

FINAL REPORT

IOWA'S ADVANCED MANUFACTURING STRATEGIC ROADMAP

PREPARED FOR:
Iowa Department of Economic Development

PREPARED BY:
Battelle's Technology Partnership Practice

September 2005

Battelle
The Business of Innovation

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**Iowa's Advanced Manufacturing Strategic Roadmap:
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Executive Summary

For the last 200 years, the U.S. economy has been able to sustain a general trend of economic growth and standard of living increases for its population—this progress has occurred largely through the innovation of Americans and a sustained ability to achieve ever higher levels of productivity in agriculture, industry, and commerce. Over the last decade, however, it has become increasingly apparent that America's leadership cannot be taken for granted. Global competition is eroding the U.S.'s economic leadership, as indicated by disturbing trends:

- As the Council on Competitiveness has reported through its *National Innovation Initiative*, globalization has changed the competitiveness paradigm. “Low cost, high quality and rapid product deployment no longer create market advantages for companies. Rather, they represent the baseline requirements just to enter the game. Prosperity in this global economy is tied to the ability to innovate—to translate knowledge into new products, processes, and services.”¹
- K-12 educational performance in the U.S. has fallen behind that of most competing developed nations. In terms of educational performance per dollar spent, U.S. educational productivity has been in a fairly dramatic decline—rather than increasing as it should.
- The U.S. has a negative balance of trade that is growing. The country is consuming many more goods produced by competing nations than it is in turn selling overseas. For 2004, the U.S. recorded a current-account deficit--the combined balances on trade in goods and services, income, and net unilateral current transfers-- of \$665.9 billion up from \$530.7 billion in 2003. As a share of U.S. GDP, the deficit rose from 4.8 percent in 2003 to 5.7 percent in 2004. The trade deficit is not a short term anomaly; it is now a sustained trend.²
- The U.S. has become the world's largest net debtor nation, having run up massive trade deficits since the 1990s. In response to the growing national debt crisis, Congress is now considering a bill, the Foreign Debt Ceiling Act of 2005, in an attempt to slow, if not reverse, this trend. At the end of 2002, the net United States foreign debt stood at \$2.553 trillion. The nation's foreign debt position has continued to worsen over the last two years as the U.S. trade deficit has continued to increase. Moreover, the growing accumulation of foreign claims on U.S. assets, including over \$1.2 trillion in United States Treasury securities, makes the United States economy vulnerable to the whims of foreign investors.³

At the heart of the problem, is a nation that is falling behind in its ability to innovate, is consuming more than it produces, is falling deeper and deeper into debt to foreigners to pay for this consumption, and is lacking the education and workforce performance required to increase productivity and reverse the negative trends. These problems are compounded by the fact that within the global economy, skills are rising among third world competitors, such as India and China. If our nation's economy does not focus on its historical, sustaining competitive advantage, innovation, we will lose our ability to be first to new technological advances and subsequently will suffer economically.

¹*Imperative for Innovation:2001*. Council on Competitiveness.

² <http://www.bea.gov/bea/newsrelarchive/2005/trans404.htm>

³ <http://thomas.loc.gov/cgi-bin/query/z?c109:S.355.IS>

Within an environment of stiff and increasing competition, it is tremendously important for the State of Iowa to be able to make informed decisions regarding the right investments for its economic future. **Research performed by the Battelle Technology Partnership Practice (TPP) indicates that the key determinant of the future wealth of U.S. states lies within their ability to innovate and produce economic output based upon that innovation.** Generating an economic fabric conducive to innovation and, more importantly, innovation *commercialization* is increasingly central to the future sustainability of state economies.

The U.S. economy has always been carried upon the back of inventiveness and creativity, so the “innovation economy” *per se* is not a new phenomenon; rather it is more accurate to say that innovation has increased in importance as the primary impetus of economic growth and competitiveness among developed nations. Two fundamental forces are driving the pre-eminent importance of technology and knowledge advancement as the determinant of economic success:

- The first of these is the rapidly accelerating pace of scientific discoveries and the technologies that these discoveries give rise to (advances in genetics, for example, have dramatically accelerated the discovery process in the biosciences). The opportunity to speed the discovery and development processes, in concert with the ability to protect and profit from intellectual property, is leading to an innovation race among competing countries, regions and states.
- The second fundamental force is the globalization of world markets and the increasing pressure on the U.S. to maintain its high-wage/high-skill employment base through consistently staying ahead in technology and (it is hoped) productivity.

