Destination 2025

envision our future

A collaboration between
The BioBusiness Alliance of Minnesota
and Deloitte Consulting LLP

Destination 2025

Roadmap: Recommendations To Grow Minnesota's Life Science Industry

The BioBusiness Alliance of Minnesota™

Deloitte

Table of contents

To the leadership and citizens of Minnesota

Minnesota is blessed with an exceptionally strong life science industry. The state's economy is about 24 percent more dependent on the life sciences than the national average.[1] This success is anchored in the state's agricultural and medical technology industries, but is made possible by the strength of its high-technology industries, defined broadly.

In partnership with government and academia, these segments of the state's industrial sector have historically worked together to create an economic environment that has given Minnesotans a quality of life that is among the best in the world. Solid funding in education and infrastructure has contributed to the success of business in developing a strong tax base and high-quality jobs. These jobs have created opportunity in a range of occupations at all levels of employment. Notably, for every two scientists/engineers employed in Minnesota's life science industry, there are approximately three technicians or production workers, and many more employees in such business-service areas as sales, information technology, and administrative support.[2]

As a committee of Minnesota citizens who work in and with the life science industry, we emphatically believe that the state has lost some of its competitive edge. The environment that existed in Minnesota and enabled the growth of strong economic clusters such as food and medical devices is not as favorable as it once was. The state's public, private, and academic communities have gradually drifted apart, and today the partnership between these three sectors is no longer "best in class." It is average, and in some cases, below average. Critically, unlike nearly 30 states across the country, Minnesota has not developed, funded, or implemented a major, comprehensive science and technology initiative to support recruitment and retention of talent, develop and maintain infrastructure, encourage research, and attract external financing critical to Minnesota's competitive position in the growing knowledge-based economy.

We strongly believe that Minnesota can quickly regain its edge and move toward a bright future through the type of focused investments and collaborative efforts and activities outlined in this roadmap. As a mid-sized state, the way Minnesota can win and lead industry segments is by tightly aligning strategies and efforts among the critical stakeholders. This roadmap is just one example of how Minnesota can reinvigorate that spirit of working together as one community in a way that we can benefit from the collective effort.

We believe that the Minnesota culture is about winning in our own quiet and unassuming way, and contributing to making Minnesota and the world a better place. Minnesotans are entrepreneurial, strong in character, and well educated, and the state has a demonstrated history of being willing to do the right thing at the right time. The same strengths and capabilities that made this mid-sized state so powerful are still here. The Destination 2025 project has enlisted the help of over 600 people from around the world who have demonstrated their belief that Minnesota is a special place by committing money, time, and most importantly their knowledge and skills, to bring you the following roadmap.

---

[1] These numbers were calculated by Dr. Kelvin Willoughby using data from the 2002 U.S. Economic Census of the U.S. Bureau of the Census. The data used excludes employment inside universities, hospitals, and other not-for-profit organizations involved in biobusiness.

[2] 2005 data compiled from the national Biotech Work Portal. Available online at: www.biotechwork.org.

The roadmap creates a picture of what the Destination 2025 team believe is Minnesota's responsibility to set the direction and competitive tone for the rest of the world in the industries where the state chooses to compete. In many areas we are uniquely positioned to assume this role and create disruptive, effective solutions to life science-related problems that have remained stubbornly unaddressed. To do so means re-establishing best in class capabilities in the state's private, public, and academic sectors to develop new knowledge and turn it into jobs and economic wealth. We believe today is a time of opportunity.

We hope you enjoy reading the following Minnesota roadmap for the life science industry as much as we enjoy presenting it to you. We look forward to working with you to implement the recommendations over the coming years.

Scope and approach

The Destination 2025 project was a collaborative effort between The BioBusiness Alliance of Minnesota and Deloitte Consulting LLP (Deloitte Consulting) that involved over 600 people who work in and with the industry and who are experts in their area. The development of the roadmap was the last of three steps in the Destination 2025 process. This roadmap provides high-level recommendations for the Minnesota life science community for each of the six markets in which the state competes: **Medical Devices, Biologics and Biopharmaceuticals, Animal Health, Food, Renewable Energy, and Renewable Materials.**

The first step was to analyze emerging market trends and technologies that are likely to influence each of the six markets over the next two decades. The relevance of these technologies and products was explored across a range of global scenarios of the future. The result is the identification of a probable set of technologies and products that will be relevant across a broad range of scenarios. This analysis is presented in a series of white papers which presents a global view of the future market landscape for each of the six markets studied. These white papers can be downloaded for free from either the Deloitte Consulting website (www.deloitte.com/us/d2025), or the BioBusiness Alliance of Minnesota's website (www.biobusinessalliance.org).

The second step was to develop a vision for Minnesota's role in each of the six markets. This was accomplished by comparing the findings regarding relevant technologies, products, and knowledge clusters from each of the six white papers against an analysis of Minnesota's current strengths, weaknesses, and limitations. By doing so, recommendations were identified, that when implemented, will strengthen Minnesota's competitive position in these emerging opportunities. Copies of these vision documents by market can be obtained by requesting a copy from the BioBusiness Alliance of Minnesota at (www.biobusinessalliance.org).

Development of the recommendations was based on the following criteria. The recommendations must:

- Be strategic in direction and build towards a sustainable life science industry that provides job creation at different employment levels
- Leverage Minnesota's existing strengths, assets, and previous investments
- Have broad state appeal and have short-term or strategic long-term potential economic impact

Collectively, the information presented in Destination 2025 can be used to make decisions that affect the broader life science community and the economic health of the state.

Recommendations

The set of Destination 2025 recommendations is not directed at only one sector or community in Minnesota. Some of the recommendations require leadership from the public sector, others from the private sector, and still others from academia. Most will require the partnership of more than one of these.

Whereas some of the recommendations require statewide effort, all of them depend upon the participation of communities across Minnesota that are committed to growing their local, knowledge-based economy because they believe it to be a powerful strategy – perhaps one of many – for creating local wealth and stable, high-quality, future-oriented jobs.

Some recommendations will require additional investment by the public, private, or academic sectors over time. Virtually all, however, will benefit from aligning new and existing efforts and activities through new or strengthened partnerships.

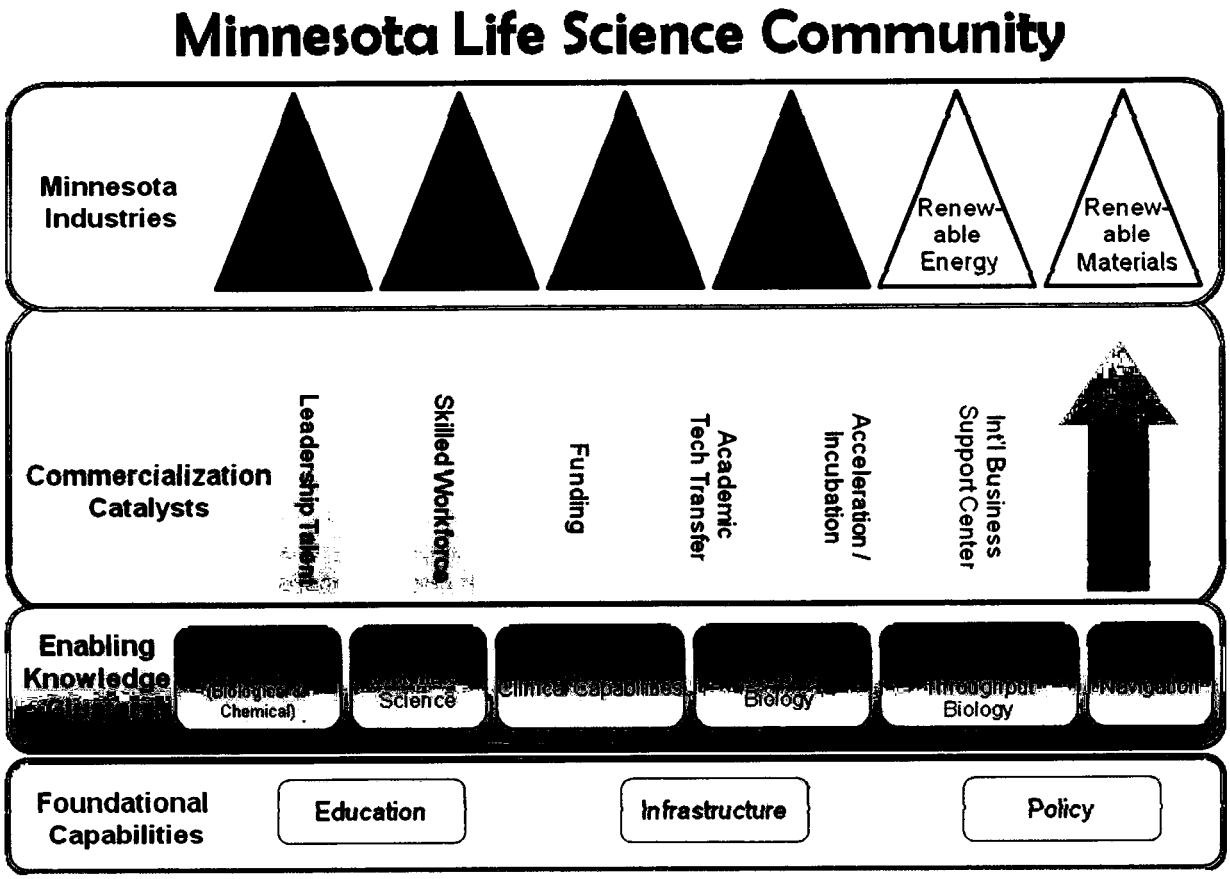
The recommendations are organized using the BioBusiness Alliance of Minnesota's framework of the Minnesota life science community shown in Figure 1 (see Appendix 1 for definitions). The first set of recommendations focus on the development of ***industry clusters*** in the state that have great potential. These recommendations are specific to industries in which Minnesota is uniquely capable of competing globally, and are both short and long term in scope. The second series of recommendations focus on ***community capabilities***, specifically foundational capabilities, enabling knowledge clusters, and commercialization catalysts. Together, these represent the capabilities a community must have to be able to attract or grow companies that provide sustainable jobs for its citizens. The final set comprises a single ***overarching recommendation*** that the Destination 2025 team believes is necessary to implement this roadmap and provide the leadership and environment to make it come to life.

In presenting the roadmap, we frequently employ the terms "core" and "contingent" in reference to many of the recommendations and community capabilities. These terms are adopted from the Strategic Flexibility (SF) framework, a decision-making model developed by Deloitte Consulting that was used to create the Destination 2025 white papers and vision papers (see Appendix 2). "Core" is used in this document to refer to actions or capabilities that affect, or are common, across the six life science industries that we assessed, and in many cases are core across all industries in the state. "Contingent" is used to refer to actions or capabilities that require ongoing assessment and review to determine what steps, if any, need to be taken to leverage the potential opportunities they offer.

The recommendations and action steps are numbered for ease of reference. The numbers ***do not*** reflect a prioritization of the recommendations. All are important, though some may have broader impact than others. Some represent an immediate opportunity or need, while others will require long-term effort and ongoing stewardship.

