Creating successful biotechnology clusters

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Presentation for “The Shape of Things to Come” conference, Stanford University, Jan 17-18, 2008
Why have some regions succeeded in biotech while others have failed?

Source: Meldman, M. and E. Romanelli, "Organizational Legacy and Internal Dynamics of Clusters", working paper, University of Toronto, 2006
US-European comparisons on the success of biotechnology clusters

Source: Boston Consulting Group, 2003
Comparison of UK, German, and San Diego biotechnology

Source: Casper, Creating Silicon Valley in Europe, OUP, 2007
UK-Boston comparison, 2001

With similar “engines of scientific ideas” Boston is transforming those ideas into more pronounced economic value compared to UK.

Data from 2001
Source: DTI, Brookings Institute, Ernest & Young, NIH
Perspectives on creating biotechnology clusters: public policy approach

Governments can orchestrate the development of biotech

- Most biotech firms originate in universities – which governments control through funding and regulation
- Policies can:
  - Stimulate the commercialization of science
  - Surround universities with infrastructures designed to hasten commercial development (e.g. technology parks)

However...

- There are many more world-class universities than there are well-performing clusters
- There is very little evidence that government intervention has directly lead to successful cluster creation
  - German experience with “public venture capital”
  - Frameworks, e.g. Bayh-Dole in USA, are important
Economic sociology approach

- Successful high-regions develop social structures promoting innovation
- Social ties and labor market mobility – Saxenian (1994); Almeida and Kogut (1999):
  - Studies have documented high inter-firm mobility in Silicon Valley and a correlation between high mobility and innovation within clusters – mobility helps generate a decentralized social structure
- Mobility helps explain cluster performance in two ways:
  - Innovation: knowledge is diffused through job-hopping
  - Career management – High inter-firm mobility (implicitly facilitated through social networks) can dramatically reduce the career risk of leaving a stable job to work in a start-up
My current project: a ‘sociometric’ history of California biotech

- Study compares social networks linking senior scientists and managers over the history of California biotechnology, 1976-2005
  - Two of the world’s very few successful biotechnology clusters are in California (SF Bay Area and San Diego), but also a perhaps surprising failure case: the Los Angeles area

- My previous research focused on public policy towards technology clusters in Europe, focusing on UK-Germany comparisons
  - Modest success of UK/Cambridge biotechnology cluster
  - Failure of German technology policy towards biotechnology
Characteristics of successful technology clusters – three factors to emphasize

- **Network effect**: Successful clusters develop social networks linking managers, scientists, and financiers.

- **Heterogeneity**: They are populated by individuals and organizations with a diverse range of skills and experiences.

- **Marketplace orientation**: They become “hubs” of activity, with fairly rapid entry and exit of organizations and individuals.
1. Successful clusters develop rich networks linking individuals and firms

- Draws on ideas from Saxenian and other researchers linking cluster performance to the quality of social ties linking scientists, engineers, and managers.

- Use of social network analysis to map career affiliation ties linking senior managers
  - Developed from gathering career histories of 2500 senior managers employed in CA biotech
  - Network models “decay” ties over time (in most graphs I will show, after 5 years)

- Thus a partial representation of social ties (does not include ties formed through professional associations, informal networking, etc.)

- Evidence from California biotech
- Comparisons with Cambridge/UK and Germany (scientists only)
Career affiliation networks linking senior managers: San Francisco biotechnology, 2005, using 5 year decay rule

Senior manager career affiliation networks, San Francisco, 2005
San Diego 2005 (again using 5 year decay rule)
Less successful biotech clusters lack social ties linking managers and scientists across firms
European clusters are smaller and less dense

- Evidence from an earlier study of career affiliation networks of scientists working within Cambridge/UK and four German clusters
- Social ties in Europe are generally less dense and smaller
  - Less career mobility
Career Affiliation Ties Across Cambridge/UK Scientists (2002): No decay in ties and no need to work in same place at same time
Germany – career affiliation ties of scientists (both junior and senior), 2002
San Diego – Career affiliation ties of senior scientists, 2004
What factors impact network emergence?

- Role of founders
- Role of anchor companies
Networks linking founders often form the “backbone” of technology clusters.

San Francisco founder networks
The success of San Francisco biotech is driven by a high number of serial founders

<table>
<thead>
<tr>
<th>Number of Companies Founded</th>
<th>LA</th>
<th>SD</th>
<th>SF</th>
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<tbody>
<tr>
<td>1</td>
<td>80% (85)</td>
<td>75% (134)</td>
<td>54% (146)</td>
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<tr>
<td>2</td>
<td>12% (13)</td>
<td>19% (34)</td>
<td>26% (69)</td>
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<tr>
<td>3</td>
<td>4% (4)</td>
<td>4.5% (8)</td>
<td>12% (32)</td>
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<tr>
<td>4</td>
<td>2% (2)</td>
<td>1% (2)</td>
<td>4% (11)</td>
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<tr>
<td>5 or more</td>
<td>2% (2)</td>
<td>.5% (1)</td>
<td>4% (11)</td>
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<tr>
<td>Repeat Founders</td>
<td>20% (21)</td>
<td>25% (45)</td>
<td>46% (123)</td>
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<tr>
<td>Total # Founders</td>
<td>106</td>
<td>179</td>
<td>269</td>
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Technology clusters often emerge through the emergence of “anchor companies” whose employees go on to found other companies.

