



The BioBusiness Alliance

of Minnesota

Biobusiness: Minnesota's Present Position and Future Prospects

Executive Summary

Report of the
Statewide Biobusiness Assessment Project
of the BioBusiness Alliance of Minnesota
August 2006

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Foreword



The BioBusiness Alliance of Minnesota (“BioBusiness Alliance”) is an industry-led, 501(c)(3) not-for-profit organization dedicated to the advancement of bioscience-based industries to create jobs for the citizens of Minnesota. The participants consist of experienced people from industry, academia, and state and local government. Those involved share the following common characteristics and beliefs.

1. First, we all believe that the biosciences will have a profound impact on the lives of the global community in the future. We believe the impact of the biosciences over the coming 20 years will be similar to the impact that computers have had on our lives over the past 20 years. These dramatic impacts are already happening.
2. Second, because we all work in the industry in some manner, we are exposed to what is happening around the world in bioscience and biobusiness. We share a belief that Minnesota needs to be at the forefront in the areas in which we choose to participate, or we will lose an important portion of our economy. We also share a concern that Minnesota will have to do more than is currently being done in order to keep up. Biobusiness is an industry that has become the platform for growth of many global communities.
3. Third, we are all willing to donate our time, knowledge and skills to help understand what needs to be done to ensure our future. We are also willing to donate the same to help implement the changes that are identified.

The Board of Directors of the BioBusiness Alliance was assembled for the first time in February 2005. We agreed on the following three strategies as most critical to retaining and growing biobusiness jobs in Minnesota:

1. Conduct a **Statewide Assessment** of our knowledge and business generation capability. This is our first deliverable.
2. Develop a short-, medium- and long-term plan for growth in the biobusiness industry. This is called **Destination 2025**.
3. Create a support mechanism to help start-up companies, entrepreneurs and existing companies to expand in or move to Minnesota. This is called the **BioBusiness Resource Network**.

The BioBusiness Alliance will be publishing information and results on a periodic basis. If you would like to learn more about the BioBusiness Alliance, or what you can do to participate, please check our website at www.biobusinessalliance.org or contact the organization at 952.746.3812.





Preface



As the Chairman of the Board of Directors for the BioBusiness Alliance of Minnesota, it is my great pleasure to present to the citizens of Minnesota the final report of the BioBusiness Alliance’s Statewide Assessment. This report was conducted by the Statewide Assessment team under the guidance of the BioBusiness Alliance of Minnesota’s Board of Directors. Its purpose is to present objective data that will yield the reader a sense of where Minnesota stands in the rapidly growing areas of bioscience and biobusiness. In addition, the Board of Directors offers the reader its perspective of what it means, and some preliminary thoughts on where we need to focus our efforts to ensure that our state’s future continues to be bright. It is also important to understand that this report is not the end of our work. It represents a moment in time and a place where we can start work on Destination 2025, our long-term planning process. The report truly represents **the very beginning**.

Background

When the BioBusiness Alliance Board of Directors initiated the assessment process, we made some promises to the people of Minnesota and our funding partners. The promises included:

- The assessment would take a grassroots approach and would look at large, mid-size, small, and start-up companies.
- It would include knowledge generation (basic and applied research, mostly in the not-for-profit sector), and private-sector commercialization capability and focus.
- We would study the major categories of biobusiness that are important to Minnesota: agri-bio technology, bio-industrial technology, human health technology and biotechnology.
- We would reach out to the four corners of the state.
- We would investigate markets and products, but focus the assessment on technologies. We chose this focus to develop a clear understanding of what Minnesota’s technological “pillars of strength” really are so we can build on them for the future.
- Finally, we would provide an analysis of the work that would give context to Minnesota’s competitiveness in the national and global economy.

To accomplish the assessment and deliver on our promises, we commissioned two independent studies. The first was a **comparative study** conducted by Willoughby International, LLC. This study used **public information** to assess the **private sectors** of Minnesota compared to 10 other states with similar goals for their economic growth in biobusiness-related fields. The academic sector was not part of that study. The study yielded a clear picture of where Minnesota stands compared with these other states.



The second commissioned study was conducted by the ANGLE Technology Group. This study followed a **grassroots** approach that included **both for-profit and not-for-profit organizations, in both the academic and industry sectors**. There were two primary deliverables for this study. The first was to develop a census of both for-profit and not-for-profit enterprises (operating independently or as a unit of a larger corporation or organization) in Minnesota that develops biobusiness-related technology. We refer to these as biobusiness technology enterprises (BTEs). The second was to produce an understanding of the markets, products and technologies these enterprises employ to meet their organizational objectives. ANGLE looked at both current capacity and future directions. The research was conducted using questionnaires, telephone conversations and face-to-face interviews. To protect confidential information provided by respondents, most of the data reported in this study is presented in aggregate form only.