In addition to the consolidated recommendations contained in the roadmap, most of which span multiple life science industries, individuals interested in specific life sciences sectors should read the corresponding vision paper for more detail on industry-specific recommendations.

Figure 1

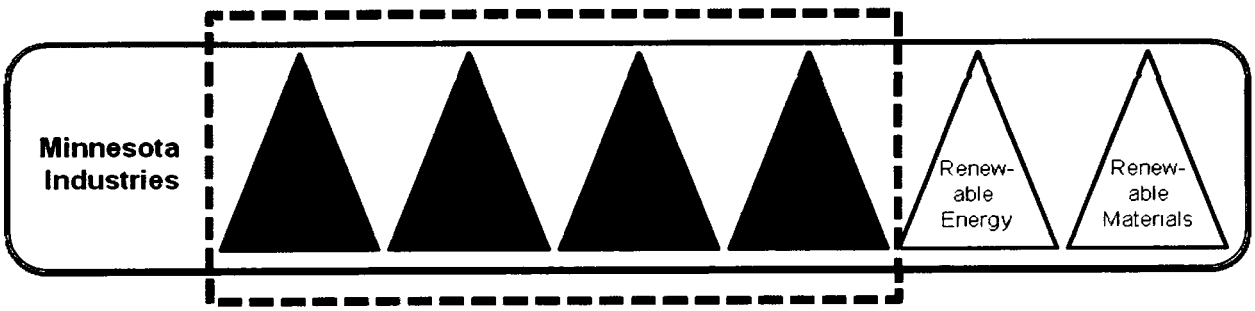


Minnesota industries

There are many opportunities in different industry sectors to start or grow businesses in Minnesota. The state has capabilities and infrastructure to support a diverse economy, and that diversity should be encouraged. During the Destination 2025 process, we elected to look at all six life science industries at one time in an effort to identify synergies and areas that overlap with each other, as well as with other industries within the state. As expected, we found that there are many areas where existing investments combined with well-planned future investments can have an impact on multiple industries at the same time. This will increase the effective use of the state's limited dollars -- and accelerate the commercialization of creative products that capitalize on the convergence of historically separate industries. The following recommendations for areas of investment and focus are not intended to pick "winners and losers." However, based on the extensive research conducted for this report, they present industrial growth opportunities that build on Minnesota's existing investments and strengths in which Minnesota has the potential to be dominant. There is no intention to discourage investment in other areas of business and in fact many other opportunities will arise over time, but we believe the recommended areas clearly have high potential for success if appropriate strategies are implemented.

Medical technology cluster

Figure 2



Four of the industries studied are included in this grouping of recommendations (Figure 2): medical devices, biologics and biopharmaceuticals, animal health and food. We included these industries in the medical technology cluster of recommendations because of the overlap and convergence that is occurring among them. Although there is potential overlap among all six industries, food (plant and animal) design and production cross over all of the other markets; hence, the food industry is included in both sets of clusters.

Minnesota is in an enviable position in regard to the four industries that comprise the medical technology cluster. The state is ***uniquely*** positioned to leverage existing and future investments to lead the world in certain segments of these markets. There are few states that have world-class clusters in human medical technology and in food design and production, as well as a very strong animal health industry, and a strong biotechnology research capability. Minnesota is alone in housing these capabilities, and needs to grasp the opportunities this situation offers the state. To support these industries, Minnesota is also a leader in the delivery of health care, establishment of reimbursement policies, conducting medical research, and design and manufacturing of medical products. The recommendations for this cluster focus primarily on products that offer job creation opportunities at all levels and leverage these broad strengths while considering the future.

Situation analysis: Minnesota is dependent on the medical device industry for a significant portion of its economic health. Minnesota medical device companies are generally focused on the cardiovascular market. As this market matures, its growth is slowing, or in some cases, shrinking. As a result, medical device companies that have been heavily invested in the cardiovascular market are all looking for opportunities to grow new businesses that use their core technology (e.g., active implantable technology, surgical tools, and procedural support products)[3] to treat new indications. Gut stimulation, neurological stimulation, therapy delivery systems and navigation inside of the body are examples. Application is only limited by the lack of understanding of the possibilities that exist for other treatments. We believe there will be many other opportunities where application of this technology will benefit patient outcomes.

Device companies are also under tremendous pricing and regulatory pressure.

The impact to Minnesota as a result of these industry trends is a slowing of local hiring. In many cases, companies are setting up operations in other geographies where newly forming academic and private sector clusters offer technology that competes with "active implantable technology," at the same time offering incentives and cost advantages that are significant. This is an extremely important issue to Minnesota that needs to be understood and managed.

A second evolution of importance to Minnesota's medical technology industry is the rapid expansion of the biologic and biopharmaceutical industry. This industry has a disproportionate level of influence on defining the future for medical health care delivery for both animals and humans. Commercialization of new products in the biologic and biopharmaceutical industry is not Minnesota's strength. Yet, there are several reasons why Minnesota needs to be part of this industry as the "age of biology" matures.

- The industry is growing at approximately 15 percent per year and has the potential to accelerate as more knowledge is created. Minnesota is hardly participating in that growth, and is not developing the management talent, workforce, funding mechanisms, technology transfer know-how, and all of the other "commercialization catalysts" that are necessary for a community to become a hub for the industry.
- Biologic and biopharmaceutical products are converging with medical devices. If Minnesota is not the place that "dominates" in the convergence of these industries, the state has the potential to lose its dominant role in the device industry. Today Minnesota is not the recognized "hub" for convergent product, as it is for active implantable products.
- The University of Minnesota, Mayo Clinic, and other private-sector entities are strong in the development of new knowledge and product concepts in biologic and biopharmaceutical products. If a commercialization capability for the human market is not established in Minnesota, both institutions will continue to be forced to license their intellectual property in other states and countries. As a result, Minnesotans will not benefit from their world-class capabilities.

Global population growth, the rise in demand for animal protein in developing countries, and the demand in developed countries for antibiotic-free food are just some of the trends that are driving the move toward the development of many products to support the animal health and food industries. These products are targeted at preventing, identifying, and

[3] Active implantable technology uses implantable sensors and computer technology to sense body signals, and appropriately deliver an electrical stimulus that "treats" a given medical need. This is the basic technology on which much of Minnesota's medical device industry is built.

controlling diseases that affect the animal food supply. They are the same types of issues Minnesota faces in managing human health. The products that will serve this industry include vaccines, diagnostics, specialty antibiotics, and control systems.

Fortunately, Minnesota has strong capabilities in animal health in both research and commercialization of these types of products. For example, Worthington-area companies are leaders in the development and manufacture of porcine vaccines. Willmar area companies are leaders in design and manufacture of poultry vaccines, and one of them has already begun using its technology platform to develop a human version of its product. In addition, Minnesota is renowned for its laboratory capability to identify and control the spread of both human and animal diseases.

With the combination of its human and animal health capabilities, Minnesota is in a unique position to heavily influence the future of the industry. Between the two capabilities, the state has world-class research and world-class manufacturing. The critical pieces that are missing are world-class collaboration and a clear understanding of how to leverage the capabilities across the boundaries that exist today. Collaboration, a shared vision, and strategically targeted investments to fill holes in the value added chain are needed to create a strong new industry for Minnesota.

Specific recommendations for the medical technology cluster

1. Grow the state's job base by expanding the application of current medical device technology

Why: The medical device cluster is critical to Minnesota's knowledge-based economy, accounting for 75 out of every 100 jobs in the state's life science industry as of 2002. The strength of a particular "cluster" is determined not only by the strength of its private sector, however. The ultimate strength of a cluster and its ability to survive long term is defined by the combined strength of its private sector and the academic capability to help reinvent the industry and prepare the workforce to create the future. With regard to the private sector, Minnesota currently dominates some aspects of the medical device industry, and is competitive in many others. The state is in a strong position in the industry, a position that has taken more than 50 years to build. It is a capability the state can leverage and must strive to maintain. The infrastructure, service industries, financial mechanisms and talent are already here, and with the layoffs that have occurred in the industry as of late, many in the life science workforce are available. It is easier and cheaper to expand on what you have than to build something new. We are confident that there are opportunities to capitalize on these strengths if Minnesota chooses to do so.

With regard to the academic sector, stakeholders throughout the Destination 2025 process expressed the viewpoint that the University of Minnesota has lost its once-recognized leadership role in medical device research and in development in support of the medical device industry. The university is facing formidable competition as Georgia Tech, MIT, Stanford, the University of Wisconsin-Madison, the University of North Carolina at Chapel Hill, and Johns Hopkins University have all invested strategically in building their capabilities to support the modern device industry and are producing students and research that are of very high quality.

Recommended actions

a. **Actively pursue implantable medical technology that leverages our infrastructure.** For short-term benefit, we strongly recommend that the state of Minnesota actively target companies to expand or locate in Minnesota that need access to the state's skilled workforce and underlying infrastructure. This should not be difficult, since Minnesota has a world-renowned reputation for being ***the*** global center for active implantable technology, and it offers many other unique locally grown skills and products that also can be leveraged. Minnesota's strength in this domain, which has enabled it to dominate the cardiovascular market, has great potential for application to several growing markets, such as neurology, gut stimulation, and diagnostics/monitoring. This action would have two strategically important benefits. First, most employment growth comes from startup and small companies. Second, smaller and startup companies often become acquisition targets for larger companies. In most situations, the acquired company stays in the location where it was acquired, but is now positioned for growth through its alliance with a larger company. For these reasons, it is critical to grow Minnesota's base of startup and small life science companies. This strategy would allow Minnesota to leverage its strengths and previous investments but will require targeted incentives and marketing in order to be successful.

b. Re-establish Minnesota's academic leadership role in medical devices

i. The University of Minnesota must re-establish its premier status among universities by supporting research relevant to the medical device industry. We recommend, in particular, focusing on the future device industry and the incorporation of convergent technologies, such as imaging, navigation, biotechnology, drugs, and others into their curriculum and research. The recent formation of the University of Minnesota Medical Devices Center is an example of a very positive move on the part of the university to rebuild its leadership role, and one we endorse strongly. We recommend that an increased level of support and funding be directed to the center. This center demonstrates the kind of forward thinking the local device industry needs to help reshape and redefine itself.

ii. The partnership between the University of Minnesota and Mayo Clinic should be extended and expanded to include a focus on medical devices. Mayo Clinic has strength in the creation of new device applications and technology. The collaborative effort between the two institutions in this area would send a strong message to the private sector and help to bring attention and potential funding back to Minnesota.

iii. The Minnesota State Colleges and Universities system should increase its efforts in medical device applications research and workforce development. As a start, the system should consider creating a device technology advisory board to recommend areas where expansion of applied research and workforce development efforts could have the largest impact on Minnesota and the communities where particular colleges and universities are located.

