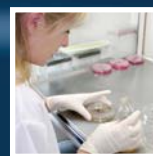


Manufacturing Biotechnology in Massachusetts



SHIRI M. BREZNITZ

ALREADY A VIBRANT RESEARCH AND DEVELOPMENT SECTOR, BIOTECHNOLOGY ALSO PROVIDES NEW POTENTIAL FOR THE REGENERATION OF MANUFACTURING IN MASSACHUSETTS. BUT THE STATE MUST SEIZE THE OPPORTUNITY.

This third in a series of articles about manufacturing clusters in Massachusetts focuses on biotechnology, which has emerged as one of the state's leading industries. This article explores the status of the industry, with specific attention to its current phase in the value chain, its relationship with the state and its rank among other U.S. biotechnology clusters.

As noted in previous articles in *MassBenchmarks* on the metalworking and plastics industries, Massachusetts has lost a significant number of good-paying manufacturing jobs (Forrant, 2003). While some might be surprised to hear the word "biotechnology" in conjunction with "manufacturing," this sector, in fact, provides new opportunity for the regeneration of manufacturing in Massachusetts. Today's biotechnology is maturing, with many companies moving further along the value chain; companies no longer focus only on research, having progressed to the stage towards development and manufacturing (MBC and BCG, 2002). This change presents a new set of industry needs and requirements for the Commonwealth.

Industry status

With 1,473 biotechnology companies, the United States leads the international arena, followed by Canada with 500 companies, Germany, the United Kingdom and France, according to a 2005 Ernst & Young report, which also

finds that companies have moved beyond national borders to achieve competitiveness. Companies now search for the best research, technology and researchers on a global level, opening R&D operations as well as manufacturing facilities outside their home countries. Firms are also involved in alliances, mergers and acquisitions. Cross-border alliances grew by 14 percent after 2003 (Ernst & Young, 2005).

The Massachusetts biotechnology cluster, along with California's and North Carolina's, is among the largest and leading clusters in the nation and world. California's biotechnology industry is built from three different clusters: San Francisco Bay, San Diego and Los Angeles/Orange County. Today, of 198,300 people employed by biotechnology nationally, 26,329 are employed in Massachusetts. According to the Biotechnology Industry Organization (BIO), the number of employees in Massachusetts increased by 12 percent between 2000 and 2002 (MBC, 2002). Massachusetts is home to 280 biotech firms, of which 23 percent (65 firms) are located in Cambridge. Other major centers in Massachusetts are Boston, Woburn, Waltham, Lexington and Worcester. There are also companies scattered within the Route 495 perimeter in eastern Massachusetts, with one to three companies in each town (Breznitz and Anderson, 2005).

State policies in support of biotechnology

ERIC NAKAJIMA

The Commonwealth of Massachusetts has a history of more than 25 years of support for the state's biotechnology industry. While gubernatorial administrations have favored different approaches to assist biotechnology companies, all have publicly acknowledged the growing importance of the industry to the Commonwealth's future.

As the state considers how to encourage the development of biotechnology manufacturing in Massachusetts, it is useful to consider the various ways in which the state has supported the growth of biotechnology research.

EDUCATION & RESEARCH

An educated workforce and advanced centers of education and research are the cornerstones of the knowledge economy. The Commonwealth has actively supported the development of the biotechnology industry through support of educational institutions from the secondary level through the state's medical school, UMass Worcester.

- **Workforce Development**

From its early days as the Bay State Skills Corporation, the Commonwealth Corporation has developed training programs that link workers, from high school students to middle-aged, with the training and experience they need to succeed in the biotechnology field. In the 1980s, the state provided a 50/50 match to the Massachusetts Biotechnology Council for worker training.

- **Higher Education**

Public colleges at all levels are training students to succeed in the field of biotechnology. To cite three examples, Quinsigamond Community College, Worcester State College and UMass Medical School all have educational programs that provide a point of entry into the industry for students, from new entrants to the labor market to freshly-minted PhDs.

- **Advanced Facilities & Research**

Biotechnology firms tend to locate near clusters of advanced medical facilities and personnel. State support for the UMass Medical School and the Tufts School of Veterinary Medicine in Grafton are the most important factors in the development of the biotechnology industry in central Massachusetts.

