Economics Center
for education & research

Cincinnati USA
Industry Cluster Profile: Biotechnology

prepared for

The Cincinnati USA Partnership

August 2004

UNIVERSITY OF Cincinnati

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Industry Cluster Profile:

Biotechnology

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Prepared by the

Economics Center
for education & research
College of Business, University of Cincinnati

in collaboration with the

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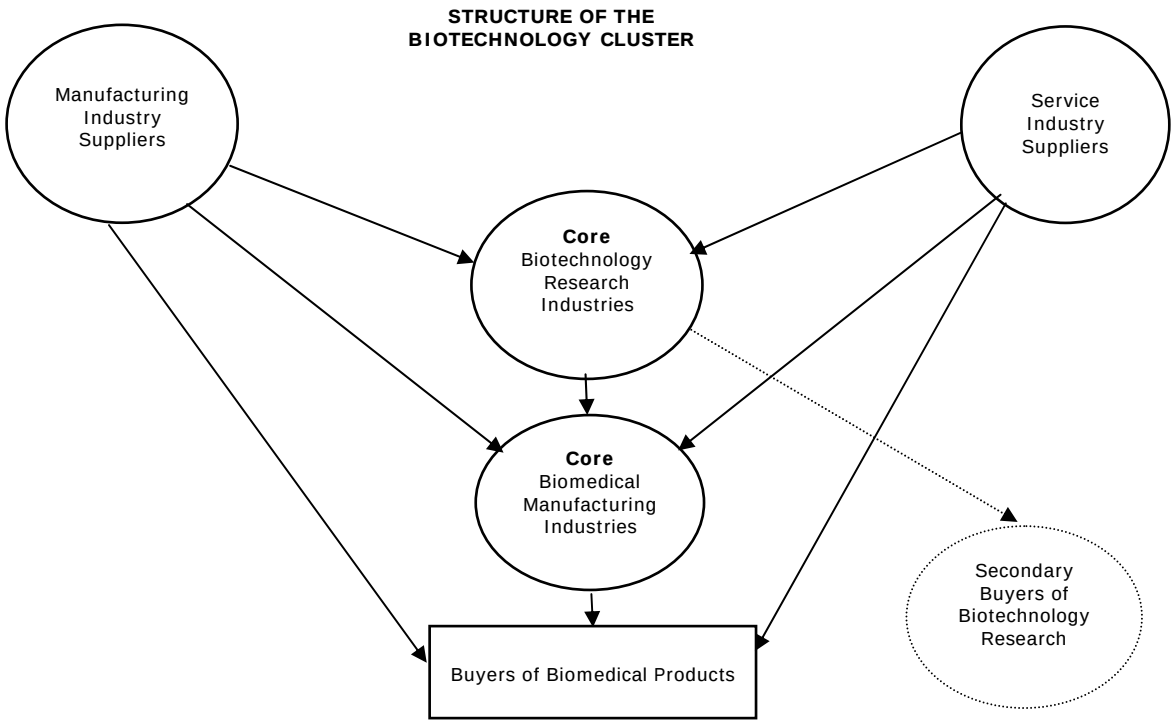
Executive Summary

Cluster Description

- This report contains an industrial profile for the *Biotechnology* cluster, which was identified in a May 2004 report, entitled *Identification of Industry Clusters for Guiding Economic Development Efforts in Cincinnati USA*, as a cluster meriting further analysis.

- The *Biotechnology* cluster is a geographic concentration of inter-connected companies and institutions working in biotechnology, and has become the focal point of economic development efforts in regions across the United States.

- The following diagram represents the structure of the *Biotechnology* cluster:



National Characteristics

- There are **eight core industries** in the *Biotechnology* cluster, including three biotechnology research industries and five biomedical manufacturing industries.

  There are three core biotechnology research industries:
  Testing Laboratories
  Research & Development (R & D) in the Physical & Life Sciences
  Medical & Diagnostic Laboratories

There are five core biomedical manufacturing industries:

Pharmaceutical & Medicine Manufacturing
Electromedical & Electrotherapeutic Apparatus
Analytical Laboratory Instrument Manufacturing
Irradiation Apparatus
Medical Equipment & Supplies Manufacturing

Two of the eight core industries, ***R & D* and *Pharmaceuticals*, account for 70 percent of the firms** that responded to the 2003 Department of Commerce survey of firms using biotechnology.