2. Develop a biologic and biopharmaceutical industry in Minnesota

Why: Minnesota lacks sufficient private-sector capability in biologics and biopharmaceuticals for significant commercialization and job creation to occur. Establishing a healthy biologic and biopharmaceutical industry in Minnesota is a strategic building block of the state's economic future. This industry is the source of much of the knowledge that will shape the medical health industries and markets of the future. An important aspect of this recommendation is the acknowledgement that Minnesota does not need to be ***the*** leader in this industry to succeed, but it must be a globally recognized leader in a targeted area of the industry, and establish the state as the place to do business globally in that market, just as Minnesota did in the cardiovascular portion of the device market. By doing so, Minnesota can develop a hub capability that will be sought out by investors and companies. If the state doesn't focus, it will not develop the community knowledge, infrastructure, and supporting capabilities that will give it the "ticket" to play in the industry of the future. This is both a short- and long-term investment in the health of our state. There will be a need for incentives and some public investment in infrastructure that is yet to be defined. We have world-class academic research at both Mayo Clinic and the University of Minnesota that is being commercialized today -- most of it outside of the state. It is important that Minnesota establish a private-sector base in human health biotechnology to supplement its strong academic sector. By doing so, Minnesota will have the makings of a hub capability in a targeted market that can be utilized to advance job creation in both human and animal health markets. Our recommendations include the following:

Recommended actions

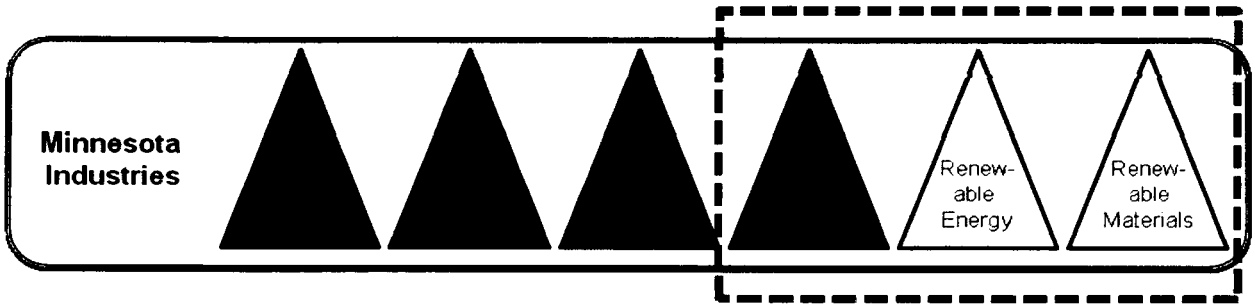
a. **Establish an implementation team of industry experts from both the animal and human health industries**, whose first step would be to develop a strategy for leveraging cross-industry capabilities to expand commercialization of intellectual property and grow biotechnology jobs in Minnesota. Since no one state can do everything, is important to define and recommend a targeted submarket of the industry where Minnesota could leverage its strengths and establish a global leadership position that would be sustainable over time. By doing so, Minnesota can begin to develop a biotechnology niche from which it can establish a global reputation. Stem cell therapies targeting non-Hodgkin's lymphoma and immunotherapy for cancer treatment are just two examples of niches in which Minnesota has a strong research and development (R&D) position that might be exploited. The strategy developed by the team also should seek to fill gaps in the drug development life cycle that are preventing Minnesota from being able to convert its basic research in biologics and biopharmaceuticals into commercialized products.

b. **As an initial step in building biologic and biopharmaceutical capacity in the state, leverage Minnesota's strengths in a concentrated effort to expand the state's diagnostics and monitoring industry**. The diagnostics and monitoring market is growing very rapidly, approaching the size of medical devices and Minnesota has existing capability in key technologies needed to establish a leadership position. These include: diagnostics (biotechnology and chemical); medical devices (both implantable and wearable monitoring systems); bioinformatics and associated support technologies, such as computer modeling; high-throughput screening; and both human and animal biologics

manufacturing capability. There are also experienced leaders in the state who have expressed their willingness to help make this recommendation a reality. This industry is important because the rapid and economical identification and categorization of diseases is being enabled by new developments in biotechnology and diagnostic equipment. In this key area of convergence between devices and biotechnology, Minnesota can leverage its strengths to establish a leadership position in this rapidly evolving industry. Active and aggressive participation in this industry will allow Minnesota to build the community infrastructure that will attract management and investments.

Agricultural and biomass cluster

Figure 3



Three of the industries studied during the Destination 2025 process are included in this cluster. They are (Figure 3): food, renewable energy, and renewable materials. These three industries are grouped together because, for the most part, they use similar processing technologies and feedstock (forest resources in the north and agricultural resources in the rest of the state). Many of the products used by the industry also overlap, and the producers and opportunities for vertical integration of business opportunities are quite connected.

Situation analysis: Minnesota is part of the Midwest breadbasket and benefits greatly from having a world-class food industry. Agricultural production is one of the state's largest industries, with corn, soybean, and small-grain production predominantly located in the west and south. All of the top-50 food companies have operations in Minnesota.[4] With companies like Cargill, General Mills, Schwan's, Land O'Lakes, Hormel and others, the state's ability to convert raw materials to final food products is world-renowned.

Forest products have played an important role in northern Minnesota's economy for centuries. There is a strong supply chain, from timber harvesting to lumber and paper manufacturing. Minnesota has more acres of certified-sustainable forestland than any other entity in the country.[5] With demand for some traditional products decreasing, at least in the short term, alternative uses of forest products are now under study.

Minnesota also has established itself as a global contributor in the production of alternative energy. Policies supporting ethanol and biodiesel production are strong and have contributed significant economic benefit to farms and communities in Greater Minnesota, in particular. Wind energy is becoming a large industry, and efforts are underway in by both public and private sectors to integrate hardware manufacturing into the state's economy to supply the growing demand for wind generation components and expand the state's manufacturing base. Several solar companies are already establishing themselves as market participants.

In general, the biofuels and wind industries are well established and are receiving good support from the public sector. Most issues of concern relate to the sustainability of the industry as a whole due to conflicting demands for feedstock, the inconsistency of pricing, public opinion, undeveloped market demand, and the limitations of science and technology to bring promising new products to the market. An additional concern is the less-than-world-class collaboration between the academic and private sector. For these reasons, many of the recommendations offered for this cluster relate to stabilizing the market and improving access to support for commercialization.

Two years ago, a computer model was developed by the BioBusiness Alliance of Minnesota in conjunction with Sandia National Laboratories and Forio Business Simulations with engineering support provided through a private-sector work-in-

---

[4] Food Processing 2005. Available online at: http://www.foodprocessing.com/articles/2005/474.html. Accessed 12/20/08.
[5] Minnesota Forest Industries Inc. 2007. Factbook 2007. Available online at: http://www.minnesotaforests.com/resources/pdfs/2007factbook.pdf. Accessed 1/25/09.

kind contribution. The goal of the project was to develop an integrated model of different sources of renewable energy to generate sustainable, data-driven strategies for Minnesota to meet the 25 x '25 renewable portfolio standard, which set a goal that by the year 2025, 25 percent of energy produced in the state will be generated from renewable sources. The results of the modeling initiative demonstrated that this goal will be very difficult to achieve. Some of the recommendations below are being offered as supplements to current strategies in order to improve the probability of meeting the 25 x '25 challenge.

Many good ideas currently under consideration have the potential to help Minnesota expand its role in renewable energy. These ideas range from conservation and efficiency products to multiple methods of renewable energy production. Energy sustainability will continue to be a strong concern for the global community, and Minnesota is well-positioned to take advantage of this global need. The economic plan being advanced by President Barack Obama as he took office calls for significant investments being made in renewable and green technologies. It is important that Minnesota access these and other federal funding opportunities to help fuel local innovation. This juncture presents a rare opportunity for Minnesotans to gain access to funds that can have an immediate impact on business development.

Specific recommendations for the agricultural and biomass cluster

1. Uncover overlapping and convergent opportunities and resolve conflicting demands between the food, renewable energy, and renewable materials industries

Why: Investors and producers need help to manage the conflicting demands between the food, renewable energy, and renewable materials industries. Policies, programs, and tools that help investors make sound and economically viable choices need to be developed and made available to decision makers in all sectors. It is critical that decisions be based on data, with the involvement of experts and stakeholders. In a context of rapidly evolving and uncertain technologies and significant market gyrations, decision makers and investors frequently need to take action with less than adequate data. Minnesota has an opportunity to take the lead in establishing a decision-making model that can help to solve problems and shape these industries. It is possible to put in place the policies and mechanisms to drive the integration of these industries into a balanced and economically sustainable environment. Without doing so, it will be difficult to stabilize confidence in the industry and minimize investment risks to support a sustainable and prosperous future.

Recommended action

a. **Form a public-private partnership to lead efforts in establishing a long-term vision and strategy to stabilize the market.** One critical aspect of this recommendation is the creation of a set of data-based decision-making tools to help private investors and policy makers move forward in ways that will grow these industries and create sustainable value. To maximize impact to Minnesota and the marketplace, these tools should be developed in conjunction with the national laboratory system and other federal, private, and public sector partners with the appropriate skills. Partnering with federal and national entities has a secondary benefit. Many of Minnesota's relationships with national entities have historically been transactional in nature, meaning the state uses the relationship for a specific project or issue. Minnesota could, however, use the process of developing this tool kit to deepen and build relationships with federal labs and agencies, national organizations, and multinational companies. Doing so could enhance the state's ability to compete for large-scale federal grants and other projects.

2. Establish Minnesota as a leader in sustainable biomass supply

Why: The key success factor for establishing any type of biomass-based industry is the availability of a sufficient biomass supply. Establishing a sustainable supply implies that appropriate pricing structures, policies and capability to support planting, harvesting, logistics, processing and storage are in place. This supply not only has to be affordable, but also needs to be produced in a sustainable manner to meet international standards and consumers environmental expectations. Minnesota has significant experience in the production of a broad range of traditional biomass (forestry and agriculture) as well as a good foundation for innovative biomass crops (mixed prairie grasses). Minnesota has the largest certified (sustainable) forest land base in the United States, as well as significant brush and peat resources.[6] Bringing this talent together can position Minnesota to develop new biomass business models that can reduce the environmental footprint of a variety of industry activities while providing a sustainable and profitable business model. By establishing Minnesota as a

[6] Minnesota Forest Industries. 2008. http://www.minnesotaforests.com/.

center of excellence in this niche, this capability will not only be applied within the state, but can also create an export business to other states and countries (e.g., expertise, methods, new seeds).

Recommended actions

a. **Establish a team to coordinate efforts in building a comprehensive statewide database for biomass supply.**

b. **Encourage the formation of an inter-disciplinary team of agronomists, forestry experts, plant geneticists, plant breeders, and ecologists** to develop new strategies and technologies for minimizing the carbon and ecological footprint of biomass production while improving the profitability of the business.

3. As a first step to help build a robust biomass-based economy, develop a combustible biomass industry

Why: As mentioned previously, the modeling work done during the Destination 2025 process identified a potential gap in the state's ability to reach its 25 x '25 renewable portfolio standard. One opportunity to help close that gap, and at the same time create immediate job opportunities, is to establish a combustible biomass industry in Minnesota that leverages both its forest and agricultural resources. Research revealed that the countries having the greatest success replacing fossil fuels with renewable fuels, such as Sweden, are leveraging biomass combustion heat and electricity generation. This technology is both available and affordable, and can be utilized at different levels of consumption, from individual homes to large electricity production facilities. Minnesota, like several other Midwestern states, already has a combustible biomass industry, but due primarily to the lack of a complete supply chain and an incented market, its regional penetration has been limited. There is an opportunity to develop local markets that can catalyze jobs almost immediately if the incentives are put in place to jump-start the industry, as has been done with ethanol and biodiesel. An additional benefit of establishing this industry is the role it can play in developing the biomass production and logistics systems needed to support follow-on industries (such as ethanol/mixed alcohols, MTBE, gasoline, synthetic natural gas) and future higher-value biomass-based industries. By leveraging the acceleration in the global expansion of this industry, Minnesota can learn how to operate profitable businesses using biomass, and establish a leadership role in the bioeconomy.