INSTITUTIONAL SUPPORT & COMMUNICATION

State government has taken an active role in understanding the needs and concerns of the state's biotechnology leaders and facilitating the development of the industry. In the 1980s, the Massachusetts Biotechnology Council was formed, following the suggestion of the governor that the industry organize itself to present a coherent set of needs to the state. In the 1990s, the administration appointed a biotechnology specialist to provide the state with a direct outreach to the Massachusetts Biotechnology Council. Governors from the 1980s to today have met regularly with biotechnology lead-

ers to hear their concerns and update the state's approach to supporting the industry.

The state has directly supported the development of intermediary institutions that provide technical assistance and support for biotechnology and biomedical start-up companies. The Legislature appropriated start-up and support funds to the Massachusetts Biotechnology Research Institute in Worcester. In recent years, the state has provided significant assistance to University of Massachusetts/industry collaborations in Amherst, Boston, Worcester and Lowell.

OUTREACH & BUSINESS RECRUITMENT

Governors tend to be the chief cheerleaders for industries in their states. Recent examples of successful efforts include the promotion of Massachusetts as a location of biotechnology expansion at national biotechnology trade shows and conferences. In the 1980s, Massachusetts successfully steered the German pharmaceutical giant BASF to locate in Worcester near UMass Medical School (instead of Burlington, MA). Subsequently, Abbott Laboratories expanded its facilities at that site.

ZONING & REGULATION

The state has a history of assisting biotechnology and life sciences firms overcome zoning and regulatory hurdles to expansion and research. In the 1980s, the Governor's Office of Economic Development provided technical assistance to municipalities seeking to implement zoning by-laws consistent with guidelines of the National Institutes of Health (NIH). The state provided technical assistance to the cities of Worcester and Cambridge, among others. In 2005, the Legislature provided legal and regulatory clarity to life sciences institutions seeking to engage in stem cell research.

LAND ASSEMBLY AND FINANCE

The Commonwealth has long identified the biotechnology industry as a key priority in the state's economic development program. The state has directly assisted in the land development process through the disposition of surplus state land at the former Boston and Worcester state hospitals. MassDevelopment administers a series of loan funds for facility construction and expansion, as well as the purchase of equipment.

INFRASTRUCTURE

The principle means of state support for biotechnology — beyond education — is in the provision of basic state services. Massachusetts has supported the development of major infrastructure, such as Interstate 290 or the refurbished MBTA Red Line, which linked emerging centers of biotechnology research to Boston and the region. The state has indirectly supported the costs of development through Public Works Economic Development Program (PWED) grants that cover the cost for local roads and infrastructure adjacent to biotechnology facilities.

Industry locational factors

Several possible explanations account for the concentration of biotechnology firms in Cambridge. These include the available knowledge base and highly skilled labor force derived from local universities, as well as the availability of venture capital. There are also numerous supporting and related industries, ranging from waste disposal companies and microscope manufacturers to law and accounting firms specialized in biotechnology. In addition, several networks of research hospitals dealing with incurable and other diseases are in Cambridge or nearby Boston, including Massachusetts General Hospital, Dana-Farber Cancer Institute and Brigham & Women's Hospital.

An industry survey conducted in 1999 by the author found that the most important variable for companies' location decisions is existing knowledge base. The biotechnology industry is based on knowledge — success is very much predicated on a firm's ability to learn new things and innovate. Even firms that locate outside of Cambridge continue to monitor the workshops, seminars,

and conferences that take place in that city. As one biotechnology company executive put it:

Information gathering, either through personal networks that the individual scientists have or through company-university interactions through tech-transfer offices, is a major source of information.