- In the *Biotechnology* cluster, there are **24 additional industries**, including four industries that buy biomedical manufactured products; nine industries that provide manufactured goods to the core industries; and eleven industries that provide services or infrastructure to the core industries. These industries are listed and described on pages 7 - 9.

  Glass, *Printing*, and *Basic Chemicals* are the top three manufacturing purchases for *R & D*. Together, they account for 16 percent of all *R & D* purchases.

  Real Estate Services is the top service purchase for *R & D*, accounting for 10 percent of all *R & D* purchases.

  Plastics, *Semiconductors*, *Basic Chemicals*, and *Computers* are the top four manufacturing purchases for the *Biomedical Manufacturing* industries, together accounting for 10 percent of all core manufacturing purchases.

  Management of Companies and Enterprises, *Wholesale Trade*, and *Patent Services* are the top three service suppliers to the *Biomedical Manufacturing* industries, accounting for 24 percent of all core manufacturing purchases.

  Venture Capital is very important to start-up biotechnology firms.

- Relative to the average demand for various types of workers, there is a heavy reliance on the following categories of **occupations in the *Biotechnology* core industries**:

  Computer & Mathematical Science occupations
  Architecture & Engineering occupations
  Life Science & Physical Science occupations
  Social Scientist & Related occupations
  Life, Physical, & Social Science Technician occupations
  Production occupations

- Most of the industries in the *Biotechnology* cluster have a **balanced distribution of firm sizes**, ranging from just a few employees to over 500 workers. The industries are not dominated by just a few large firms.

- Most of the industries in the *Biotechnology* cluster have a high percentage of small establishments (over 80 percent of establishments have fewer than 100 employees), indicating that **efficient, low-cost production can occur at many different output levels**.

Cincinnati USA Strengths in Biotechnology

- The Cincinnati USA region has over 200 biotechnology-related enterprises, including leaders such as

  Cincinnati Children's Hospital Medical Center
  Ethicon Endo-Surgery
  P & G Pharmaceuticals
  University of Cincinnati Medical Center

- Start-up companies are a very important part of the *Biotechnology* cluster generally; BIO/START is Cincinnati USA's biomedical business incubator, which has launched a number of biotechnology companies into the region.
- One of the region's greatest strengths is its **biotechnology patent activity**. Over the decade of the 1990s, Cincinnati USA, with 972 patents, ranked **10th** among all metropolitan areas in the number of biotechnology-related patents received. Based on patents per 100,000 people, Cincinnati USA ranked **7th**.
- Over **$160 million in research funding** was received from the National Institutes of Health (NIH) by institutions in the Cincinnati USA region in 2003. Two institutions, the University of Cincinnati (U.C.) and Cincinnati Children's Hospital Medical Center (CCHMC), were among the top 100 recipients of NIH funding. In 2003, U.C. ranked 59th, while **CCHMC** ranked 81st, or **3rd among all children's hospitals**.
- The Cincinnati USA region shows *strength* in buyer industries, which indicates strength in local outlets for locally manufactured biomedical products.

  Regional specialization in the four buyer industries (*Veterinary Services*, *Ambulatory Health Care Services*, *Hospitals*, and *Nursing & Residential Care Facilities*) is relatively high; regional concentration in each of the industries approximates the national average for those industries.

  Employment in all four buyer industries grew between 1998 and 2001.

  For *Veterinary Services* and *Ambulatory Health Care Services*, regional employment growth exceeded national employment growth. (For *Hospitals* and *Nursing & Residential Care Facilities*, regional growth lagged slightly behind national growth.)

  Nevertheless, none of the buyer industries should be a focus for economic development. Relatively low average wages and the local, non-export nature of these industries lessen their desirability as development targets.

- The region shows *strength* in five of the nine manufacturing supplier industries, which indicates the ability of local biotechnology firms to obtain certain supplies locally. These five industries are as follows:

  Paper Products
  Printing
  Basic Chemicals
  Plastics
  Fabricated Metals

  Regional specialization in these five industries exceeds that of the nation.

  Except for *Printing*, regional growth exceeded national growth between 1998 and 2001.

Of these five industries, *Basic Chemicals* is a particularly attractive economic development target. Average wages in this industry in 2001 were $58,778. Moreover, *Basic Chemicals* is a key part of the *Chemicals & Plastics* industrial cluster, as well as the *Biotechnology* cluster, so contributes to the regional economy through this conduit as well.