The final report presented here is a consolidated analysis that combines the content of the two studies into one report. This was done to reduce the complexity of documents for the reader, and to help build context for a more comprehensive understanding of biobusiness in Minnesota.

Report Highlights

We are very pleased with the final product, and feel very positive about the content of the report. We have met the commitments we made. Some commitments were met more completely than others. For example, even though the census of BTEs identified 425 entities, a significantly larger number of Minnesota BTEs than we previously were aware of, we know it is still not complete. We will find more BTEs as we take the research to the next level of detail. We also found it very difficult to find “good” publicly available data on the bio-industrial and agri-bio technology sectors. These sectors are relatively new, and good measures are not readily available. We are already working to resolve this issue with the Minnesota Department of Agriculture and the Agricultural Utilization Research Institute (AURI). We now know this is a problem shared by all U.S. communities involved in agri-bio and bio-industrial economic activity.

We found information to validate some previously held opinions. Certainly, Minnesota remains a **dominant player in medical devices**. We rank near the top of nearly all indicators measured in this area. We also are a **dominant player in renewable fuels**, an area where the world is watching Minnesota.

We also found some areas of strength that were not so well known. For example, Minnesota is a **dominant player in materials science**. This is true for both renewable and non-renewable materials. It also may represent a crossover opportunity between our industrial, agricultural and medical device sectors. We are also heavily focused and very strong in **delivery systems** (e.g., drug delivery or therapeutic device delivery) for animal and human health applications. As with the life sciences, the animal and human health sectors continue to “converge.” We know and understand advanced materials and delivery technologies, and these skills will serve us well in the future and are critical in facilitating the aforementioned convergence (convergence of technologies within



existing industries, and convergence of previously separated markets and product categories around emerging technologies). They offer great value to us when building our future economy.

Areas of weakness and concern were also identified. Even though we are dominant in renewable fuels, medical devices and a few other areas, we lost ground from 1997 to 2002 in total biobusiness technology employment and in key sectors within biobusiness technology where we historically have had clear dominance. We turned the trend around between 2002 and 2005, but we know that our competition is also improving.

Our initial analysis would indicate that most of our large companies are still hiring and growing. Since 2002, some of Minnesota's larger biobusiness companies have hired significant numbers of new employees. However, for some reason total hiring across the whole of biobusiness technology in Minnesota does not reflect this growth as much as we might have expected. The measures of the study indicate to us that our small, medium-sized and start-up companies may be struggling disproportionately. We will be conducting an in-depth study to analyze this issue. For now, we are confident that we need to continue to support our large companies, but we also need to put more focus on helping the smaller companies and on catalyzing start-up activity. These efforts cannot wait for Destination 2025. We are, therefore, starting this work immediately.

Another area of concern to the Board of Directors is the category of jobs called "R&D in the life sciences." These jobs represent the core skills that are required for development of products such as catalysts for fuels or biopharmaceuticals. In effect, it is the study of the function of organisms, and their interactions between each other and their environment, that may lead to commercial products or applications. This is one of the pillars of knowledge for the new economy that is evolving. It turns out that Minnesota is **not a strong competitor** in commercialization of R&D in the life sciences. We do have a strong educational and research capability, but the commercial side of employment in this area is only slightly bigger than it is in Iowa and Utah, and smaller than in all other states studied. Most significantly, all of the other states studied, including Iowa and Utah, are growing this sector faster than Minnesota.

The lack of competitive strength in commercialization (translating invention into new start-up companies and enterprises within Minnesota) may be our most disturbing finding. To compete long term, in addition to a strong academic sector, Minnesota needs to have a base of private-sector employment in life sciences devoted to R&D that is at least commensurate with a state of our size. To accomplish this goal, we would need approximately 5,000 high-tech employees involved in commercial life sciences R&D compared to the 2,200 we have today.

We feel this is important for two reasons. First, by itself R&D in the life sciences will provide an opportunity for economic and job growth in the future. Second, it is the knowledge base that will support the convergence of life sciences with medical devices. Since nearly 80 percent of the private-sector biobusiness technology jobs in Minnesota today are involved in medical devices, we cannot allow that sector to erode. In the future, the human health skill base will need the life science skill



base. As you can imagine, understanding the implications of the data is our highest priority. We are already implementing strategies to address this issue. The need is obvious.

About the Process

Our first goal was to agree on a few definitions and begin the process of creating a language for our work. As you begin to read this report, I would recommend that you at least become familiar with the definitions. They are the beginnings of a language that we will develop further over time.

I would also recommend that you spend some time becoming familiar with the measurements contained in the comparative study section of the report. These are the measurements that you will see again and again. They will be the basis of measurements used as we monitor the impact of our projects, and the impact that Destination 2025 will have on our state.

The area of the report that may seem the most confusing to you is the section on the grassroots assessment and the discussion on technologies. As stated before, our skills, represented by the technologies that we have mastered, are important. They are the “gold in our treasure chest” as we build our future. Our skills represent our strengths, and our lack of skill in a given area represents our weaknesses. Yet, it is hard to discuss this topic and create shared understanding. It is even harder to measure and quantify.