Iowa has a strong advanced manufacturing sector on which to build; but, Iowa's firms, like firms throughout the United States, are under tremendous competitive pressures. Maintaining and expanding the economic performance of advanced manufacturing in Iowa and elsewhere will depend on these firms' ability to innovate and move new processes and products into the market rapidly. It is recommended that Iowa grow its advanced manufacturing sector by

- Raising the profile of the advanced manufacturing sector
- Leveraging the presence of the state's large OEMs
- Creating a robust support infrastructure for advanced manufacturing
- Tapping the expertise of the state's higher education institutions to encourage and facilitate innovation.

Raising the Profile of Advanced Manufacturing: A number of relatively inexpensive but basic initiatives need to be taken in the short term to increase public and citizenry knowledge and familiarity with the state's advanced manufacturing industries. Because the industry itself has limited its efforts in advocacy and education, a basic first step involves organizing this sector. AMRCC was a basic and important step but insufficient to build ongoing momentum and strength. In addition, increased expertise and knowledge within the public sector and identified roles and functions around advocacy for advanced manufacturing are needed. Finally, as is occurring nationally through the National Association of Manufacturers, efforts to publicize what the industry does, makes, develops, and introduces in Iowa need to begin immediately.

Leveraging the Presence of Iowa's OEMs: Iowa has a significant base of large, globally active advanced manufacturers whose knowledge, deep expertise, and networks could be better utilized not only to build a stronger supplier base for them but to bring together related industry clusters as identified in

this report, particularly in areas where Iowa has significant specialization. This vertical and horizontal effort needs to be mounted concurrently—bringing together firms with similar products and firms that are part of supplier chains to OEMs.

Creating a Robust Support Infrastructure: Iowa has a number of significant economic development tools and, with the recent passage of the Iowa Values Fund, has further improved its ability to offer competitive support. However, as is true in many states, these tools primarily relate to the creation but not retention of jobs. A thorough review and assessment of the state's tool kit as it benefits advanced manufacturing may be an important way to ensure a level playing field of the state's advanced manufacturers with firms recruited from outside the state.

Tapping the State's Higher Education Institutions: Iowa's higher education institutions—both its community colleges and research universities—offer considerable resources not only in helping educate and prepare the future workforce for advanced manufacturers (which increasingly requires some post high school education or certification) but in providing technical and problem-solving support in product design and development and process improvement. To date, community colleges appear to be more engaged with advanced manufacturers than do research universities; but, there are important roles for both in supporting advanced manufacturing in the future.

VISION

A vision for advanced manufacturing's future in Iowa by the year 2015 would be as follows:

Iowa is a global leader in advanced manufacturing, innovative in its products and processes, its strong supplier chains, its extraordinary agile and skilled workforce, and its partnerships with higher education and among firms to solve common talent and technology needs in a climate of a supportive public sector.

DEVELOPING IOWA'S ADVANCED MANUFACTURING ROADMAP

Defining Advanced Manufacturing

Advanced manufacturing includes manufacturing industries that increasingly integrate new innovative technologies in both products and processes. The rate of technology adoption and the ability to use that technology to remain competitive and add value define the advanced manufacturing sector. Advanced manufacturers assess, investigate, and invest in technology across a wide spectrum of scientific and engineering fields. These technological advances, once embedded in the manufacturing operation either in the form of new products or processes, enable companies to raise productivity and provide value to customers.

The advanced manufacturing base tends to be more sophisticated than assembly-line production operations, encompassing lean production techniques, enhanced supply chain integration, and technology assimilation. Accurately depicting the advanced manufacturing base requires examining the effects technological innovations play in improving the efficiency of production processes and adding value to the product life cycle through product development.