- The region shows *strength* in three of eleven service/infrastructure industries important to biotechnology firms: *Wholesale Trade*, *Advertising*, and *Patent Services*.

  Regional industrial concentration exceeds national concentration for each of these industries.
  Local employment growth exceeded national employment growth for all three industries between 1998 and 2001.
  All three industries make attractive economic development targets, with relatively high average wages and the potential for exporting their services outside the region.

- The region has a **relatively high concentration of workers** in three of the key biotechnology occupation groups:

  Computer & Mathematical Science occupations
  Architecture & Engineering occupations
  Production occupations

Cincinnati USA Biotechnology Cluster Concerns

- As measured by private-sector employment, the **region is currently weak in core biotechnology industries**.

  There are approximately 5,600 private-sector employees in the Cincinnati USA region working in biotechnology; they represent less than one percent of the private-sector regional workforce.

  Specialization in any of the eight core industries (with *Testing Labs* as the one exception) is rather low. *R & D* has a concentration less than half of that of the nation, while *Pharmaceuticals* has a concentration of only three fourths of that of the nation, though both showed higher regional employment growth than national employment growth between 1998 and 2001.

  All core biotechnology industries are attractive targets for economic development, with average 2001 wages as high as $67,000 in *R & D* and potential for export outside the region.

- There is regional *weakness* in *life science*, *physical science*, and *social science* occupations, in the sense that these three occupation classes have less of a presence in the Cincinnati USA region than for the nation overall.

- The region is currently *weak* in four manufacturing supplier industries, including both the *Computer* and *Semiconductor* industries, with very low regional concentrations. This observation is troublesome since the successful biotechnology centers of Raleigh, San Diego, and Seattle are characterized by *strength* in both *Computer & Peripheral Equipment Manufacturing* and *Semiconductor & Other Electronic Component*

Manufacturing. These two industries pay above-average wages and would make attractive economic development targets.

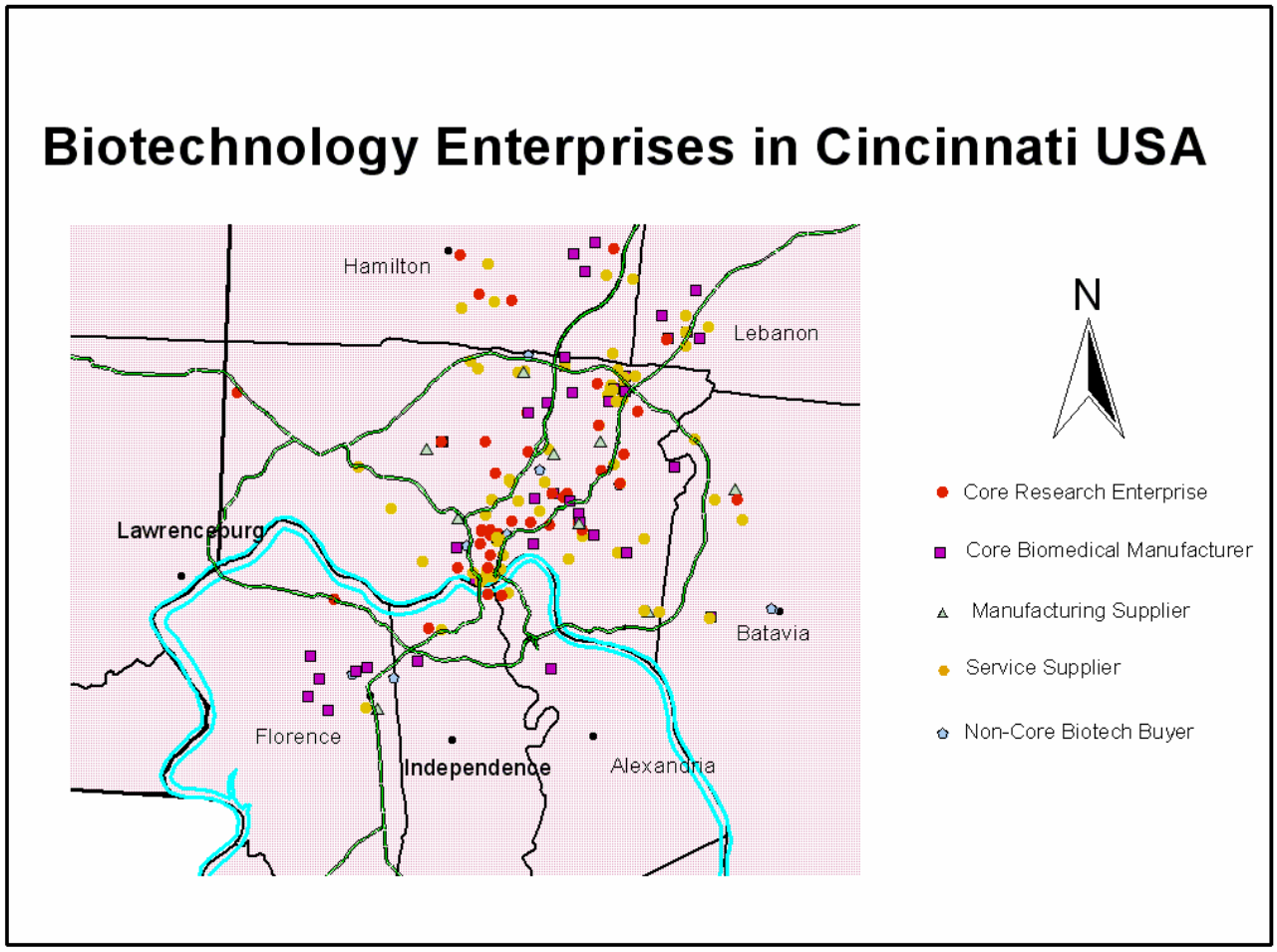
- Data suggest that the biggest single service/infrastructure concern for the Cincinnati USA region currently is *Venture Capital*. Employment in this industry is quite low, and regional growth lagged national growth between 1998 and 2001. With average wages of $88,000, ***Venture Capital* should be a component of any economic development strategy regarding biotechnology**.