The world needs a standard method and language to allow meaningful dialogue on this topic of biobusiness skills. To address this issue, we have incorporated a color-coded classification system initially introduced by the trade group EuropaBio. We have added a couple of dimensions to this (hopefully) simple-to-understand system, and hope to build on the approach working in collaboration with our European colleagues. They have initiated an important concept, and we would like to see it evolved further to create a global biobusiness language. I would encourage you to take a close look at this section of the report. The concept is young and is under construction. Failure to create a language for applied biotechnology is not an option, however.

We already have enough clarity, as a result of our initial work, to allow us to initiate Destination 2025 and are confident we will be able to communicate our results to you effectively in future reports.

Acknowledgements From the Chair

I want to take a moment to specifically call attention to the contributions of a few people who played key roles in achieving the monumental task of this project. The first is Jeremy Lenz. Jeremy has functioned as the Project Executive and has been invaluable in keeping the process moving and the volunteers on task. Vincent Ruane, the Statewide Assessment team Co-Chair, has repeatedly demonstrated his leadership skills by pulling us back to the key issues and messages when we began to get lost in the mountain of details. Gail O’Kane repeatedly applied her analytical capabilities to



uncover key points that are important to the story. Some of our key takeaways would have been missed without her contributions.

Finally, we want to express our deepest gratitude to Dr. Kelvin Willoughby. During the past year Dr. Willoughby has worn many hats in the Statewide Assessment project. As the Statewide Assessment Lead Chair, Dr. Willoughby was the architect of the process that we collectively subscribed to and wholeheartedly implemented. His leadership was evident from framing the request for proposals, to providing a framework to capture Minnesota's global areas of technological excellence, to conducting the comparative study. Drawing on his considerable experience in performing assessments, Dr. Willoughby completed the analysis of the two commissioned studies and published this consolidated report, which helps us to connect the dots and draw valuable meaning out of all of the data. We wish to express our deepest appreciation to Kelvin, without whom we could not have completed this enormously challenging task.

Summary

The Board of Directors of the BioBusiness Alliance of Minnesota is proud of the document you are about to read. Not all of the news is good news, but neither is it all bad news. The data would indicate there are reasons for us to stop and take a good, hard look at what we are doing. We believe the direction of the wind is shifting, and Minnesota does need to adjust the “tack in our sails.”

We are not concerned about our ability to make the needed changes. We have a great educational system, educated and informed employees with tremendous skills, and an unquestioned work ethic. We are blessed with industries that are truly world class, and have the ability to attract global talent. We start this improvement process in an enviable position.

We think that our success in preparation for the future is dependent on three things: collaboration, vision and personal commitment. With these three things, combined with appropriate leadership, we can create the momentum that we need to compete wherever we choose.

We look forward to working with you to create Minnesota's biobusiness future.

Respectfully,

Dale Wahlstrom
Chairman of the Board
The BioBusiness Alliance of Minnesota





Executive Summary



By late 2002, the most recent year for which detailed national data from the U.S. Economic Census is available, the biobusiness technology sector in the United States consisted of over 55,000 establishments, about 1.2 million paid employees, an aggregate annual payroll of over \$60 billion and aggregate annual revenues of over \$330 billion.* In addition, according to data from Battelle, average wages in the bioscience sector (at \$65,775 in 2004) were over \$26,000 greater than the average private-sector wage. With statistics for a “young industry” outlined above, Minnesota has motivation to understand its position in this increasingly competitive and global industry.

This report represents the first-ever comprehensive assessment of Minnesota’s statewide biobusiness technology industry and provides Minnesota’s leadership with a “line in the sand” against which to benchmark this industry. The project was designed to confirm Minnesota’s technological capabilities and to uncover emerging technology-related opportunities in the human health and agri-bio/bio-industrial sectors of the economy.

The specific goals of the assessment were to:

- Provide a baseline assessment of biobusiness technology in Minnesota against which the state may be benchmarked.
- Provide thoughtful, well-researched recommendations to help guide the state in becoming more competitive in specific areas of biobusiness. These recommendations will reflect the convergence of technologies, products and markets that exist within Minnesota.

Through focusing on specific and distinctive biobusiness technology categories in which Minnesota can compete as one of the top few global centers of excellence, we are confident that Minnesota will continue to find future areas in which to excel and thus create and retain biobusiness jobs in Minnesota.

The success of the Assessment was directly linked to the process covering every scale of technology enterprise from start-ups and small organizations to medium-sized and large organizations, whether they were located in the private or the public (academic research) sectors. Additionally, the Assessment was statewide and incorporated Minnesota enterprises from corner to corner, across the state.