There is also an historical reason for industry location: for many years, Cambridge had abundant available space. In the late 1970s and early 1980s, the area around MIT was dotted with empty warehouses, which made it easy for many companies, especially local university spin-offs, to find space and remain in the region. Firms were able to rent or purchase existing buildings close to their research university and their potential labor force.¹

Manufacturing biotechnology

At the research stage, Massachusetts firms benefit from proximity to top research universities and institutes and

Figure 1. Massachusetts Biotechnology: Input - Output Flowchart

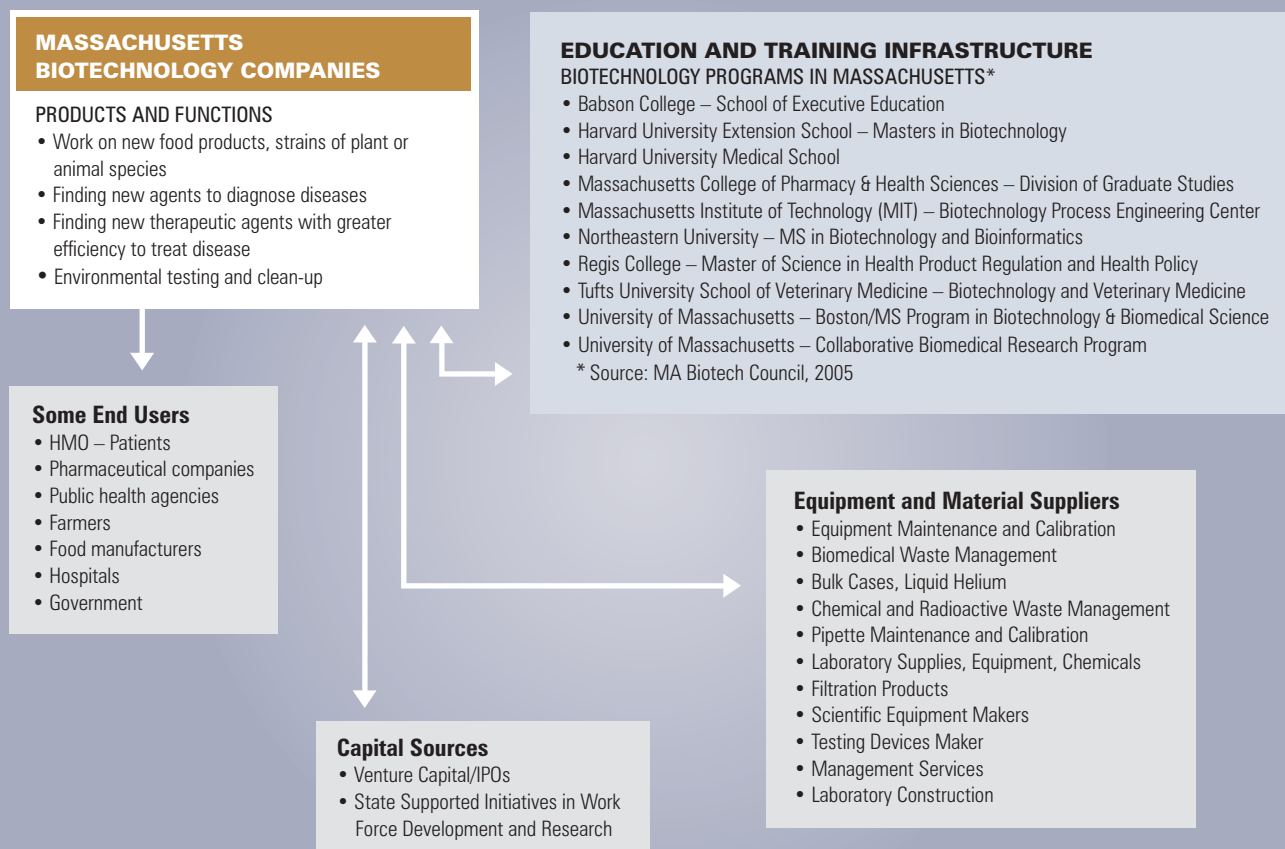
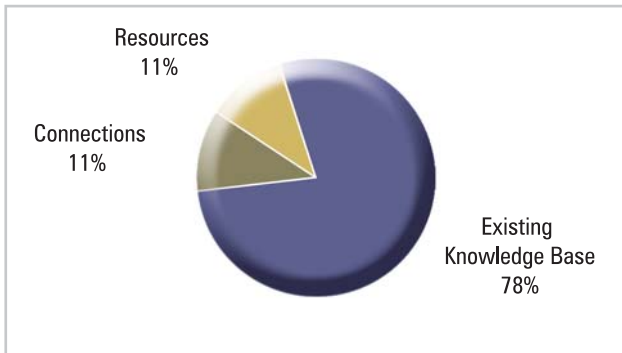


Figure 3. Top Factors Affecting Locational Choices of MA Biotechnology Firms, 1999



Source: Survey of biotechnology firms conducted by Shiri Breznitz, 1999.

qualified researchers. In addition, as shown below, the state offers the industry numerous inputs not found in many other regions of the world.