The Geography of Biotechnology in Cincinnati USA

- Biotechnology enterprises engaged in research are concentrated in central locations, particularly in Cincinnati and adjacent communities.

- Core biomedical and supplier manufacturing enterprises are more dispersed, indicating that firms in these industries may be good candidates for retention, expansion, or attraction in outlying communities.

- The map below shows the location of biotechnology enterprises in Cincinnati USA:



Regional Biotechnology Comparisons

- In comparison to the successful biotechnology centers of Raleigh, San Diego, and Seattle,

  Cincinnati *competes well* in terms of patent activity and funding from the National Institutes of Health.

  Cincinnati is *not as strong* in the core biotechnology research industries of *R & D* and *Medical Laboratories*, as measured by industrial concentration and regional growth. It surpasses San Diego and Seattle with respect to *Testing Laboratories*.

  Cincinnati is *stronger* than Seattle in *Pharmaceuticals*, stronger than Raleigh in *Electromedical Apparatus*, and stronger than Raleigh and Seattle in *Laboratory Instruments*. It trails all three successful centers in *Medical Equipment & Supplies*.

  Cincinnati is *as strong* as the three successful centers in the buyer industries.

  Cincinnati is *stronger* than the three successful centers in many of the manufacturing supplier industries, but is less strong in both *Computer & Peripheral Equipment Manufacturing* and *Semiconductor & Other Electronic Component Manufacturing.*

  Cincinnati shows *considerable weakness* in *Venture Capital* and *Computer Systems Design & Related Services*, but compares favorably to the successful biotechnology centers in *Wholesale Trade*, *Advertising*, *Professional Services*, *Management of Companies & Enterprises*, *Administrative Services*, and *Employment Services*.

- In comparison to the three nearby metropolitan areas of Columbus, Cleveland, and Indianapolis,

  Cincinnati *competes well* in terms of patent activity and funding from the National Institutes of Health.

  Cincinnati is generally *similarly situated* with respect to biotechnology research, though lags slightly behind Cleveland in *Testing Labs*, behind Columbus in *R & D*, and behind Indianapolis in *Medical Labs*.

  Cincinnati is generally *similarly situated* with respect to biomedical manufacturing, though Cleveland shows considerable *strength* in *Irradiation Apparatus* and *Medical Equipment & Supplies Manufacturing*, while, due to the location of Eli Lilly, Indianapolis shows *strength* in *Pharmaceutical & Medicine Manufacturing.*

  Cincinnati is generally *better situated* with respect to manufacturing supplier industries.

  Cincinnati is generally *similarly situated* with respect to the service/infrastructure suppliers.

