stakeholders in the Nanotechnology Economy

Stacey Frederick, Research Scientist
Center on Globalization, Governance & Competitiveness (CGGC), Duke University
Center for Nanotechnology in Society, UC-Santa Barbara

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Goals & Obstacles

• **Goal/Objective:** Track and measure economic, social and/or environmental impacts related to developments in nanotechnology.

• **Obstacles:**
  - Nanotechnology is not an industry; it enables developments in all industries in different ways
  - U.S. firms are not required to disclose activities or products involving developments on the nanoscale
  - No centralized effort to collect firm/product/worker data
  - No firm or product classification
  - Need to track developments along the entire value chain
Value Chain Analysis

- Value chain: activities that firms and workers do in the process of creating a product or service
  - Includes physical alterations (supply chain) as well as activities that add value (research, branding, services)
- Six main activities – need to be able to identify firms in each stage of the entire supply chain performing each activity
- Need to be able to map the structure for a particular product without nano and “layer” on nano developments
Existing Efforts to Identify Firms & Generate Metrics: Data Sources & Methods

- Research
- Design & Development
- Manufacturing
- Logistics & Distribution
- Marketing & Retail
- Services

Publications
- Patents
- Government Funding

Data mining/keyword searches → nano classifications
Only capture a subset of value-adding activities

Lack supporting methodology & dataset

“Expert Opinion” Statistics

Firm-Level Reports & Directories

Need: combined effort; classification system; users can include/exclude at will

Often one-time efforts * Limited scope (geography, activities or supply chain) * Several lack a methodology
Suggested Data Collection & Estimation Model

(1) Compile/verify existing info

(2) Add new companies & provide R&D details

(3) Add general business info; develop non-nano value chain maps

(4) Compare results to existing estimates

(5) Continue search for new sources; maintain & update info

Expert Opinion Statistics
- Lux, BCC, F&S, NSF, etc.

Business Data Sources
- Dun & Bradstreet
- Government Statistics
- LinkedIn
- Company Websites
- Market Reports

Firm-Level Nano Datasets
- Web-Based Directories
  - Nanowerk, NSTI, NanoVIP, InterNano
- Research Projects, Reports & Journal Articles
  - Woodrow Wilson Center, CADTSC, Lux
- Conference Attendees & Presenters

R&D Datasets
- Publications & Patents
- Funding Sources
  - Government & Private
Goals: “Master” Database and Classification Codes

Classification-Based or Data-Supported Statistics

Business Data Sources + R&D Datasets

Nano Classification Codes
- Firms (NAICS)
- Products (HS, SITC)
- Workers (SOC)
- Patents (IPC)
- Publications (WOS)

Master Firm/Product Database

Defensible, method-based dataset
- Publicly available
- Multiple variables available
- User can dictate inclusion/exclusion

Firm-Level Nano Datasets

Repeatable Classifications built on best available data

Supplement rather than replacement for data mining efforts
Progress to Date

1) Developed a value chain model
2) Firm & organization-level data
   - Compiled/cleaned data from 20 sources
   - Enhanced by mapping stakeholders to the value chain
3) Developed web-based platform: educational tool and a means of disseminating information
4) Ability to provide in-depth analysis of the nano activity in California across multiple variables
5) Preliminary estimates of U.S. workforce
Basic Nano Value Chain Model Overview

Layers: 120+
Stages: 5
Sectors: 27
Subsectors: 91

Value-Adding Activities

Firms / Supply Chain
Layers: 120+
Stages: 5
Sectors: 27
Subsectors: 91
California in the Nano Economy
www.CaliforniaNanoEconomy.org

- Industry and education-focused website for the nano community
- Presents California's footprint in nanotechnology
- Interactive, web-based application of a value chain research approach

Main Areas
- Firms & Products
- Value Chain Mapping
- Education and Workforce Development Programs
- Public Policy and Economic Development Initiatives