Recommended actions

a. **Develop an appropriate incentive program to create a market for this industry in Minnesota**. Development of sustainable strategies to stabilize this market will require additional research, but the potential benefits for Minnesota warrant establishing this industry as a high priority for the state. Careful articulation of potential benefits to consumers will also help establish grassroots support for this strategy.

b. **Appoint a cross-functional leadership team to include representatives from the different sectors of the industry**. This team should be charged with the generation of critical momentum and the development of appropriate strategies and policy recommendations in support of the combustible biomass industry in Minnesota. The team should include stakeholders from all biomass-consuming industries, to ensure a balanced use of feedstocks that supports multiple markets.

Given the immediate potential for success, this strategy must be implemented without delay. In fact, this industry has such great potential that a coordinated effort has already begun to frame a development initiative and implementation and planning, in anticipation of the formation of a formal leadership team, as recommended above. The BioBusiness Alliance of Minnesota will coordinate statewide activity and lead the initiative until a leadership organization emerges to assume this role at the statewide level. There are organizations in northern Minnesota that have indicated their willingness to lead development of strategies for woody biomass, and The BioBusiness Alliance of Minnesota is actively seeking other organizations to lead efforts to build an agricultural-based biomass combustion industry in the southern and western part of the state. Existing relationships in Sweden and Canada will be leveraged to understand their business models for application in Minnesota, where appropriate.

4. Position Minnesota as a world leader in engineering and processing to produce products from renewable materials

Why: Most renewable materials being produced today are not drop-in replacements for petrochemicals. These materials have unique properties and, thereby, require unique processes for manufacturing final products. This is an area where Minnesota can play a global leadership role in everything from basic science to manufacturing, leveraging its considerable strengths in material science, engineering, and processing. Minnesota's strengths can be exploited to manufacture these new materials into a myriad of new consumer products and various forms of packaging materials. This is expected to be an

increasingly important market because of the rising cost of petroleum (over time), the cost of disposing of petroleum-based waste, and the growing consumer demand for more environmentally friendly products and services. Moreover, this industry has the potential to create a significant number of manufacturing jobs in the state.

Recommended actions

a. **Establish policies and incentives to encourage Minnesota companies to establish business models based on renewable materials.** Most importantly, success will require passage of policies to create and nurture the market. This can come in the form of mandating that certain products be used by consumers or through establishment of requirements for use of non-petroleum based products within the marketplace. One possible approach would be to enact a policy comparable to the state's 10 percent ethanol-blend mandate but targeting a designated renewable materials market. Appropriate target materials and replacement schedules would need to be developed by industry experts. A second form of incentives would support the conversion industries' efforts to retool and re-engineer their manufacturing processes to support use of renewable materials. In the absence of incentives to support such efforts, few will be encouraged to seize this opportunity.

b. **Engage Minnesota's colleges and universities in cutting-edge research and workforce development in support of renewable material-focused industries.** To create a sustainable cluster in this emerging market, the state's higher-education institutions need to increase their research efforts directed at developing new renewable materials and new processes that can put the state at the forefront of product and technology development. To this end, we recommend that the Minnesota State Colleges and Universities system establish two-year technical degree programs, as well as bachelor's and master's degree programs, to support workforce development and applied research in process development, which will strengthen the renewable materials industry. We further recommend that the University of Minnesota enhance its efforts to support advanced materials and processing research to feed the industry. It would also be highly beneficial for Minnesota's higher-education institutions to establish partnerships with software companies to develop computer assisted design (CAD) software that can simulate, model, and accommodate the unique properties of novel renewable materials, thereby facilitating transfer of this technology from design to manufacturing.

5. **Support clean, green, and renewable products and services**

Why: Global trends indicate that the cost of energy is going to continue to rise over time. There will be peaks and valleys in prices, but overall the value and cost of energy will increase. The most effective way to control cost is to control consumption. Minnesota has a significant industry in heating, ventilation, and air conditioning. The state also has a significant construction industry with a global presence. These companies offer Minnesota an opportunity to leverage their skills and infrastructure to add green technology to the Minnesota product offerings by creating a market and leveraging their manufacturing infrastructure.

The monetization of carbon emissions is already a reality in many other nations. It seems to be inevitable in the United States, as well. As a result, carbon emissions will factor into the cost of production for energy and many other products. Such actions, both inside and outside of the United States, and the increasing need for environmentally friendly products, will increase demand for renewable energy and energy conservation products around the world. Carbon reduction treaties have already have led to a sharp increase in European imports of combustible biomass pellets from Canada and the United States, and ethanol from Brazil. Active participation in worldwide carbon controls before they are even implemented in the United States would be immediately beneficial to Minnesota industry through the establishment of an export market, and the development of an understanding of how to leverage the value of carbon credits. This would, in effect, increase the private sector's sophistication in using carbon credits as a business model, giving the state a head start on learning how to capitalize on what will likely be a large business opportunity.

Recommended actions

a. **Establish incentive systems that reward integrating energy reduction with green energy consumption, thereby creating markets for clean, green, and renewable products.** If the industrial, commercial or private consumer has incentives to reduce consumption, and replace energy with green energy where possible, the market will be created and industry will grow. There is a need for the green industry constituents to interface in some coordinated manner. The numerous activities occurring around the state could be interfacing with each other to share best practices and to jointly create policies and markets for products and services. This pie is big enough for everyone.

b. **Educate the population on how to benefit and leverage carbon emissions credit systems**, and develop business models to help capture value from this opportunity through the creation of carbon accounting systems and methods. This can be a source of product and service industries, and a department or focal organization in state government to help companies understand how to work with different credit systems would be beneficial.

Community capabilities

Companies consider many factors when deciding where to settle and grow. We summarize these major considerations in the bottom three levels of Figure 1: foundational capabilities, enabling knowledge clusters, and commercialization catalysts. We refer to the combination of these three categories as "community capabilities." Together, they define the strength of a community to attract and grow business, thereby creating a high quality of life for its citizens. Figure 1 is developed specifically for the life science industry, but the concept is applicable to other industries as well.

Each of these categories of capabilities plays a different role in creating the right environment for corporate growth and prosperity. There is no single combination of these different components that creates the "right formula" for success in all cases, across all industries. Therefore, in order to compete most effectively with other states and countries for the broadest array of industries, our community -- the state of Minnesota -- must have above-average strength in each of these supporting capabilities. In short, these fundamental capabilities are essential to Minnesota's ability to establish a strong, knowledge-based economy with its accompanying high salaries and quality of life benefits. The community must be world class in the core capabilities essential to the recruitment, growth, and retention of high-tech business and industry.

Although the recommendations mentioned in the previous sections of this roadmap target opportunities for specific industry clusters or business opportunities, the recommendations in this section address capabilities and environments critical to the successful establishment of a sustainable knowledge-based economy in general. Any and all of the previous recommendations are dependent on implementation of the following recommendations in support of targeted opportunities already outlined. Our recommendations regarding foundational capabilities, enabling knowledge clusters, and commercialization catalysts are described in this section. They are defined as "core" or "contingent" according to the Strategic Flexibility framework that has been adopted as the guiding principle for the development of Destination 2025, as described previously.

Foundational Capabilities

Foundational capabilities include public policy, physical infrastructure and education (Figure 4). They represent the general assets of a community, and in most cases, were designed for purposes that extend far beyond the needs of knowledge-based economies. Yet knowledge-based economies cannot succeed unless these foundational capabilities are present and are of high quality.

Figure 4

Recommendations for core, foundational capabilities

As defined by the Strategic Flexibility model the following recommendations are considered to be "core" to Minnesota's ultimate success because they positively affect the six life science industries that we assessed, and in many cases are core across other industries in the state.

1. Education

The quality and quantity of human talent in a region are key drivers for economic growth. The skill base of the local population, measured in both educational attainment and cognitive competencies, has been shown to be critical to

economic expansion.[7, 8, 9] This is especially true in colder regions, like Minnesota, where a warm climate cannot be depended upon to draw population and drive economic growth.[10] As we undertake this long-term visioning process, we recognize that the generation Minnesota will depend upon to innovate and lead the life science industry in and beyond 2025 are today in classrooms in K-12 schools and postsecondary institutions across the state. If predictions hold true, today's youngest students will spend much of their lives in the "Age of Biology." At the other end of the age spectrum, as Minnesota's labor pool ages in the coming decades, re-training resources will be critical for mature workers to adapt to rapidly changing technologies. For these reasons, the existence of a globally competitive educational system – serving citizens from early childhood through adulthood – will represent a critical foundation for the success of Minnesota's knowledge-based economy.

2. Infrastructure

The ability of communities to provide a competitive environment for business is highly dependent on their infrastructure. No one infrastructure investment is sufficient to promote economic growth. Key components include water, sewer, roads and bridges, mass transportation system, cost-effective utilities, quality of regional airports, and effective and widespread broadband access. Throughout our research, stakeholders cited the importance of water availability, broadband access, and other infrastructure needs. Minnesota's ability to maintain a high-quality infrastructure will be key to building a vibrant knowledge-based economy. We have no specific recommendations for infrastructure at this time. They will be attached to specific industry projects as they are developed.

3. Public policy

Appropriate public policies can help drive the growth of entire industries or economies. The success of Minnesota's biofuel and wind industries relative to many other states, for example, can be attributed in large part to aggressive public policies governing production and consumption of renewable energy that reduced private-sector risk, thereby stimulating wealth creation and job creation. While some policies, such as these, are specific to an industry, those recommended below would have broad benefit for the entire life science industry, as well as the many other high-tech sectors that are part of Minnesota's knowledge-based economy.

Recommendations related to public policy

1. Establish public-sector policies that encourage private-sector investment and commitment to grow industries and jobs in Minnesota.

Why: The Destination 2025 team recommends that the state put a very high priority on providing incentives that will help to create, retain, recruit, and expand companies in Minnesota. Today, the environment in Minnesota is not ideal for new-business creation or business expansion due to its higher cost of doing business and its lack of options for incenting private-sector investment. To help compensate for this the Destination 2025 team feels Minnesota needs to take a serious look at the complete portfolio of financial policies and strategies that support all aspects of business development, from very early stage funding to ongoing R&D tax credits. We strongly support a portfolio approach to best understand how to leverage financial incentives, such as investment tax credits (i.e., angel and R&D) and guaranteed loan programs with forgiveness clauses, as well as other creative incentives such as access to advanced technology that help companies to solve problems and advance their product lines. The key is to implement understandable programs that will draw private-sector investment and demonstrate long-term commitment. These programs should not be restricted by geographic boundaries but, rather, should be focused first and foremost on building the global competitiveness of Minnesota and support the entire life cycle of companies. Such policies are necessary to leverage private-sector money by incenting individuals and entities to take risks with their money to create new companies and new technologies that can benefit the establishment and retention of industries in Minnesota. We recognize that these incentives may not be able to be implemented all at once. However, it is important to consider that a region cannot create a globally, or even nationally competitive knowledge-based economy unless its growth companies have access to investment capital across all stages of company development.