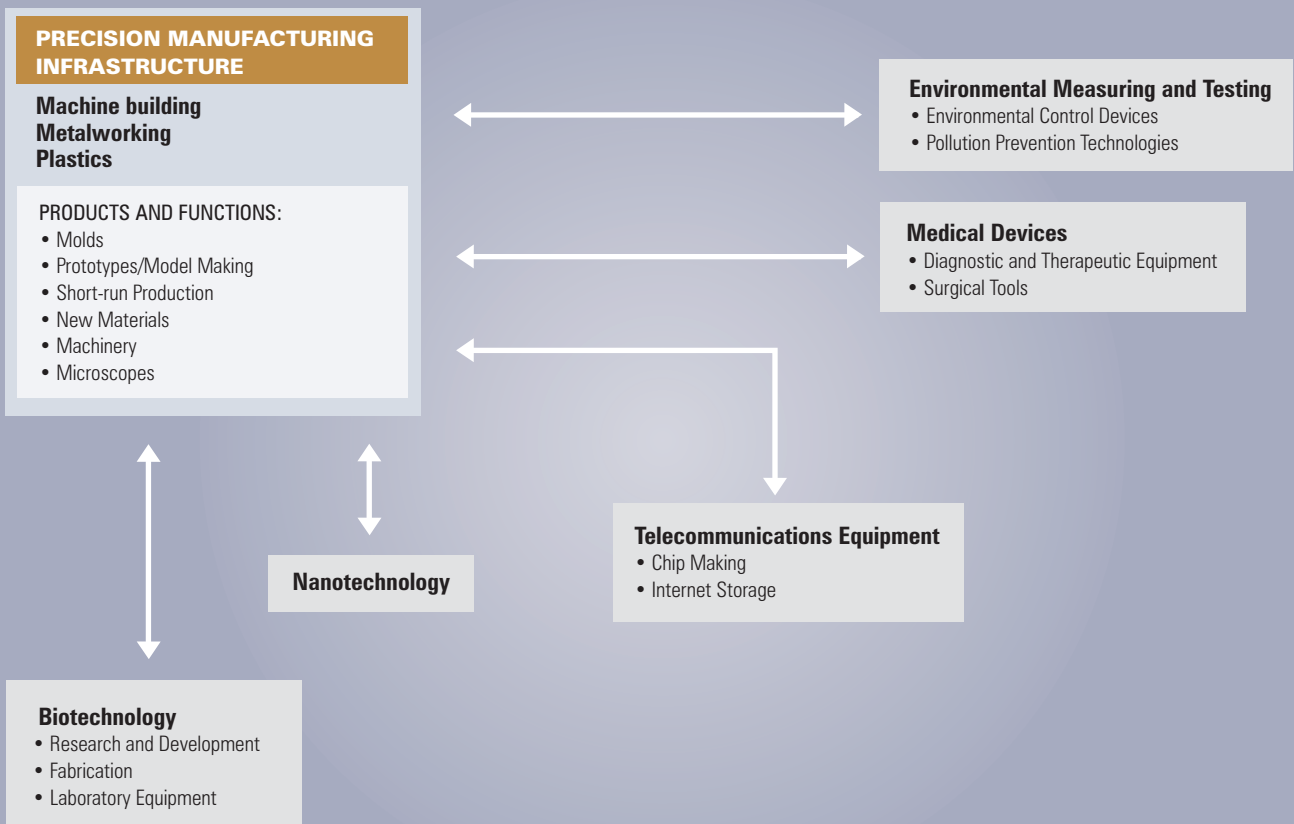
First, the supply and services sector is rich with local companies. Many of the tooling, metalworking and plas-