Center on Globalization, Governance, & Competitiveness (CGGC) at Duke University
Center for Nanotechnology in Society at UC-Santa Barbara
Value Chain Section

- Interactive value chain diagram
- Hover cursor over boxes for description & stats
- Click boxes for detailed info
  - Forward & backward linkages
  - Important global firms & organizations
  - Manufacturing methods
  - California locations
Firm & Organization Data

- **Location Pages** (Fig. 1)
  - Physical Location & Basic Info
  - Value Chain Mapping
  - Products
- **Profile Pages**: 100+ more-detailed profiles of firms & organizations
  - Company Overview
  - Buyers, Suppliers & Strategic Partners
  - Innovation & Technology

![Value Chain Mapping](image1.png)

![Company Information](image2.png)

**Fig. 1**: Example Location Page on California in the Nano Economy Website

**Fig. 2**: Interactive Geographic Maps of Nano-Related Firms & Organizations

- **Maps**: interactive, geographic maps of locations by key variables (Fig. 2)
# Snapshot of California Nano Activity

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Number in California</th>
<th>California Share of USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Firms Engaged in Nano-Related Activity</td>
<td>381</td>
<td>25%</td>
</tr>
<tr>
<td>Organizations Engaged in Nano-Related Activity</td>
<td>130</td>
<td>22%</td>
</tr>
<tr>
<td>Nano-Related Employment (Firms &amp; Organizations)</td>
<td>47,534</td>
<td>21%</td>
</tr>
<tr>
<td>NNI-Funded Centers &amp; Labs (NSF, DOD, DOE, NIH)</td>
<td>22</td>
<td>22%</td>
</tr>
<tr>
<td>U.S. Nano-Related Patents with Inventors from California (USPTO Class 977)</td>
<td>1,795</td>
<td>20%</td>
</tr>
<tr>
<td>NSF Nano* Awards (1997- Aug. 2013)</td>
<td>1,069</td>
<td>11%</td>
</tr>
<tr>
<td>Nano-Related Degree Programs (AS, BS, MS, PhD)</td>
<td>8</td>
<td>9%</td>
</tr>
<tr>
<td>Nanotechnology Dissertations*: 1999-2007</td>
<td>549</td>
<td>14%</td>
</tr>
</tbody>
</table>

Data available on the California in the Nano Economy website

Sample California Firm Characteristics

- Top three NAICS codes at three-digit level: 64% of total
  - Computer & Electronic Product Mfg.: 35%
  - Professional, Scientific & Technical Services: 21%
  - Chemical Mfg.: 9%
- Nearly half (46%) established since 2000
U.S. Nano Workforce Estimates (2010-12)

United States: Existing Estimate (2010)$^+$: 220,000

Preliminary estimates based on presented methodology:

- **Upper Bound**: all employees, all locations$^{++}$: 446,800
- **Mid-Range**: roughly half: 224,200
  - Nano-focused firms were only 2% of emp. in California
- **Lower Bound$^{+++}$**: 24,800
  - Underrepresentation from manufacturing
  - California represents around 20%

**Important Points:**

- Objective was to provide a dataset that could be used as a basis for estimation - likely does not capture all firms, but provides a starting point
- Numbers represent people potentially employed due to nanotechnology; not the number of people that will come into contact with nanomaterials

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$^{++}$ Based on employment data for 2,123 firm and support locations

$^{+++}$ Number of people on LinkedIn in the United States that selected “nanotechnology” as their industry: October 16, 2013
Conclusions/Next Steps

- Ability to measure and track impacts of nano depends on ability to identify firms/products/workers
- More complex process for nano but enough data exists to begin this process
- Focus of this research is to begin to put together the necessary pieces
- Continue to build & refine value chain model
- Identify, add and maintain firm-level data
- Expand website to other states / countries
- Partner with other groups to scale the process
Thank you

Stacey Frederick
stacey.frederick@duke.edu