Methodology

In the spring of 2005, IDED initiated work on this Advanced Manufacturing Roadmap to guide future public and private investment decisions in Iowa. A Steering Committee composed of representatives of the state's manufacturing sector was established to oversee this effort, and Battelle's TPP was engaged to develop the strategy. Battelle is a global science and technology enterprise that develops and commercializes technology and manages laboratories for customers. TPP, which includes leading analysts and practitioners in technology-based economic development, helps clients develop, implement, and evaluate technology strategies, policies, and programs.

This Roadmap was developed with input from large and small manufacturers, Iowa's universities, and other public and private leaders from all regions of the state. The Battelle project team collected and analyzed data on Iowa's advanced manufacturing sector, assessed the sector's competitive position vis-a-vis a number of competitors and peers, and conducted interviews and focus groups to gain an understanding of the issues facing the state's advanced manufacturing sector and to gather input on actions that could be taken to further enhance the global competitiveness of this sector.

This report includes the following:

- Findings from an economic analysis of the state's advanced manufacturing sector
- A competitive assessment of Iowa's infrastructure to support the advanced manufacturing sector as compared to a set of benchmark states
- A strengths, weaknesses, opportunities, and threats (SWOT) analysis that reports findings based on more than 130 interviews of manufacturers, manufacturing associations, labor organizations, government officials, and representatives of educational institutions in addition to three focus groups.
- Proposed strategies and actions to enhance the competitiveness of Iowa's advanced manufacturing sector
- An implementation plan that outlines initial steps for executing the strategies and actions.

Roadmap Methodology

- Economic Analysis
- Benchmarking Analysis
- SWOT analysis based on interviews of manufacturers, educators, labor organizations, and economic development and workforce officials and focus groups and discussions

EVALUATING IOWA'S MANUFACTURING SECTOR

Iowa's Manufacturing Sector

Employment (2003)	219,994
Gross State Product (2002)	\$20,199,000,000
Share of Total GSP	23.2%
Avg. Ann. GSP Growth (1998–2000)	3.3%
Avg. Ann. GSP Growth (2000–2002)	0.2%
Total Value Added (2001)	\$29,636,000
Value Added per Employee	\$125,644

Manufacturing has been and continues to be a pillar of Iowa's economy, providing well-paying jobs for the state's residents. Indeed, manufacturing employed approximately 220,000 workers, nearly 19 percent of Iowa's total private sector workforce, in 2003. Manufacturing accounted for almost a quarter of Iowa's gross state product (GSP), the largest share of any industrial activity in the state and thus a key driver of the state's economy. At the national level, manufacturing accounted for only 15 percent of the gross domestic product.

Iowa's manufacturing sector has performed well in spite of difficult times for the sector nationally. During the economic expansion of the 1990s, while manufacturing employment nationally declined at an average annual rate of 0.3 percent, Iowa's employment grew by 1.4 percent. When the national economy began a downturn in 2000, Iowa's manufacturing sector experienced only a 4.3 percent decline compared with the 5.8 percent employment decrease across the entire United States.

Key Findings

To better understand the composition and performance of Iowa's advanced manufacturing sector, Battelle examined its trends, current strengths, and growth potential.

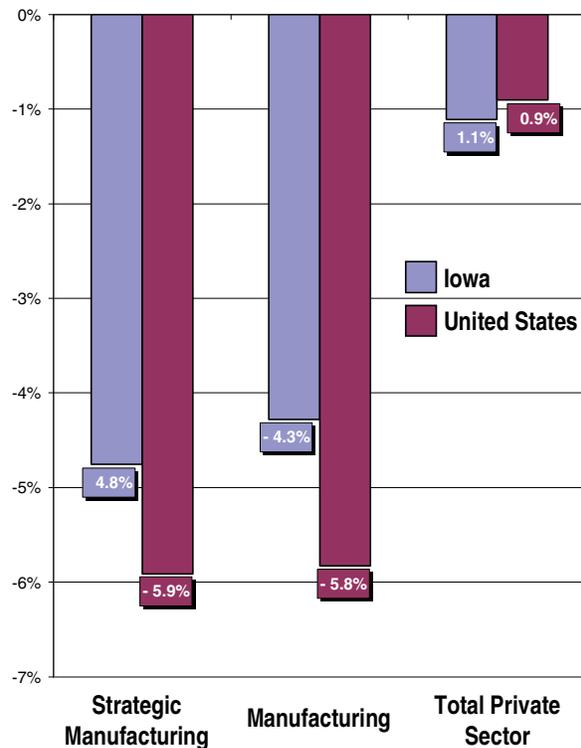
Iowa's advanced manufacturing base is large and significantly specialized, exceeding national trends in sustainability. In 2003, Iowa's advanced manufacturing sector had an employment base of 99,866 workers across 1,290 establishments. This represents 8.5 percent of total private sector employment in the State of Iowa. At the national level, advanced manufacturing accounts for only 5.6 percent of private sector employment. Relative to the nation, Iowa's advanced manufacturing base is nearly 3 percentage points larger than that of the United States. It should also be noted, however, that Iowa experienced a larger decline in the number of establishments than did the United States as a whole during this time and the sector experienced employment declines at both the state and national levels.