Additional Issues, Observations, and Recommendations for Future Study

1. ***At this time, there are excellent economic development opportunities in biotechnology***. Core biotechnology industries tend to pay high wages that contribute significantly to the economic well-being of regional residents. They are also classified as export industries, encouraging new money to come into the region from out-of-area buyers. Employment growth forecasts, provided by the Bureau of Labor Statistics (*Monthly Labor Review*, February 2004), for both *R & D* and *Pharmaceuticals* are considerably above average, implying continued additional opportunities for entrepreneurs, established firms, employees, and geographic regions in biotechnology.

2. ***High-tech regions tend to have other high-tech industries and industrial clusters besides biotechnology***. Those regions that have a strong *Biotechnology* cluster, such as Seattle, Raleigh, and San Diego, are also strong in other high-technology industries, such as *Computers* and *Semiconductors*, for example. Whether the relationship is one of causation or simple correlation (high-technology industries all require certain occupations and skills) is an open question that needs additional study. The *Biotechnology* cluster is one of three technology clusters recommended in *Identification of Industry Clusters for Guiding Economic Development Efforts in Cincinnati USA* (Economics Center for Education & Research, May 2004), along with *Digital Equipment & Telecommunications* and *Software & Data Processing*. The relationships between these three clusters need to be explored more thoroughly. It may be the case that, as far as economic development strategy is concerned, it would be best to pursue industries in these three clusters simultaneously even if primary interest is in biotechnology.

3. ***Biotechnology researchers benefit from face-to-face interaction with other researchers in order to have maximum productivity***. Employees, particularly researchers, in knowledge-based industries benefit from face-to-face interaction to develop new ideas. Phone and e-mail interactions alone are not sufficient. Biotechnology researchers need to be part of a strong community of individuals who interact both formally and informally. We recommend studying the types of economic development actions that could be taken to facilitate interaction, especially between employees in different enterprises.

4. ***Partnerships are common in the Biotechnology cluster, and the trend is growth in partnership activity***. According to a July 2004 report by New Economy Strategies, Inc. (www.new-econ.com), self-contained regional biotechnology clusters are evolving into specialized, networked regions. In other words, in order to compete in a global market, an economic development strategy might include a number of individual regions, such as Cincinnati USA along with Columbus, Cleveland, Indianapolis, Lexington, and/or Louisville. Mid-west multi-regional efforts should be explored to allow individual regional specialization yet inter-regional understanding and cooperation. As partnerships develop between regions, moreover, the trend will mimic inter-firm collaboration in the biotechnology industries. The number of collaborations between biotechnology research firms and pharmaceutical companies, for example, has been growing steadily over the last decade.

5. ***Risk-taking entrepreneurship is required in biotechnology***. Biotechnology activity starts from basic research and goes through clinical trials, regulatory approval, and business planning, to commercialization and mass production. Risk and capitalization requirements differ at each level of development. It is important to understand thoroughly the capital requirements for each of the core biotechnology industries and to determine how to facilitate capital acquisition at each stage of the process. Interviews with industrial leaders and financial experts are highly recommended.

6. ***Young, energetic entrepreneurs and researchers in biotechnology seek acknowledgment for their contribution to the regional economy***. In order to entice high-energy individuals, who make up a large number of biotechnology professionals, to settle in or relocate to the region, Cincinnati USA has to work on being attractive. Leaving aside the important leisure activities that these individuals desire, there is ample room to create a higher-profile identity for Cincinnati Biotech. The cluster has to be exciting, pleasant, and even fun. Individuals need to feel that they are a part of a high-technology environment, supported strongly by the University of Cincinnati and other Cincinnati USA institutions.

7. ***Building on the regional strengths identified in this profile, leaders from the government, business, and education sectors should work together to design action strategies for encouraging biotechnology growth in the Cincinnati USA region.*** They should address as well any barriers to development identified in this report. The linkages among these three sectors are inherently tight in biotechnology. Basic research in bioscience often takes place at universities and is funded by the federal government, before a commercially relevant idea is licensed to the private sector, or a start-up company emerges. Meanwhile, these start-up companies, as well as well-established firms, look to the regional universities to supply competent employees and to regional government and institutions to help with building, transportation, financial, and many other issues. Organizations, such as Omeris, bioKentucky, and the Ohio Valley Affiliates for Life Sciences (OVALS) bring together universities, industries, private organizations, and state and regional governments in the effort to build a well-functioning *Biotechnology* cluster.

For additional information contact the Economics Center for Education & Research, email Econeduc@uc.edu.
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