tics companies were created on knowledge bases that have existed in the region since the early 19th century. This means that unlike other states, Massachusetts can provide numerous services to the industry. Second, the education and training infrastructure is rife with existing programs that support the industry. The support is not just in qualified graduates, but in research and technology, as well as technology transfer programs that have worked with the industry for many years. But to receive the greatest benefit from biotechnology, Massachusetts needs to secure firms as they enter the development and manufacturing stages. As the industry matures, companies have more and more drugs in the pipeline. If Massachusetts does not seize the opportunity to get companies to manufacture in the state, industry advocates claim it stands to lose 100,000 potential jobs to other states and countries (MBC and BCG, 2002).

From the author's 1999 survey of biotechnology industry's locational factors, it is evident that manufacturing companies care about rent and recombinant DNA ordinances, while non-manufacturing companies remain in the

Figure 2. Manufacturing Innovation in Massachusetts

Precision manufacturing infrastructure + dynamic interaction with high tech firms = Massachusetts competitive advantage



Source: Professor Robert Forrant, UMass Lowell

research arena and thus indicate proximity to research labs as the most important variable in their location decisions.

The results indicate that manufacturing and non-manufacturing companies both find labor force and university research labs important locational factors. The interviews found that non-manufacturing companies need small labs that can be located in any building and they need proximity to university research labs so new information in their field will reach them expeditiously. Manufacturing companies, on the other hand, need larger space for production, so rent matters more to them. In addition, the recombinant DNA ordinance regarding the volume of production and waste disposal rules are very important to the level of expenses each firm had.

Most Massachusetts biotechnology companies either do not manufacture or do so outside the state for a range of reasons. Lack of space, high rents, high business costs and strict rules help explain why only 10 percent of the companies actually manufacture in Massachusetts. However, it is difficult to move a mature firm far from its first location. Both the mature company and its employees have ties to the region. A decision to move involves, in many cases, the loss of qualified and trained employees, as well as suppliers.

Many of the companies that choose to produce elsewhere leave their research facilities in Massachusetts. Others hope that they can find enough space or funding to keep their facilities in the state. Several companies that left Cambridge moved to nearby communities such as Lexington, Watertown and Waltham, in order to retain their existing workforce. (Breznitz, 2000). They moved outside Cambridge due to space limitations and soaring rental costs. Companies that made a new discovery and wanted to move into production lacked sufficient capital to continue to conduct further research; their interest in the local research knowledge base thus lessened.

Massachusetts biotech companies, including manufacturers, are typically small to medium size, and usually focus on one or two core products. Such firms rely on outside funding and cannot afford to conduct new product research as long as their existing products are comparatively new in the market. As one biotechnology executive interviewed in 2000 explained:

It is very difficult for a lot of the companies here that basically have only one product because it costs so much. To develop any invention, it costs around \$500 million, so you do not jump at everything that comes your way... We have money to develop just one product right now and maybe when it will be successful we could conduct more research.

Several of these companies prefer to remain in Massachusetts. With the correct rules and regulations, Massachusetts can keep these companies moving from the state in which they grew up.

The Massachusetts Biotechnology Council (MBC) encouraged the Commonwealth to do the following in order to boost the biotech sector's global competitiveness:

Build multiple vital partnerships within the life-sciences cluster, [e]xpand the state's job base aggressively from research to development through manufacturing, [r]etain and support existing companies, and [a]ttract new research investment at growth rates comparable to those in key competitive states.

If Massachusetts fails to continuously enhance the leading position of its biotechnology cluster, the industry will lose its competitive advantage, just as metalworking did in the 1970s and 1980s. State policies are needed to expand and preserve biotech's homegrown technology and skill base. Massachusetts has been fortunate to be able to regenerate old industry skills and create new industries based on its rich knowledge base. However, in the fast-paced global economy, the advantage appears to be slipping away. Positive policy interventions are vital. Higher education institutions may well generate new knowledge, but absent proper nurturing, the employment fruits of this industry at the manufacturing stage will be enjoyed by other regions of the nation and the world. ◀

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¹ In their research phases, biotechnology companies do not need much room, and most commercial buildings can be converted to laboratory space.

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