---

[7] Hanushek, Eric; Jamison, Dean T.; Jamison, Eliot A.; and Woessmann, Ludger Research: Education and Economic Growth. Education Next, Spring 2008, Vol. 8, No. 2. Hoover Institution.
[8] Moretti, Enrico (2004). Estimating the social return to higher education: evidence from longitudinal and repeated cross sectional data. Journal of Econometrics, 121: 175 – 212.
[9] Glaeser, Edward L. (2003) The Rise of the Skilled City. Harvard Institute of Economic Research, Discussion Paper No. 2025, December 2005.
[10] *Ibid.*

There are multiple aspects of our recommendation that we think are important. We feel it is the responsibility of the public sector to provide incentives to individuals to take risk through the application of creative policies, as has been done in numerous other states and nations with which Minnesota competes. We also think it is the responsibility of the private sector to support this effort by stepping forward to help manage the actual establishment and placement of companies in Minnesota. With this in mind, we offer the following interrelated recommendations.

Recommended actions

a. **Establish angel-investment tax credits** to catalyze the formation of seed funds and to motivate private-sector individuals and entities to invest in early-stage companies. Most of the companies that will form around the recommended industries will be small and have potential for rapid job growth. **This is among the most-high-priority actions Minnesota can take to catalyze short- and long-term job growth in the state.**

b. **Increase the availability and flexibility of R&D tax credits, investment credits, loan programs, and other financial mechanisms** that will provide those on the front lines of economic development with some tools to offer competitive proposals in targeted industries.

c. **Actively monitor trends and incentives being offered by competitive communities**. We recommend the formation of a permanent technical advisory board to state government that would be responsible for tracking the evolution of competitive incentives, and for developing competitive proposals for consideration by the state policy makers. These efforts must be directed and focused on key opportunities and industrial sectors.

d. **Establish incentives to support market creation.** The best way to create a market and industry is to provide incentives or mandates to use the product to use the product. This was true for ethanol and wind energy. It is true for other products as well. The best way to jump-start an industry is to create incentives that encourage people to use the products. In this roadmap there are several markets where we recommend the use of policy to help the industry get off the ground. This is especially true in the green economy. Carefully crafted strategies to drive market growth can both drive job creation and bring benefit to society.

e. **Establish targeted industry-specific funds capable of providing management, as well as financial support to companies.** Success of startup companies is determined more by the quality of the management than the access to startup funding. Professionally managed funds provide specific management skills as well as access to continued funding mechanisms. We recommend that the incentives supplied by the state be carefully directed to support the formation of professionally managed funds capable of providing world-class support to the companies they fund as well as access to follow on funding.

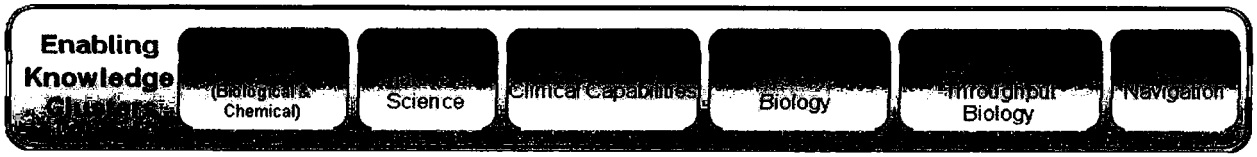
2. Consider the full range of impacts before enacting regulatory policies.

Why: Policy-makers need to be mindful that regulatory legislation, while essential for responsible management and stewardship, can have unintended consequences that may be detrimental to other efforts to attract, nurture, or retain major industries in the state. Great care must be exercised to identify and understand such conflicts and to find the right balance between beneficial and harmful regulation

Enabling knowledge clusters

Strong knowledge clusters -- including K-12 through higher education and strong academic research -- are fundamental to success in the new knowledge-based economy (Figure 5). These capabilities are critical to supporting company growth, attracting the right talent, conducting world-class research to generate new knowledge, educating a competitive workforce, and attracting investment dollars from federal and private sources. While Minnesota excels in many facets of this continuum, Destination 2025 research identified areas where Minnesota is either behind, or not at an acceptable level of capability to support the growth of the life science industry as it is evolving. We recommend the following actions to begin to remedy the situation. We consider each of these to be "core" recommendations, which will have a significant impact on all six of Minnesota's life science industries.

Figure 5



Specific core recommendations for enabling knowledge clusters

1. Develop a nanoscience and engineering capability to leverage Minnesota's historical strengths in materials science

Why: Design of new products increasingly is influenced by miniaturization, enhanced performance features, and attention to patient lifestyles. Nanoscale science and technology offers nearly unlimited opportunities for unique product solutions in many areas of industry to meet the needs of these drivers. Research conducted as part of Destination 2025 revealed that nanotechnology will play a central role in future developments in nearly all sectors of Minnesota's knowledge-based economy. Other states, such as New York and Ohio, already have developed extensive nanoscale capability and are making nanoscience and engineering an enabling knowledge cluster to aid further economic growth. Availability of trained personnel able to work at the nano- or smaller dimensions, combined with access to equipment and facilities capable of supporting their work, will be fundamental assets for any community expecting to attract or retain knowledge-based industries.

Recommended action

a. **Establish a statewide nanotechnology strategy.** Minnesota needs a coordinated strategy centered around the creation of a center of excellence focused on the application of nanoscale technology in all aspects of industry, not only the life sciences. We would envision that the strategy would include partnerships with other institutions around the world that have specialized capability. The applications for nano-dimension science and technology are so broad that no one geographical entity can have expertise in all aspects of application. Partnerships are required to give the required breath of support to industry and academia.

2. Develop capacity in systems biology and bioinformatics to support the industry

Why: Capability in systems biology and bioinformatics is catalytic to the development of a strong life science industry, affecting all six Minnesota markets. The life science industry will be shaped by the need to manage progressively larger volumes of complex data arising from the revolutionary advances in genomics, proteomics, and systems biology that are permitting the study of genes, proteins, and molecular systems, respectively.

Systems biology is an approach to analyzing biological complexity and understanding how biological systems function. Systems biology is the study of an organism, viewed as an *integrated* and *interacting network* of genes, proteins and biochemical reactions which give rise to life. Instead of analyzing individual components or aspects of the organism, such as sugar metabolism or a cell nucleus, systems biologists focus on all the components and the interactions among them, all as part of one system. These interactions are ultimately responsible for an organism's form and functions (Institute for Systems Biology, Seattle Washington). Competency in systems biology is "core" to the development of a strong life science industry. During the development of Destination 2025, stakeholders indicated that Minnesota lacks an academic focus on systems biology and any organized effort focused specifically on systems biology. The primary concern cited was the lack of "systems thinking" being taught and practiced. Other states have a significant lead on Minnesota in this area.

Data-intensive approaches and technologies also will have a profound impact on all six markets included in this study. Advances in health care, including the growth of personalized medicine, will be dependent on the ability to compile, store, and mine huge volumes of patient data and information. The ability to manage large volumes of biological or biomedical data through bioinformatics also will enable the bioengineering of plant varieties that will make for more nutritious foods containing higher energy content or natural depots of health-promoting nutraceuticals, make the promise of personalized medicine a reality, enable the prevention and cure of costly diseases in humans and animals, and offer unique insights into biological processes that can be translated into the design of new drugs, to name just a few examples. Bioinformatics, the basic enabling technology giving scientists the ability to manage, analyze, and mine massive data sets is, in turn, highly dependent on advancements in computer and software technology. Fortunately, Minnesota is blessed with a very strong

infrastructure in this rapidly growing area of science and technology, but currently the full potential of these powerful capabilities is limited by lack of general awareness and coordination.

Recommended actions

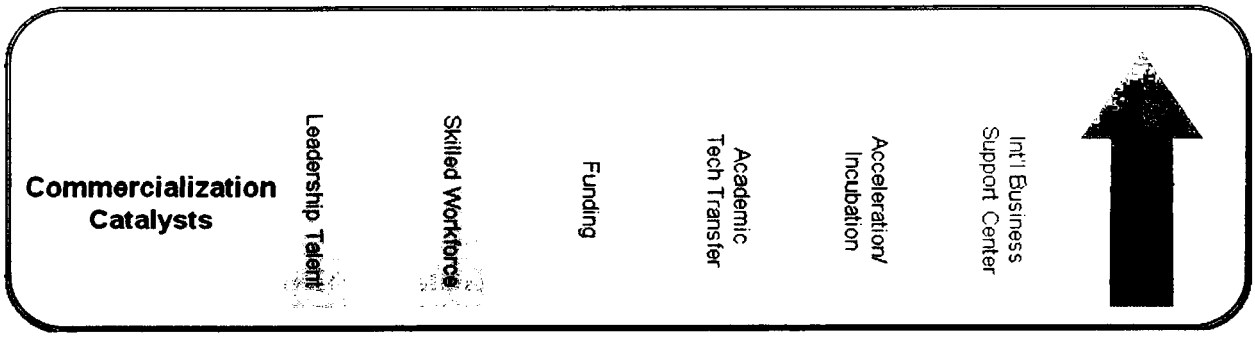
a. **Establish a statewide bioinformatics strategy**. Minnesota needs to establish a center for bioinformatics capable of supporting the life science industry. There is already a center for Biomedical Informatics and Computational Biology established by the University of Minnesota at its new Rochester campus, in close partnership with Mayo Clinic, Hormel Institute, and IBM Rochester. We propose leveraging this established center and expanding its charter to act as the central catalyst for bioinformatics in the state.

b. **Formalize a systems biology approach in education and academic research.** The understanding of the philosophy of systems biology provides a more thorough understanding of how living organisms function, and unleashes a whole new way of thinking about biological processes that helps to advance creative solutions. The Destination 2025 team thinks it is very important that the students studying biology understand systems interaction and would ask the higher educational system to enhance their approach to teaching the systems biology approach.

Commercialization catalysts

There are many variations of commercialization catalysts needed within a community to facilitate the successful transfer of technology and startup of a new company or product. Most of these capabilities are defined in Figure 6. Many of these catalysts are tied to policy and the enabling knowledge clusters that support differing company needs of each given industry. For example, in the development of the biologic and biopharmaceutical industry, the two most common barriers to starting companies are lack of money, specifically venture capital, and lack of experienced leadership talent. Another common problem is access to the appropriate infrastructure, such as nanotechnology processing equipment or GMP (Good Manufacucturing Practices) manufacturing space, to support small companies' ability to conduct research and development. These are only examples. Company needs are specific to the individual situation, so commercialization catalysts need to be as flexible as possible to support the changing needs.

Figure 6



Specific core recommendations for commercialization catalysts

1. Create a strong private-sector funding and support mechanism for startup companies

Funds to support small and startup companies are critical to the health of any business community. We have integrated into the policy section of the roadmap a recommendation to start private-sector funds that are capable of strong management as well as follow-on funding mechanisms. Please see Recommendation 1 under Public Policy.