* Battelle Technology Partnership Practice and SSTI, Growing the Nation’s Bioscience Sector: State Bioscience Initiatives 2006 (Columbus, OH: Battelle Memorial Institute, April 2006.) Note: Battelle’s term “bioscience” covers a slightly different, although closely related, business territory than our term “biobusiness” (see Appendix 3 of this report for a detailed explanation).



Overview of Components of the Assessment Project

We followed two parallel assessment pathways in order to develop a comprehensive picture of Minnesota's position in biobusiness. The two pathways were a comparative study of Minnesota with 10 other states, and a grassroots study of Minnesota's distinctive biobusiness technology capabilities.

Comparative Study

The first pathway was a comparative study of Minnesota against 10 other states. The objective of this study was to compare Minnesota's biobusiness performance measures to those key states that are targeting areas of economic development similar to Minnesota. This approach was designed to reveal how Minnesota is doing in relation to our competitors, where our relative position is strengthening or weakening, and how serious the threat of competition from other states might be.

The primary sources of data used in this study were the U.S. Census Bureau and the Minnesota Department of Employment and Economic Development. It is important to note that, because the U.S. Census Bureau does not include academic facilities in their data on biobusiness-related fields, the comparative study did not include the biobusiness technology capabilities of the state contained in the academic and not-for-profit organizations. It focused only on private-sector industry organizations. The academic and not-for-profit organizations were covered in the grassroots study.

Findings of the Comparative Study

Utilizing the most recent Economic Census data from the U.S. Bureau of the Census for the two most recent surveys, 1997 and 2002, we assessed three areas: Minnesota's overall biobusiness technology industry and two subcategories of the biobusiness technology industry: medical devices and R&D in the life sciences.

Since the Economic Census data are published only every five years, we also produced estimates of Minnesota's biobusiness technology industry from 2002 to 2005, using data from the Quarterly Census of Employment and Wages (QCEW) provided by the U.S. Department of Labor (these data are sometimes also called the "ES-202 series" data). Because the QCEW data are not categorized in sufficiently fine detail to properly represent all the biobusiness technology sectors, we relied primarily upon the U.S. Economic Census data (which use finer categories) for the majority of our analysis.

Overview of the Biobusiness Technology Industry

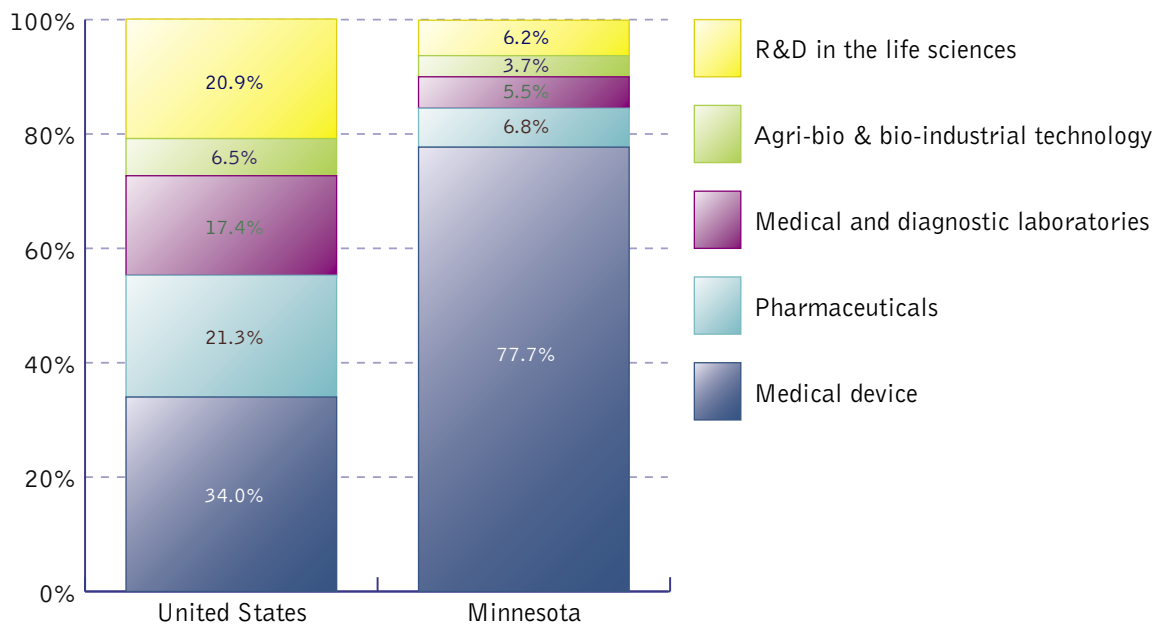
Biobusiness technology is the "macro" biobusiness technology industry category. It incorporates all five subcategories, including the two already mentioned (medical devices and R&D in the life



sciences). The other categories that we did not analyze in-depth — due to restrictions of time and space or due to problems with the quality of available data — include pharmaceuticals, agri-bio & bio-industrial technology and medical & diagnostic laboratories. We hope that these additional areas may be analyzed in the future.