Even in the midst of a transitioning economy, Iowa's advanced manufacturing base surpassed the U.S. economic trend in employment growth. Though experiencing a loss in overall employment, Iowa's decline in advanced manufacturing employment was less than the United States. Since the end of the astounding economic growth during the late 1990s, Iowa's advanced manufacturing base exhibited a 4.8 percent average annual rate of employment loss. Nationally, advanced manufacturing employment declined at an average annual rate of 5.9 percent (Figure ES-1).

Detailed analysis reveals that the advanced manufacturing employment loss in Iowa is largely the result of economic factors outside the purview of the state. Shift-share analysis indicates that more than 90 percent of employment loss in Iowa was the result of national economic factors. Despite increasing national and global competition, Iowa's advanced manufacturing base performed remarkably well from 2000 through 2003. However, Iowa's overall manufacturing sector performed slightly better than the advanced manufacturing sector in terms of employment growth.

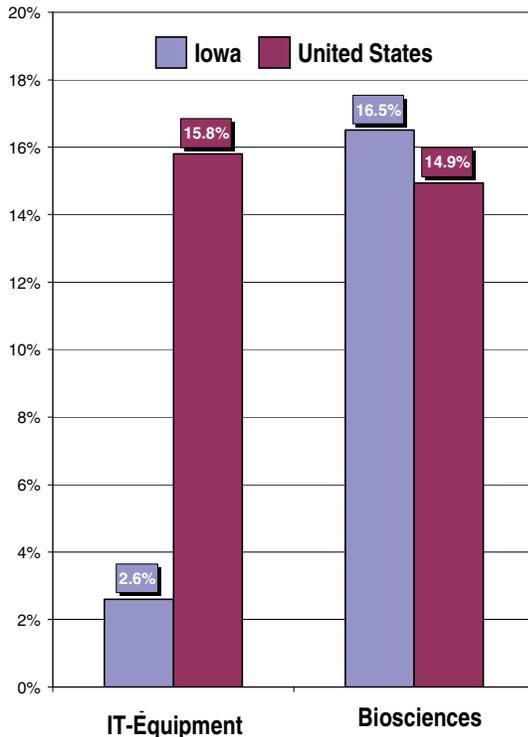
The diversity of the advanced manufacturing sector provides opportunity for growth. Several advanced manufacturing industries are closely connected with highly developed and mature

Figure ES-1: Relative Average Annual Employment Growth for Iowa and United States, 2000–2003



Source: Battelle calculations based on ES-202 from the Iowa Employment Statistics Bureau, 2000-2003

Figure ES-2: Key Industrial Segments of the Advanced Manufacturing Base, Iowa and the United States, 2003



Source: Battelle calculations based on ES-202 from the Iowa Employment Statistics Bureau, 2003

high-tech industry clusters such as the biosciences and information technology (IT). Strengthening existing connections and supporting new emerging ones provide a well-defined opportunity to grow the entire advanced manufacturing base.

Bioscience-related manufacturing in Iowa is a critical segment of the state's advanced manufacturing base. Bioscience-related manufacturing activity accounts for 16.5 percent of advanced manufacturing in Iowa, compared with 14.9 percent at the national level. Bio-related manufacturing activity includes organic and agricultural chemicals, agricultural machinery, drug and pharmaceutical manufacturing, and medical devices and equipment⁴ (Figure ES-2).