2. Resolve talent shortages and build human capital critical to the life sciences

Why: We found talent shortages to be an issue today that is projected to only get worse in the near future. Particular areas of need were in food and animal health. Key drivers of these shortages include an aging population, growth in high-tech job opportunities outside of the United States for foreign students, the cost of education in areas such as veterinary care for large animals, and a shortage of young students adequately prepared to pursue career paths in science, technology, engineering and math (STEM). A specific area of need identified was a lack of available senior leadership in the

biologic and biopharmaceutical industry. The perceived lack of management skill to lead in this area of growth is directly contributing to the difficulty in establishing this industry in Minnesota.

These are very serious issues to the life science industry and the state as a whole. Research shows that Minnesota has benefited in the past from having a concentration of talent in such areas as medical devices and food. Looming talent shortages could result in Minnesota companies turning to other regions for expansion and difficulties in luring new companies to the state.

Recommended actions

a. **Develop dependable sources of data about the life science workforce,** building on existing data tools being developed by the Department of Employment and Economic Development in partnership with Minnesota State Colleges and Universities.

b. **Leverage this data, the findings of Destination 2025 and the stakeholders convened though the BioBusiness Alliance of Minnesota's Biosciences Education-Industry Partnership Council to develop a long-term workforce development strategy for the state.** Based on analysis to date, steps that should be considered in this plan include:

   - Expand upon and develop outreach programs that raise public awareness about life science careers, leveraging existing efforts and education-industry partnerships wherever possible.
   - Increase engagement of industry in postsecondary education to advise in curriculum development and expand experiential learning opportunities, such as internships and coops. These collaborations could address an ongoing concern that graduates of many science and engineering programs have little or no familiarity with the demands of working in a regulated environment.
   - Develop or expand graduate-level programs that are important to the life sciences industry, including:
     - technology-oriented MBAs and professional science masters degrees that provide graduates with the combination of business and technical skills needed to be leaders of the life science industry. Representative examples include the Medical Industry Leadership Institute and the Center for the Development of Technological Leadership at the University of Minnesota.
     - strategically targeted technical programs, such as the Master's of Bioengineering at the University of Wisconsin-Madison, which has a focus on the convergence of biotechnology and medical devices.
     - applied research programs with affiliated labs. Some models include the Biomedical Signal Processing Lab at St. Cloud State University; the Center for Automotive Research at Minnesota State University, Mankato; and the Center for Environmental, Earth and Space Studies at Bemidji State University.

c. **Develop strategies and resources to lure top academic research talent to the state in key targeted industries,** such as diagnostics, bioinformatics, and nanotechnology. Research universities are in a global war for top talent, so additional resources may be needed to support this effort. However, success in this arena would have a double payoff. Top researchers can spawn innovations, but also lure top-tier graduate students and postdoctoral fellows to enrich the local talent pool.

d. **Develop strategies and resources to lure seasoned executives to Minnesota to support the biologic and biopharmaceutical industry and its convergence with medical devices,** and establish targeted management and mentorship programs to grow Minnesota's own leadership talent pool.

Contingent recommendations

The following are contingent recommendations that require ongoing assessment and review to determine what actions need to be taken to leverage the potential opportunities they offer.

1. **Industry: Create businesses in food safety and defense**: Food safety and defense is an important and growing area in Minnesota and globally. The state is well-positioned to leverage existing strengths in this area to create incremental business development opportunities. Examples of these strengths include the Minnesota Departments of Agriculture and Health common laboratory; University of Minnesota's National Center for Food Protection and Defense (NCFPD), a

Homeland Security Center of Excellence; and the Minnesota Food Safety and Defense Task Force. Minnesota is very strong in food quality and food safety policy development and implementation. The state could translate this experience into management systems to control disease and contain outbreaks and into new products and businesses. For example, Minnesota's food processing industries are at the forefront in adopting innovative biosecurity methods. These types of products and processes also can utilize the strong supporting industries Minnesota has in high technology. Capitalizing on these strengths would serve the state well if successful commercialization efforts could be initiated.

2. **Industry and enabling knowledge cluster: Position Minnesota as a leader in health and wellness**: There is increasing emphasis on health and wellness derived from food and innovation in food products. We believe Minnesota has the ability to become a globally recognized hub for innovative research, policy, and products in the health and wellness industry. The University of Minnesota's Healthy Foods, Healthy Lives Institute is a tremendous asset to support basic and applied research in the food and health market with the aim of creating new products and businesses within Minnesota. Manitoba's Richardson Centre for Functional Foods and Nutraceuticals, a collaboration between academic research in food and health science and industry, is potentially a good model to emulate. United Health Group and Mayo Clinic are two other examples of local institutions doing leading-edge work in this area. The potential of creating an industry hub around this capability may be quite real, but needs further understanding to determine how the private sector and academic sector can work together to leverage the potential.

3. **Policy and enabling knowledge cluster: Leverage existing Minnesota expertise in ethics to provide direction to policy and business efforts**. Science often precedes ethical debates, application and development of legal principles, and public policy analysis. Since ethical debates, legal discourse, and public policy analysis often lag behind scientific innovation, they can drag out the application of science into products and their proliferation into societies. These "soft issues" however, need to be resolved. The debates over fuel vs. food, cloning, synthesis of new chemicals, human tampering with eco-systems, tradeoffs between different options, cost benefit analyses, legal structure for the possession and processing of individual health and genetic information are all examples of "soft issues" that need to be resolved not only with scientific facts, but also through social science disciplines. It is important to develop a program where the policy makers and private sector reach out and leverage existing resources in the academic sector to help frame and manage these issues. As an example, the University of Minnesota's Consortium on Law and Values in Health, Environment & the Life Sciences is a highly respected institute that is well-positioned to help lead the state. Educating the public and engaging in a dialogue about ethical issues related to the life sciences also will be important to the successful implementation of the state's effort to grow its life science industry.

4. **Commercialization catalyst: Company incubation space: The need for additional space to house startup companies is not clear.** The need for management and money to support startup companies is very clear. Once the management and financing problem is addressed, it will be more apparent how much and what type of incubation space is needed.

Overarching recommendation

1. Develop and empower a statewide science and technology leadership structure

Why: None of these recommendations are going to happen by themselves or in isolation. They are complex and require time and a committed effort of people from industry, academia, and government. Many, if not most, of the recommendations put forth in this roadmap are heavily interdependent with the broader high-technology industry, as well as other industrial segments of our state. To ensure an optimal implementation of the recommendations, there is a need to form a higher-level collaboration that is working to integrate multiple knowledge-based industries into a shared commitment to the economic health of our state. Moreover, a standing body is needed to react to the technology and market opportunities in these fast-paced industries that will change over time, as well as evolving best practices in technology-based economic development.

To lead these efforts, we recommend the creation of an apolitical public-private partnership focused on overseeing implementation of a comprehensive and cohesive initiative to grow Minnesota science and technology-based industries (life sciences, information technology, agriculture, etc.). This approach would be similar in concept to approaches taken by other states and countries, such as Ohio, North Carolina, Florida, Ireland, and Singapore, with appropriate mechanisms for statewide involvement and oversight. The organization must be a partnership between industry, academia, and government. Its charter must be focused on implementing a long-term, statewide strategy, as well as recommending and managing investment options that will build the state's competitive strength.

It is important that this structure provide for an industry-leadership role to ensure private-sector ownership and active participation. The governance structure would be accountable to state government, but would operate in a manner that allows the development and execution of a long-term vision that can maintain consistency and momentum throughout transitions in political, academic, and private-sector leadership.

The BioBusiness Alliance of Minnesota – in partnership with other organizations such as LifeScience Alley, the Agricultural Utilization Research Institute, the University of Minnesota, the Minnesota State Colleges and Universities system, local and state economic development organizations, and many others – is chartered to provide leadership where needed to implement the recommendations for the life science-based industries included in this report. As the BioBusiness Alliance of Minnesota moves from the Destination 2025 visioning phase, it will now move into the next phase of its evolution – the implementation of recommendations and an expansion of direct support for businesses through the organization's BioBusiness Resource Network.

However, for Minnesota to fully gain the benefit of investments, it is very important that a cohesive effort be undertaken to grow high-technology industries, the first step of which should be development of a team chartered to manage the visioning and implementation of a broad-based initiative. This is consistent with the thinking of many other industry organizations and public institutions. We offer the following recommendation to assist in this process.

Recommended action

a. **Endorse the formation of a public-private organization and charter its members to develop and implement strategies to grow Minnesota's science and technology-based industry and create stable, high-quality, future-oriented jobs statewide**. At a minimum, this organization needs the following support to be successful.

   i. Endorsement by both the legislative and executive branches of state government, private-sector leadership, and academic leadership. This is an ambitious agenda that cannot succeed without the support from multiple sectors at the highest level.

   ii. Financial support to develop and implement strategies in partnership with community leadership of all three sectors.

   iii. The access to consult directly with the state executive staff, legislative leadership, academic leaders and private sector leadership organizations. Open lines of communication will be critical to expedite decision-making and implementation and ensure clear understanding across the multiple sectors.

Conclusion and next steps

Conclusion

Implementation of the recommendations provided in the roadmap is by no means the end of the story. They alone will not bring success to Minnesota. These recommendations only get Minnesota's ship headed in the right direction. The next step is to chart out a well-thought-out, collaborative, and sustained course of action overseen by people who know the industries, care about Minnesota's future, and who are capable and empowered to adjust the "tack" of Minnesota's sails when needed. Only by doing so will the state maintain the forward progress needed to compete in the rapidly changing world of the life sciences today and tomorrow.

The Destination 2025 team -- consisting of Deloitte Consulting, the Board of Directors and staff of BioBusiness Alliance, the Destination 2025 Core Governance Team, and the more than 600 people who helped along the way to bring Destination 2025 to you, are proud to be part of the process to make Minnesota's future strong. We do not view the issuance of this roadmap to be the end of the project and our responsibility. In fact, we view it as the beginning of a long journey that will be filled with opportunity and excitement. As Peter Drucker said, "The best way to predict the future is to create it." That is exactly what Minnesota is positioned to do. We look forward to working with all of you to make Minnesota better for all of us.

Next steps

The Board of Directors of the BioBusiness Alliance of Minnesota has set a course to provide support to communities that are looking for help to grow the life science industries in their region. This phase of implementation of the organization is called the Biobusiness Resource Network. The network is positioned to leverage the existing resources in the state to help focus on three things: management of large projects that have a state wide impact, support to development organizations that need help to organize a strategy to grow lifescience in their community, and support to companies that need help starting, growing, or locating in Minnesota. We look forward to partnering with you.

Next steps by members of the Minnesota lifescience community

Read the Destination 2025 roadmap and supporting vision and white paper documents. Determine the potential and interest in your community to capitalize on the opportunities. If there is an interest, begin to form a strategy. If you need assistance, you can contact the BioBusiness Alliance of Minnesota, Deloitte Consulting, LifeScience Alley, the Minnesota Department of Employment and Economic Development, or any number of resources that can help you get started. The important thing is not to wait. There are many opportunities to leverage the numerous resources available in the state and region to help you.