Minnesota’s biobusiness industry is competitive in the macro biobusiness technology category. However, there are areas of concern. For example, Minnesota’s national share of paid biobusiness technology employees dropped 1 percentage point between 1997 and 2002 (from 3.43 percent to 2.41 percent, respectively).

Executive Summary: Figure 1. Percentage of Employment in Each Field of Biobusiness Technology, 2002

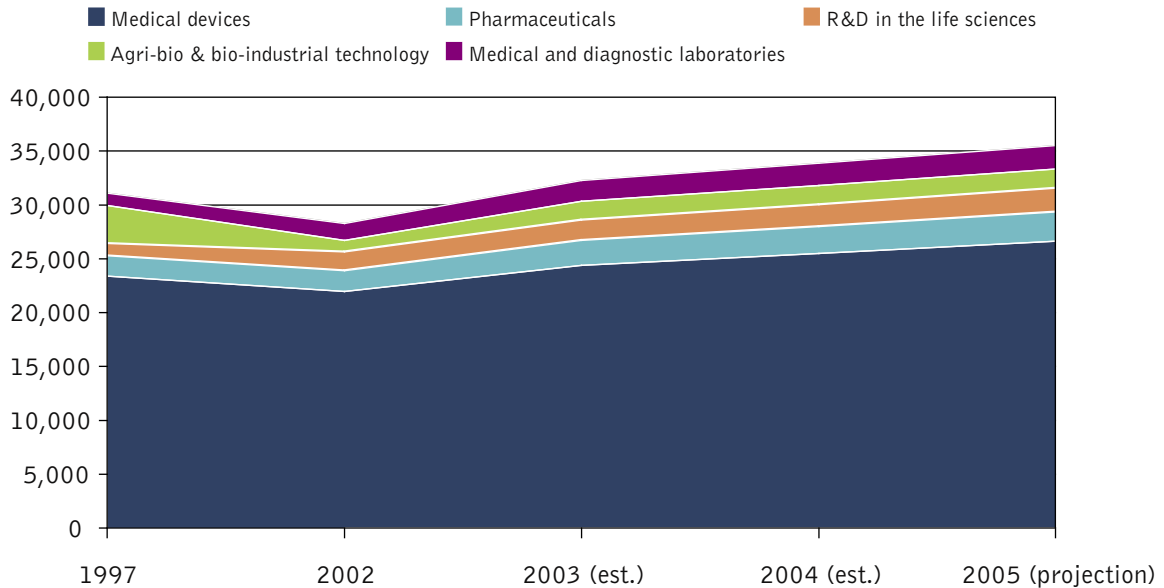


Minnesota’s economy is more heavily oriented toward biobusiness technology employment than is the economy of the country as a whole, with 1.33 percent of our workforce employed in biobusiness technology, compared with 1.07 percent for the nation as a whole. Our state’s future employment prospects are, therefore, more dependent than other states on what happens to its biobusiness sector. As the above chart (Executive Summary: Figure 1) demonstrates, the portion of biobusiness technology workers employed in the medical device industry is about twice as large in Minnesota as in the nation as a whole.

As illustrated in the following chart (Executive Summary: Figure 2), which depicts Minnesota’s biobusiness technology employment over the eight years from 1997 to 2005, the heavy emphasis on medical devices here has remained resilient over time.



Executive Summary: Figure 2. Biobusiness Technology Industries in Minnesota, Total Number of Employed People, 1997-2005



For the biobusiness technology industry as a whole, when compared with other states, Minnesota holds a respectable, but not stellar, position. The state is slightly stronger than average in generating employment, revenue and payroll, and slightly weaker than average in generating enterprises. Thus, Minnesota is less entrepreneurial in biobusiness technology than other states, even if its overall economic performance in the industry is competitive. Overall, our findings show that when the figures are weighted to take into account the relative size of the economy of each state, and the overall level of the biobusiness technology industry at the national level, Minnesota performs only slightly better than one would expect.

Overview of Medical Devices

Minnesota is a major international player in the medical device industry. Within the United States, Minnesota and Massachusetts were roughly equal in employment numbers, second only to California. In 2002, almost 22,000 employees, or 78 percent of Minnesota's biobusiness technology employees, worked in the medical device industry.

When it comes to creating business activity based on medical devices, Minnesota is solid, being home in 2002 to 2.6 percent of the nation's medical device establishments and 5.5 percent of the nation's medical device employees. Minnesota shines even more brightly as a very competitive location when the data on the medical device industry are weighted to take into account the relative sizes of the economies of each state.