Essentially, each of the bioscience manufacturing subsectors examined in the 2004 Iowa Bioscience report are contained within the state's advanced manufacturing base. This clearly illustrates a need for state economic development initiatives to dovetail strategies targeting each of these important industry segments.

Information technology equipment is also part of Iowa's advanced manufacturing base, although it

comprises a smaller share than it does nationally. IT equipment comprises only 2.6 percent of Iowa's advanced manufacturing base. Nationally, IT equipment represents 15.8 percent of advanced manufacturing. Though a smaller part of overall advanced manufacturing, the IT-equipment segment is an important part of the state's overall IT industry. Portions of IT equipment demonstrate strong growth potential, such as computer peripheral equipment.⁵ More importantly, the IT-equipment industry is a major high-tech industry segment across the nation and potentially represents a growth opportunity for Iowa's advanced manufacturing base.

The large and diversified advanced manufacturing base in Iowa possesses an employment concentration that is considered significantly specialized. The location quotient measurement of Iowa's advanced manufacturing base exhibits the level of industry concentration within the state relative to the nation. The advanced manufacturing base in Iowa has a location quotient of 1.53—meaning Iowa is 53 percent more specialized than the nation in advanced manufacturing employment. The location quotient is large because advanced manufacturing employment in Iowa accounts for a larger share of total private sector employment than it does at the U.S. level. When the ratio of industry employment to total employment is significantly above average, i.e., the location quotient is above 1.20, the state is said to possess a specialization in the industry.

⁴ See *Iowa's Bioscience Pathway for Development*, prepared by Battelle for IDED, July 2004, for further detail.

⁵ See *Iowa's Bioscience Pathway for Development*, prepared by Battelle for IDED, July 2004, for further detail.

Iowa's specialization in advanced manufacturing has intensified over time. Historically, the advanced manufacturing base in Iowa has been specialized. In 2000, the state possessed a level of specialization in advanced manufacturing that was 46 percent above the national average. This grew by 7 percentage points between 2002 and 2003 to 53 percent.

Shift-share analysis reveals that at a national scale advanced manufacturing exhibited larger employment decreases. Although the state experienced a loss of employment between 2000 and 2003, the loss was less than the national trend. A better-than-average performance in Iowa resulted in an intensifying of its advanced manufacturing base. Iowa's concentration rate rose because of state competitive factors and a more vibrant advanced manufacturing base in Iowa.

Components of Iowa's Advanced Manufacturing Sector

If Iowa wants to continue to grow its advanced manufacturing sector, it should focus on those industry divisions that possess economic characteristics and qualities that make them strategically positioned within the context of manufacturing and therefore strategic from a state economic development perspective.

Each of the 158 manufacturing industries that compose the advanced manufacturing sector were classified into 14 major industry divisions based upon end use and can be grouped into the following categories:

- Active chemical agents
- Aerospace and defense
- Automation precision machinery
- Commercial and industrial motor vehicles
- Construction components
- Digital and electronic devices
- Electronic and computer hardware equipment
- Environment control systems
- Industrial chemicals
- Industrial metal processing
- Medical drugs and devices
- Polymers and coatings
- Power generation equipment
- Printing and packaging