Next steps by the BioBusiness Alliance of Minnesota

Starting immediately, The BioBusiness Alliance of Minnesota will start a two-year education and implementation process. This process is intended to bring the Destination 2025 outcomes to you and your community. We will be scheduling small group and community presentations to explain the results and what they mean to you, your community, and the state. If you would like to have a presentation and discussion in your community, company, or organization, please contact us to schedule a time by using the "Contact Us" link at www.biobusinessalliance.org.

Appendix 1: Life science community definitions

Markets

- Medical devices
- Pharma/biologics
- Convergence (medical device and pharma/biologics)
- Animal health
- Food
- Renewable energy
- Renewable (bio) materials

Enabling technology clusters

- Catalysis & synthesis (biological and chemical)
- Nanotech & materials science
- Bioengineering & clinical capabilities
- Bioinformatics & systems biology
- Genomics, proteomics & high throughput biology
- Imaging/navigation

Commercialization catalysts

- Leadership talent
- Skilled workforce
- Funding
- Academic tech transfer
- Acceleration/incubation
- Component & service suppliers
- Facilities
- Business planning
- Others to be determined

Foundational capabilities

- Education
- Infrastructure
- Policy

Markets

Markets are a clustering of similar products and services based on research and enabling technologies. Markets are where the highest potential for job creation exists. They are the domain of the private sector.

Medical devices

The medical device market includes all instruments, apparatuses, implements, contrivances, implants, in vitro reagents, or component parts or accessories which are used to prevent, diagnose, treat, or cure diseases or other conditions in humans or animals.

Pharma/biologics

The pharmaceutical market includes traditional chemical-based drugs for the prevention, diagnosis, treatment, and cure of diseases. Traditional chemical-based pharmaceuticals are often referred to as "small molecule" drugs.

The biologic and biopharmaceutical market includes drugs or other products that are derived from life forms. Biologics are biology-based products used to prevent, diagnose, treat, or cure disease or other conditions in humans and animals. Biologics generally include products such as vaccines, blood, blood components, allergenics, somatic cells, genes, proteins, DNA, tissues, recombinant therapeutic proteins, microorganisms, antibodies, immunoglobins, etc. Biopharmaceuticals are produced using biotechnology and are made from proteins, genes, antibodies, nucleic acids, etc. Biopharmaceuticals are often referred to as "large molecule" drugs.

Animal health

The animal health market includes any and all products, mechanical, electrical, chemical, software, veterinary, and biological, to prevent, diagnose, treat, or cure diseases that affect animals other than humans. Animal health products include feed additives, vaccines, pharmaceuticals, devices, antimicrobials, topical products, imaging, parasiticides, diagnostics, etc.

Food

The intersection of the life sciences and the Food market includes the use of scientific techniques to produce desired traits in plants or animals to enhance the quality, safety, nutritional value and variety of food and increase the efficiency of food production. It also encompasses food ingredients and nutraceuticals.

Renewable energy

The renewable energy market includes the various sources of renewable energy that can be applied to the transportation, electricity, residential, commercial, and industrial sectors. Examples of renewable energy sources include ethanol (corn-based, biomass-based, cellulosic, and other feedstocks), biodiesel, combustible biomass, wind, hydrogen, photovoltaic (solar), geothermal, etc. Bio-based energy is typically defined as renewable fuels. This definition includes all renewable energy sources, not just renewable fuels, because all of these sources of energy will become integrated over time.

Renewable materials

The renewable materials market includes materials that are made from biological sources. These can be biofibers, biopolymers, biodegradable plastics, or bio-packaging.

Enabling knowledge clusters

Enabling knowledge clusters comprise the basic knowledge and technologies that allow the development of products. They are the domain of academia and corporate R&D.

Catalysis & synthesis (biological and chemical)

Definition

Catalysis and synthesis relate to the development processes for both small- and large-molecule (chemical and biological) pharmaceutical products, or post-processing of biomass using enzymes or other means to produce products such as ethanol or biomaterials.

Examples of technology involved

- Assay development
- High-throughput screening
- X-ray crystallography
- Physical characterization
- Medicinal chemistry
- Toxicology
- Formulation
- Preclincial trials
- Clinical trials
- Enzyme production

Example applications

- Drug development
- Stem cells
- Gene therapy
- Renewable energy
- Renewable materials

Nanotechnology & materials science

Definition

Materials science is an interdisciplinary field involving the properties of matter and its applications to various areas of **science** and **engineering**. This science investigates the relationship between the structure of materials and their properties. It includes elements of **applied physics** and **chemistry**, as well as **chemical, mechanical, civil** and **electrical engineering**. **Nanotechnology** refers broadly to a field of **applied science** and technology whose unifying theme is the control of matter on the atomic and **molecular** scale, normally 1 to 100 **nanometers**, and the fabrication of devices within that size range.

Examples of technology involved

Industrial applications of materials science include materials design, cost-benefit tradeoffs in industrial production of materials, processing techniques (**casting, rolling, welding, ion implantation, crystal growth, thin-film deposition, sintering, glassblowing**, etc.), and analytical techniques (characterization techniques such as **electron microscopy, x-ray diffraction, calorimetry, nuclear microscopy (HEFIB), Rutherford backscattering, neutron diffraction**, etc.).

Example applications

- PLA (biodegradable plastic)
- Turning bio-based materials into plastics
- Implant
- Nanomedicine
- Electronics
- Coatings
- Films
- Drug delivery
- Information storage and communication technologies
- Renewable energy
- Food

Bioengineering & clinical capabilities

Definition

Biological engineering is a discipline that applies engineering principles to biological systems for the purpose of developing new technologies and services to improve the living standards of societies. It requires traditional engineering skills to exploit new developments in molecular biology, biochemistry, cell metabolism, microbiology, ecology and engineering principles and applies them in order to understand living systems and to bring solutions to various problems associated with these systems. Bioengineers work closely with medical doctors and other health professionals to develop technical solutions to current and emerging health concerns.

Examples of technology involved

- Bioprocess engineering
- Bioprocess design
- Biocatalysis
- Bioseparation
- Bioinformatics
- Genetic engineering
- Synthetic biology
- Cell engineering
- Tissue culture
- Molecular biology
- Biochemistry
- Microbiology
- Neurosciences
- Sensing
- Electronics
- Imaging
- Genetics
- Pharmacology
- Biomechanics
- Surface science
- Polymer science

Example applications

- Medical devices
- Diagnostic equipment
- Imaging equipment
- Biocompatible materials
- Agricultural engineering

Systems biology & bioinformatics

Definition

Systems biology is an approach to analyzing biological complexity and understanding how biological systems function. Systems biology is the study of an organism, viewed as an *integrated* and *interacting network* of genes, proteins and biochemical reactions which give rise to life. Instead of analyzing individual components or aspects of the organism, such as sugar metabolism or a cell nucleus, systems biologists focus on all the components and the interactions among them, all as part of one system. These interactions are ultimately responsible for an organism's form and functions (Institute for Systems biology, University of Washington).

Systems biology relies on bioinformatics and computational biology to understand how biological systems function. According to the National Institutes of Health, **Bioinformatics** is the research, development, or application of computational tools and approaches for expanding the use of biological, medical, behavioral or health data, including those to acquire, store, organize, archive, analyze, or visualize such data.

Computational biology is the development and application of data-analytical and theoretical methods, mathematical modeling and computational simulation techniques to the study of biological, behavioral, and social systems.

Examples of technology involved

- Applied mathematics
- Statistics
- Informatics
- Computer science
- Artificial intelligence
- Chemistry
- Biochemistry
- Physics
- Engineering
- Behavioral science

Example applications

- Personalized medicine
- Large- and small-molecule development
- Diagnostics (human and animal)
- Protein folding
- Sequence alignment
- Gene finding
- Genome assembly
- Protein structure
- Gene expression

Genomics, proteomics, & high-throughput biology

Definition

Genomics is the study of an organism's entire **genome**. This includes determining the DNA sequence and genetic mapping. **Proteomics** is the study of **proteins**, particularly their **structures** and **functions**. **High-throughput biology** includes using the techniques from biology, physics, chemistry, mathematics, computer science and engineering to speed research and knowledge creation. It is the basic technology that supports the rapid screening and development of new biologic and chemistry-based products. These three disciplines study the interactions of chemical compounds, genes, cells, organisms and the networks formed by the interactions between them.

Examples of technology involved

- Crystallography
- Computational prediction of protein folding
- High throughput "next generation" DNA sequencing
- High throughput genotyping (analysis of individual variation in gene structure)
- High throughput gene expression profiling (microarrays)
- Biobanking
- RNAi resources
- Assay development
- Physical characterization
- Medicinal chemistry
- Toxicology
- Formulation
- Preclinical trials
- Clinical trials
- Robotics
- Mass spectrometry
- Bioinformatics
- Mathematics
- Engineering
- Physics
- Chemistry
- Biology

Example applications

All forms of life sciences, including:

- Gene Therapy
- Pharmacogenomics
- Gene discovery, mutation analysis and functional studies
- Identification of new drug targets
- Rational drug design
- Biomarker discovery and validation
- Clinical test development
- Identification of pathogens
- DNA mapping
- Biologic and chemistry-based pharma
- Personalized medicine
- Genetic engineering of crops and natural materials for use in biofuels and renewable products

Imaging/navigation

Definition

Imaging science is concerned with the generation, collection, duplication, analysis, modification, and visualization of **images**. As an evolving field it includes research from **physics**, **mathematics**, **electrical engineering**, **computer vision**, **computer science**, and **perceptual psychology**, among others.

Navigation is the integration and registration of medical devices that are used to deliver therapies and create an image to allow for precise delivery of therapies or diagnostic capabilities to identified target locations.

Examples of technology involved

- MRI
- Fluoroscopy
- CT scans
- Catheter delivery systems
- Biological implants
- Mechanical and electrical implants
- 3D computer graphics
- Animation
- Digital imaging
- Color science
- Digital photography
- Microdensitometry
- Remote sensing
- Radar imaging
- Radiometry
- Ultrasound imaging
- Printing technologies
- Holography

Example applications

- Delivery of gene therapy
- Delivery of autologous cells
- Precise positioning of materials-based implants
- Ablation

Commercialization catalysts

Commercialization Catalysts are generic environmental and infrastructural support to convert knowledge into products. They link and leverage talent to achieve more effective and efficient use of resources, time and leadership. They are the domain of the public, private, and academic sectors.

Leadership talent

Leadership talent is defined as having access to leaders who are experienced CEOs, executives, and advisors who are willing to help guide and build a structure around the technology to commercialize the product and get it to the marketplace. Leadership has both a strong academic and private sector experience base.

Skilled workforce

A skilled work force is necessary for achievement in the life sciences. This includes adequate training programs, links between industry and academia, and quality mentorship programs.