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<tr>
<th></th>
<th>Genentech</th>
<th>Amgen</th>
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<tr>
<td>Total number of Senior Managers that worked in company and went on to found another biotech firm</td>
<td>25 (22 Companies)</td>
<td>4 (3 Companies)</td>
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<tr>
<td>Percent of Senior Managers that founded biotech companies</td>
<td>16% (25/158)</td>
<td>3.5% (4/116)</td>
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Biotech companies founded by former senior managers employed by Genentech and Amgen.
The ‘failed acquisition’ of Hybritech in San Diego drove the formation of this cluster.
San Diego 1982

Hybritech (always red)

San Diego 1987

Network backbone emerging

San Diego 1989

San Diego 1990
2. Successful clusters have a heterogeneous population

- The heterogeneity of a network is important – access to different types of individuals, organizations, etc.
  - Successful entrepreneurs form bridges across different communities of actors
- Non-market actors, e.g. universities, hospitals, and research institutes, must actively participate in local technology marketplaces
- Companies must have access to a deep labor pool consisting of both scientists and managers with industry experience
Successful clusters develop networks linking a variety of academic and commercial participants.

Composition of biotech inventor networks, 1995
Source: NBER patent database
Within biotech clusters, recruiting a large population of individuals with industry experience is crucial to success.

San Diego career affiliation networks, 2004
Successful technology clusters build both scientific communities and networks of non-technical managers.
3. Successful clusters develop a “hub” or marketplace effect

- Cluster theory tends to privilege local actors and assume that competencies develop through long-term investments
  - Many studies of cluster development start with current actors and “work back”, creating a methodological bias

- My research on California shows:
  - Labor market are very dynamic with extensive entry and exit of individuals
  - Companies frequently bring in resources from outside the region

- European comparisons:
  - Weaker labor markets exist for experienced managers, particularly in Germany
Mobility Analysis: SF vs. LA

SF career patterns:
- Between 1976 and 2005 there were 809 instances of people leaving a job in SF biotech:
  - 58% (466) of moves were out of SF biotech (retired, moved to a biotech firm in another region, or stayed in region but not in biotech)
  - 42% (343) were lateral moves to other SF biotech firms

LA career patterns:
- Between 1981 and 2005 there were 170 instances of people leaving a job in LA biotech:
  - 88% (149) were moves out of LA biotech
  - 12% (21) were lateral moves to other LA biotech firms
A strong marketplace for talent exists within successful clusters

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<tr>
<td>Founder Lab</td>
<td>40</td>
<td>17</td>
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<tr>
<td>Local Academic</td>
<td>2</td>
<td>17</td>
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<tr>
<td>Non-Local Academic</td>
<td>24</td>
<td>27</td>
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<tr>
<td>Biotech</td>
<td>6</td>
<td>168</td>
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<td>Pharma/Industry</td>
<td>12</td>
<td>47</td>
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<td>Total Sample</td>
<td>84</td>
<td>259</td>
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Most previous job of senior scientists working within German and San Diego biotech companies

Source: Casper, 2007; German data from 44 companies located in Munich Heidelberg, Cologne, and Berlin.
Previous jobs of senior managers: San Diego 1982-2003

Note: Very few people came to a senior management position from an academic background (e.g. as part of the founder network) – this differs from Europe
San Diego Biotech: Agglomeration effects v. inter-firm mobility

Agglomeration Effects (539 new entrants)

Mobility effects (267 total moves, plus 44 local moves from universities)
Wrap-up: take away points

- Social network methods are an important lens to examine how technology clusters emerge and become sustainable.
- Benchmarks and comparisons across clusters are important and often neglected within cluster research.
- My research on technology clusters re-affirms the importance of universities as participants in clusters, but also stresses the importance of organizing social networks across “market” participants.
  - Furthermore, the growth of CA biotech regions was strongly linked to founder and company dynamics.
  - I’m critical of “strong” public policies hoping to orchestrate the growth of companies within clusters (again German experience).
Thank you!

Acknowledgements:

- **KGI REU students**: Tiffany Sun (Cornell), Christina Sher (MIT), Erin Robertson (U. Chicago), Alana Celia (Linfield), Christine Tarleton (U. Georgia), David Lee (UCSD), Nick Szapiro (Swarthmore)

- **KGI students**: Kim Sevilla and Jennifer Boyd (SD founder networks)

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Variation in the success of Ca biotech by region

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<th>Year</th>
<th>SF Bay Area</th>
<th>San Diego</th>
<th>Los Angeles</th>
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<tbody>
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<td>1976</td>
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<td>2004</td>
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Number of Public Companies, California Biotechnology 1976-2005

![Graph showing the number of public companies in San Francisco, San Diego, and Los Angeles from 1976 to 2005.](image)