Although still a leader in the medical device sector, not all of the news is good. Minnesota lost jobs in the medical device industry from 1997 to 2002, during a period when most of its competitors



were gaining jobs in the field. Our share of medical device jobs dropped almost 1 percentage point, down from 6.45 percent in 1997. During this same period, our state's relative strength in generating jobs and enterprises in medical devices declined. Additionally, we are lagging in medical device entrepreneurship (density of company generation) in comparison to many of the other states studied.

Overview of R&D in the Life Sciences

Taking some liberty to simplify the definition, this industry category is most easily defined as “core biotechnology R&D,” including enterprises “primarily engaged in conducting research and experimental development in medicine, health, biology, botany, biotechnology, agriculture, fisheries, forests, pharmacy, and other life sciences including veterinary sciences” (U.S. Census Bureau, North American Industrial Classification definition). Because this category represents core knowledge and technology, we consider this to be a foundational category for future high growth itself and a core area of convergence with medical devices. Due to the way that industry data is classified by the U.S. government (the NAICS system), this industry category includes only companies that engage primarily in R&D activities, not those engaged primarily in manufacturing activities.

In contrast with its historical leadership role in the medical device industry, Minnesota is not a leading employer in this category. Of the 11 comparison states (chosen because of their peer status in terms of economic development ambitions vis-à-vis biobusiness), only Iowa and Utah exhibit smaller absolute employment levels than Minnesota. While Minnesota did increase its employment in this field between 1997 and 2002, both Iowa and Utah showed significantly larger growth rates than Minnesota. Simply put, Minnesota is improving, but is starting from a small base, and is growing more slowly than the competition. Since start-up companies tend to remain and grow in the place where they are founded, this is a salient indicator of the future biobusiness technology sector in Minnesota.

Overview of Agri-bio and Bio-industrial Technology

Agri-bio and bio-industrial technology is technology directed primarily toward applications of biological systems outside the human body. Agri-bio and bio-industrial technology may incorporate technical means from any field of technology, including biotechnology, but it must be directed toward applications in living systems or biology-related contexts. Examples would include controlled fermentation systems for the food or energy industries, or advanced biomaterials production systems.

There is no standard industrial classification that the U.S. Census Bureau has adopted for this general domain of biobusiness. The quality and comprehensiveness of the data published on agri-bio and bio-industrial technology as part of the U.S. Economic Census — which are drawn from a disparate set of subcategories — are uneven; so while they have been included as part of the



aggregated data for the whole biobusiness technology sector, they are not separately presented here.

Ethanol production is the one area of these industries where strong, comparative data were available. For farmer-owned ethanol production, Minnesota is an extraordinarily strong performer, second only to Iowa. Our state's annual production value now approaches an estimated \$1 billion.

Many interesting conclusions were drawn from the grassroots assessment regarding these sectors, and the BioBusiness Alliance of Minnesota has identified this area as a target for future work. Because of the challenges outlined, the BioBusiness Alliance is actively working to ensure that future comparative studies will have access to better developed data sets for this critical industry area.

Grassroots Study

The second pathway we followed in our assessment project was a grassroots study that aimed to identify the technological strengths and weaknesses of the state. We believe that understanding the skills and capabilities of the technologies our biobusiness technology enterprises (BTEs) have mastered today, or are developing for the future, will give us a picture of where Minnesota is heading in biobusiness. This information will help us to understand where we are investing and will allow a comparison to the picture of where we believe the future of our industries lies. The fundamental goal of this exercise is to give our state the strongest foundation to be able to retain and create biobusiness enterprises and biobusiness jobs.

To accomplish this task, we conducted a comprehensive census of all biobusiness technology enterprises and a detailed study that involved contacting each enterprise identified in the census. This detailed study identified the core technologies and products which Minnesota companies are involved in producing, the markets in which they are selling and where the academic sector is focusing its research. Unlike the comparative study, the grassroots study focused on **both for-profit and not-for-profit organizations, in both the academic and industry sectors**. The source of this information was direct contact with companies, academic institutions and other organizations, using questionnaires, telephone interviews, and face-to-face interviews. Due to their nature, much of these data are confidential and are presented in an aggregated format to protect the identity of participants.

To categorize the results of the census and detailed study, we adopted and modified the color biotechnology classification system originally developed by EuropaBio. The modified EuropaBio and Minnesota combined approach defines the following classifications of technologies in the form of biobusiness categories:

- **White biobusiness technology** is biobusiness focused on the application of biological technology in industrial fields such as biomaterials, bioprocessing, bioenergy, bio-based chemicals, food ingredients and bioremediation. This field of biobusiness is sometimes called “bio-industrial technology.”



- **Green biobusiness technology** is biobusiness focused on the application of biological technology in the field of plants and agriculture. This field of biobusiness is sometimes called “agri-bio technology.”
- **Red biobusiness technology** is biobusiness focused on the application of technology in the biological domains of human health and veterinary medicine. It includes medical devices, pharmaceuticals and complex medical technology systems. This field of biobusiness is sometimes called “medical technology” or “human health technology” (as shorthand for both human and animal medical technology).
- **Blue biobusiness technology** is biobusiness focused on the application of biological technology in aquatic contexts. It includes aquaculture, biotechnology-enhanced environmental remediation in both freshwater and oceanic settings, and other water-related bioscience-based economic activities.