Funding

- Funding is critical to starting a business. Funding for businesses comes from several different areas, including:
  - **Traditional**: This includes obtaining loans from banks to start a business
  - **Venture Capital**: Venture Capital is a type of private equity capital that is generally held by professional organizations that invest the money businesses in exchange for an equity stake in the company. Venture capital may be invested at any stage of the business development cycle, although it is more likely to be invested in later stages of development.
  - **Angel**: Angel funders are high-net worth individuals who provide money to start up a business in return for a convertible debt or ownership stake in the company. Often times angel investors pool resources in the form of an angel network.
  - **Grants**: Grants are "gifts" of money that are provided to businesses for a specific purpose. Grants can be provided by many sources, including non-profit organizations, foundations, government agencies, or other sources.
    - » SBIR/STTR

Academic tech transfer

Academic tech transfer capabilities are critical to ensuring that the innovative research conducted at academic institutions has an avenue to be further developed and commercialized for the benefit of the public. Tech transfer capabilities include patent support, commercialization support, funding support, management support, licensing, or other assistance in helping discoveries made at the academic institution become a product available to consumers.

Acceleration/incubation

Incubation is a shared and often subsidized space where companies can locate in their early stages to continue their product development work. Acceleration is space, plus the addition of money, management, technical resources, and other skills that help a business speed up its product development timeline.

Component & service suppliers

Component and service suppliers are those companies and organizations that provide needed expertise to help companies commercialize their products. They can be contract research support, manufacturing support, design support, component suppliers, legal counsel, regulatory services, etc.

Facilities

Most companies need space in which to operate the business. This can include laboratory space for further research and development, general office space for things such as sales and marketing, or manufacturing space to make the product.

Business planning

Business planning support includes advice or contract support about the various aspects of the business, from marketing and sales, technology assessment, finance, value chain development, to business strategy.

Others to be determined

Foundational capabilities

Foundational capabilities are the fundamental building blocks that underlie any life science or business endeavor. They are the domain of the public sector.

Education

A high-quality education system from pre-K, through K-12, and into higher education, with particular strength in math, engineering, and biology and other sciences are required to support a life science economy.

Infrastructure

Basic infrastructure, such as roads, sewers, buildings, internet/telecommunications capabilities, and other amenities must be in place to support the development of businesses in the community. Infrastructure is of special importance to new industries where no current infrastructure exists to support this new type of technology-based business.

Policy

There must be sound public policy concerning the regulation of business and sciences to support the life science industry sector. In addition, there need to be public policy decisions that help to catalyze innovation and formation of new industries and companies. It is important that catalysts are targeted to encourage and leverage private sector investment.

Appendix 2: The Strategic Flexibility framework

The Destination 2025 Industry White Papers, Minnesota Vision documents and the Minnesota Roadmap are based on an approach pioneered by Deloitte Consulting called Strategic Flexibility (SF). SF is an effective tool to help make sense out of a complex industry operating in uncertain external environments so one can frame appropriate strategies for the future. The white paper provides a detailed discussion on the application of SF. A brief summary of SF is included below, so that those reading only this vision paper or the roadmap may understand the underlying process the BioBusiness Alliance of Minnesota and Deloitte Consulting used to establish the findings presented in the Minnesota Roadmap.

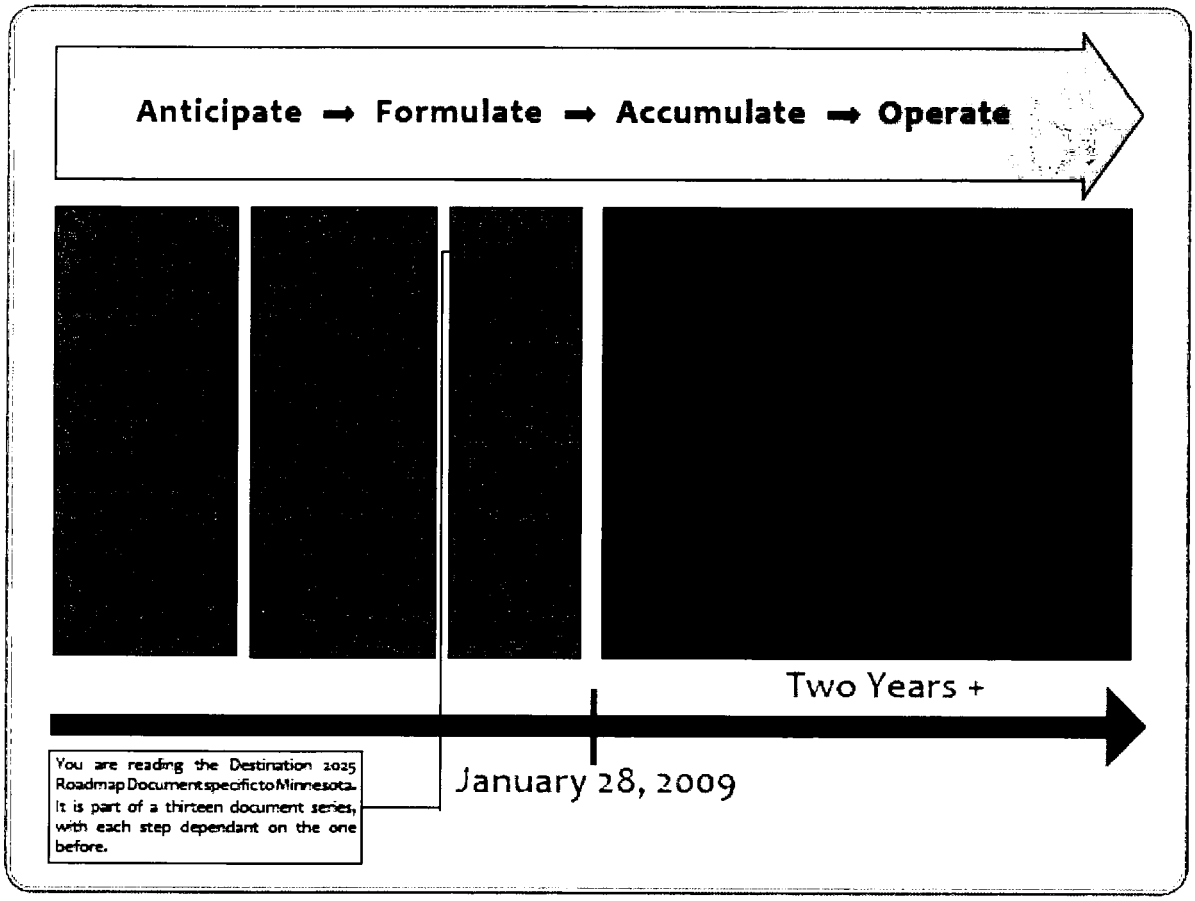
SF has a four-step flexibility framework, defined by Michael Raynor in his book *The Strategy Paradox: Why Committing to Success Leads to Failure (and What To Do About It)*. During the strategic planning process, it is impossible to determine the one "right" choice for all elements of a complex strategic plan. In the application of SF, the key is to identify and commit as quickly as possible to decisions that are clear, while maintaining as much flexibility as possible in making decisions on elements of the strategy that are unclear. The implementation steps are:

Anticipate — The process begins by defining the drivers that are shaping the future. Once these drivers are understood, the next step is to develop scenarios that provide "stories" about possible future realities. These scenarios are statements of how the drivers could shape the global environment in which the state will be operating. Each scenario attempts to identify the extreme limits of one of the drivers. This step is important because the insights gained by the process give guidance to strategic planners to define the degree of flexibility the roadmap must provide decision makers.

Formulate — Once the drivers and future possible scenarios are identified, the next step is to create effective strategies for each of the scenarios. These strategies have "core" and "contingent" elements. Core elements are those that are important components of all strategies and will be important and needed regardless of which scenario becomes reality. Contingent elements are part of one or more scenarios, but require discussion to determine on which elements decision makers should "purchase options" so access can be maintained while the future unfolds.

Accumulate — In this step, core and contingent elements are identified through discussion and debate, and a determination is made as to which options are required. Core elements are committed to, and options are "purchased" on the contingent elements to try to ensure long-term access to those elements with minimal investment.

Operate – Management of the portfolio of options occurs in this step. The changing environment is monitored, final determination of the optimum strategy is made, and relevant options are exercised and combined with the core elements to produce the desired outcome.



Led by Deloitte Consulting, the Destination 2025 team completed step 1 (Anticipate – documented in "Destination 2025: Focus of the Future of the Biological and Biopharmaceutical Industry") and the initial phases of step 2 (Formulate - documented in this paper, "Minnesota's Biologic and Biopharmaceutical Industry: A Vision for the Future"). Drivers have been identified for the global biologic and biopharmaceuticals market, and possible scenarios that bound the possible future global environment have been developed. We have also begun step 3 (Accumulate) by identifying core and contingent elements, where possible, in this paper. Over the coming two years, specific statewide partnerships and initiatives will be developed to complete step 3 (Accumulate) and undertake step 4 (Operate).

Acknowledgements

This document is a combined effort of the BioBusiness Alliance of Minnesota, the Destination 2025 core governance committee, Deloitte Consulting, and many dedicated stakeholders.

Core governance committee

Jim Bensen (co-chair)
Alex Cirillo (co-chair)
Drew Flaada
Don Gerhardt
Tim Laske
Kurt Markham
Dave Melin
Tim Mulcahy
Gail O'Kane
Teresa Spaeth
Marc von Keitz
Dale Wahlstrom
Eric Wieben

Project editor

Gail O'Kane

BioBusiness Alliance of Minnesota staff & associates

Johan Hult
Amy Johnson
Rebekah Kent
Melissa Kjolsing
Jeremy Lenz
Gregg Mast
Susan Melton
Karen Moe
David Peterson
Rita Shor
Alan Spillers
Qin Tang
Tom Vasicek
Tara Vogelgesang
Dale Wahlstrom
Tim Welle
Robert Yawson

We thank the subject matter specialists from Deloitte Consulting for their reviews and insight.

We thank industry, academic, and government leaders who provided their professional support throughout the project even though all could not be named.

Note: Institutional affiliations of the participants have not been identified as opinions expressed were those of the individuals that may or may not represent the positions of their organizations.

Contacts

The BioBusiness Alliance of Minnesota

Dale Wahlstrom
Chief Executive Officer

dwahlstrom@biobusinessalliance.org

Jeremy Lenz
Vice President of Operations

jlenz@biobusinessalliance.org
952.746.3812

Rita Shor
Project Manager, Destination 2025

rita.shor@innovatika.com
651.260.6653

Melissa Kjolsing
Communications Assistant

mkjolsing@ biobusinessalliance.org
952.746.3844

Deloitte Consulting LLP

Steve Dahl
Director

stdahl@deloitte.com
612.397.4267

K.C. Healy
Director

khealey@deloitte.com
312.486.2438

Mohammed Rehan Malik, Ph.D.
Project Manager, Destination 2025

momalik@deloitte.com
612.659.2639

Carol Lynne Jones
Senior Manager, Marketing & Communications

caroljones@deloitte.com
312.486.1751

Destination 2025

A collaboration between The BioBusiness Alliance of Minnesota and Deloitte Consulting LLP

Destination 2025 is an initiative of The BioBusiness Alliance of Minnesota in collaboration with Deloitte Consulting LLP to develop a roadmap for the bioscience markets in Minnesota for the next 20 years. The Destination 2025 project examines six markets of the bioscience industry: Animal Health, Food, Medical Devices, Biologics and Biopharmaceuticals, Renewable Materials, and Renewable Energy.