Census

The census identified 425 Minnesota biobusiness technology enterprises (BTEs), which are enterprises devoted to the development and/or commercialization of bioscience or bioscience-related technologies, products, or services. A critical outcome of this phase was generation of the most comprehensive list of Minnesota’s biobusiness technology industry to date.

The BioBusiness Alliance of Minnesota has developed a database of this information that will be maintained to track the industry. This database has basic descriptors about each BTE, including organization name, location, contact detail, enterprise description and activities, primary field of technology and primary mode of activity.

Detailed Study

Once the census was completed, a questionnaire was mailed to all BTEs, and many organizations were also contacted directly by telephone, face-to-face interview and other means. The questionnaire was focused on understanding the core technologies, products and markets in which the BTE is currently active, and also where it expects its future focus to be. Through this direct interaction with BTEs, we were able to collect data to develop a macro view of Minnesota’s technological strengths.

As a result of this survey, three fascinating features of Minnesota’s biobusiness sector were revealed. First, the vast majority (about 93 percent) of Minnesota’s biobusiness technology enterprises are oriented in one way or another toward red biobusiness (i.e., health care technology/medicine); and a significant majority (almost two-thirds) are oriented exclusively toward red biobusiness. Second, over a quarter of the enterprises in the sample (about 27 percent) are active in multiple fields of biobusiness. In other words, over a quarter are involved in some kind of biobusiness industry



convergence. Third, of the enterprises active in white biobusiness and green biobusiness (just over one third of the sample), 78 percent are also active in red biobusiness. The implications of this third discovery are profound. In short, it appears that the future prospects of non-medical biobusiness and medical biobusiness in Minnesota are interlinked.

This last topic — **the interconnectedness of different fields of biobusiness in Minnesota** — will be a pivotal theme for subsequent work of the BioBusiness Alliance of Minnesota. In coming months, further analysis of the data produced in this project will be conducted to identify important sectors in which Minnesota can best focus resources to succeed.

Conclusions

Our two parallel, yet distinctly different, analyses of Minnesota’s biobusiness economy yielded some results that we fully expected to affirm and others that could only have been revealed through the process of conducting the assessment. This assessment is prompting immediate action steps based on the findings of the report. We anticipate that ongoing action steps will be suggested as the data continues to be analyzed. Based on our understanding of the data today, our key conclusions include:

Minnesota’s economy is more dependent upon biobusiness than other states. Minnesota’s economy is 24 percent more dependent upon biobusiness technology, vis-à-vis employment, than is the norm for the whole of the United States. There is more at stake for Minnesota, as the emerging biobusiness economy unfolds, than is the case for the rest of the country. What we do to nurture this sector of employment and to strengthen it against competition matters for the citizens of our state.

Minnesota’s biobusiness sector is distinctive. Biobusiness in Minnesota is not merely a microcosm of the biobusiness sector of the United States. It has unique characteristics that need to be cultivated for distinctive and sustainable competitive advantage. For example, medical devices account for a greater share of biobusiness technology in Minnesota than they do for the United States as a whole. In addition, Minnesota’s biobusiness technology sector is much more prominent in bioenergy than is the case for other states. Minnesota needs strategies and policies designed to enhance our state’s distinctive biobusiness technology profile.

Minnesota’s emerging biobusiness sectors exhibit high levels of convergence with established biobusiness sectors. Organizations in Minnesota engaged in biobusiness — whether for-profit companies, not-for-profit institutes or units of universities, hospitals or for-profit companies — are often active in multiple fields simultaneously, stretching across conventional market and product categories. The proportion of Minnesota’s enterprises engaged in the application of biological technology in the fields of plants and agriculture, or in industrial fields such as biomaterials, bioprocessing, bio-based chemicals, food ingredients, or bioremediation, that are also engaged in the general area of medical technology, or human health technology, is substantial.



The future of Minnesota's health care (red) biobusiness sector is interdependent with the future health of Minnesota's agri-bio (green) and bio-industrial (white) biobusiness sectors. The future competitiveness of biobusiness in Minnesota requires cooperation between stakeholders in the different biobusiness sectors. The fact that there are underlying technologies and fields of science that transcend multiple biobusiness fields is one of the reasons for the interdependence of Minnesota's biobusiness sectors.

Minnesota's biobusiness sector is growing. Despite problems faced by the state between 1997 and 2002, in the face of competition from elsewhere, the overall biobusiness sector is growing. Over 7,000 new biobusiness jobs are estimated to appear to have been created in Minnesota since 2002. This growth generates opportunities to capitalize on the interplay that already appears to have emerged between the various fields of biobusiness in the state. It also provides hope that the unusually high contribution of biobusiness to the economy of Minnesota (compared with the economies of other states) may be sustained, as long as the threats posed by the growth of biobusiness elsewhere are addressed.

Minnesota's competitive position is under threat due to heavy biobusiness investment and growth in other states. Despite growth in biobusiness overall in recent years, Minnesota's current competitiveness is under threat as other states invest heavily, aggressively and creatively in developing their own biobusiness industries. Our state needs to act strategically and decisively to maintain a competitive position in biobusiness in future years

The health of Minnesota's economy will be affected by whether or not the competitiveness of the state's biobusiness sector can be strengthened. Minnesota's economy is more dependent on biobusiness than are the economies of most other states in the United States, and biobusiness in Minnesota is facing serious competitive threats from elsewhere. This means that strengthening the biobusiness sector matters for the citizens of our state. Given that the average wage in the biobusiness / biosciences sector is about 165 percent of the average private sector wage in the United States, and every new bioscience job results in the creation of an additional 5.7 jobs, the positive benefits to the citizens of Minnesota from strengthening biobusiness will be amplified disproportionately throughout the state's economy.¹

We are optimistic. The dynamism, uniqueness and recent continued growth of the employment and business activity in our state's biobusiness technology sector provides solid grounds for hope that the necessary steps can be taken to sustain Minnesota as a global player in a handful of biobusiness fields where we can truly be among the best of the best.

¹These two items of economic data are taken from the following source: Battelle Technology Partnership Practice and SSTI, Growing the Nation's Bioscience Sector: State Bioscience Initiatives 2006 (Columbus, OH: Battelle Memorial Institute, April 2006).





Acknowledgements



First, and foremost, we wish to extend a special thank you to funders with the foresight and commitment to make this assessment happen: the University of Minnesota (Office of the President, Academic Health Center and Office of the Vice President for Research), the Minnesota Department of Employment and Economic Development and the Minnesota Department of Agriculture.

We also would like to express our most sincere gratitude to the dedicated team of people who worked so long and hard over the last year to assess the state of biobusiness technology in Minnesota. This assessment could not have been completed without the leadership and participation of volunteers throughout the process.

We wish to extend our appreciation to the entire BioBusiness Alliance Board of Directors:

Doug Cameron	Dave Melin
Mitch Davis	Tim Mulcahy
Mark DuVal	Gail O’Kane
Ray Frost	Lynne Osterman
Donald Gerhardt	J. David Prince
Gene Goddard	Christopher Puto
Jennifer Kuzma	Ken Stabler
Tim Laske	Dale Wahlstrom, Chair
Kurt Markham	Eric Wieben

We also wish to extend our appreciation to a team of volunteers who participated in numerous different ways during the Assessment:

Bonnie Holte Bennett	Ruth Lane
Pete Bianco	William McGinnis
Kit Borgman	Patricia Neuman
Kathleen Crandall	Douglas Petty
Jessica Deegan	Sara Thurin Rollin
Bob Elde	Dick Sommerstad
William Hoffman	Marc von Keitz
Bob Isaacson	Jill Zullo
Jennifer Kocs	



Additionally, we would like to thank Robert Butterbrodt for staffing assistance during a key part of the project.

Last, it is with great appreciation that we call attention to the three people without whose support, insights and leadership this project would not have happened:

Dale Wahlstrom – for his leadership as Chairman in the creation of the BioBusiness Alliance, and his strong support and involvement throughout the Statewide Assessment process.

Jeremy Lenz – as the staff person for the Statewide Assessment project, who was intricately involved from pre-inception through completion.

Gail O’Kane – whose insights and participation have greatly enriched the outcomes of this report.

Vincent Ruane and Kelvin Willoughby



Table of Contents



Foreword	i
Preface	iii
Executive Summary.....	xi
Acknowledgements	xxi
1. Introduction	1
2. Goals of the Project	3
3. Our Philosophy	5
4. Two Parallel and Complementary Assessment Pathways	7
Comparative Assessment of Competitiveness	7
Grassroots Assessment of Capabilities	7
5. Basic Profile of Minnesota’s Biobusiness Economy	9
6. Minnesota’s Competitive Position in Biobusiness.....	13
Overview of Methodology and Data Sources	13
Biobusiness Technology.....	16
Medical Devices	23
R&D in the Life Sciences	30
Agri-bio and Bio-industrial Technology.....	37
Conclusions: Competitiveness	40
7. Grassroots Assessment of Minnesota’s Distinctive Capabilities.....	45
Overview and Methodology.....	45
Results from the Census.....	46
Results from the Detailed Study	48
An Industry Perspective on the Grassroots Assessment	55
8. General Conclusions of the Assessment Project: Minnesota’s Present Position and Future Prospects.....	59
Appendix 1	63
Appendix 2	69
Appendix 3.....	71
Appendix 4.....	73
List of Figures.....	75



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