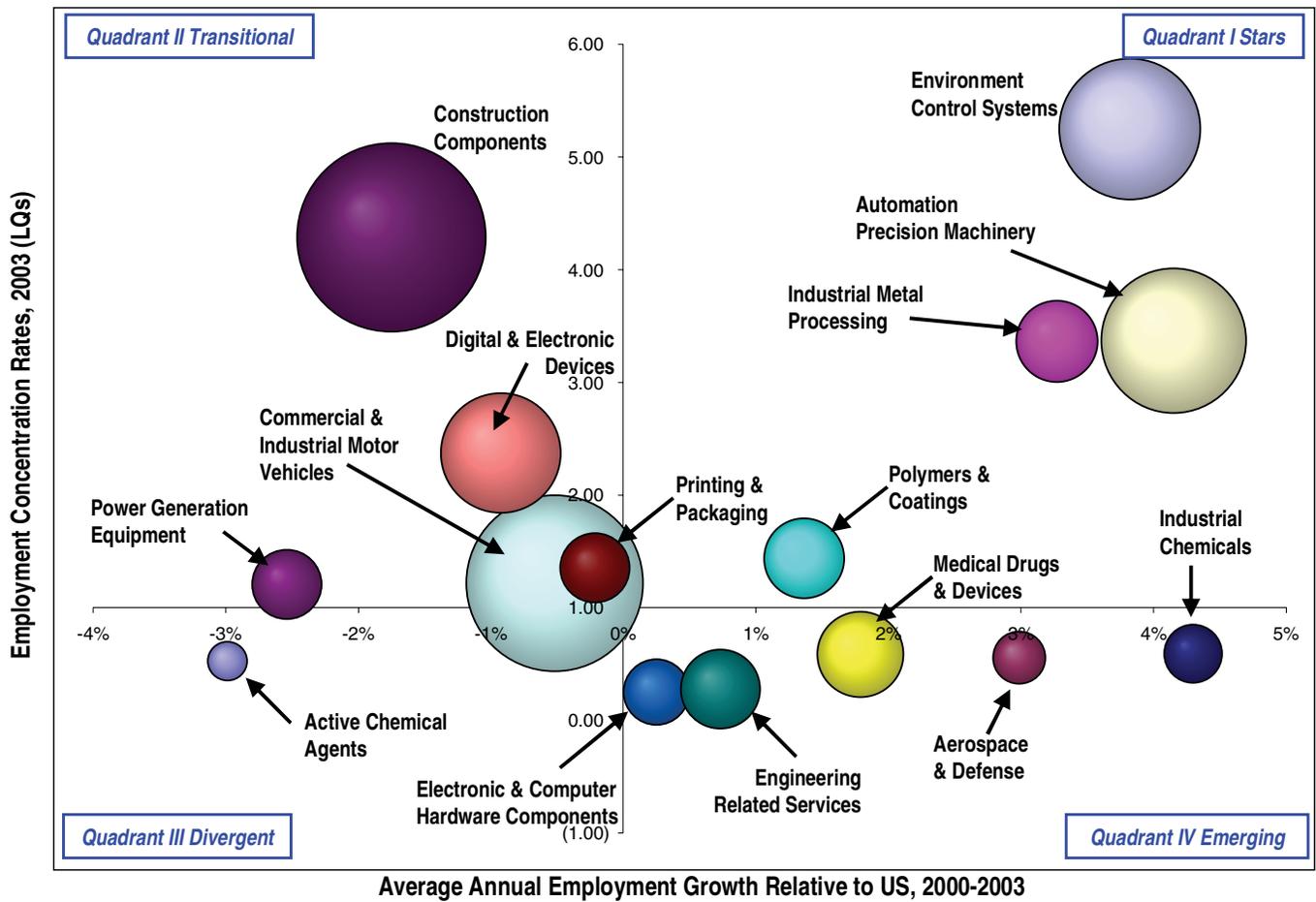
In addition, engineering-related services is also included in the subsector component analysis. Though not a manufacturing industry per se, it is included because it plays an integral role in supporting the manufacturing sector.

The industry division of Iowa's advanced manufacturing base can be categorized into four groups based upon economic performance between 2000 and 2003. Industry divisions were categorized based on location quotient and growth relative to the United States. Those industry divisions classified as *stars* and *emerging* are vital for the overall advanced manufacturing base and its future development potential. These industries are often seen as the key drivers of the sector. Industries classified as *transitional* or *divergent* are experiencing declines in employment and will not be contributing to economic growth unless these trends are reversed. Transitional and divergent subsectors require a strategic responsiveness for repositioning.

Figure ES-3 illustrates the general overall performance of each advanced manufacturing industry division between 2000 and 2003. The analysis reveals that all but one industry division demonstrated above average characteristics, either surpassing U.S. employment trends or possessing exceptional employment concentrations. Only the active chemical agents industry division exhibited below standard performance.

Three industry divisions are especially well positioned as major platforms for growing the state's advanced manufacturing base. Environment control systems, automation precision machinery, and industrial metal processing each have the advantage of very strong regional specializations and employment trends well above the national standard. This analysis clearly demonstrates that Iowa's advanced manufacturing base is very well situated to benefit from the successes of its manufacturing industry divisions.

Figure ES-3: Performance of Iowa's Advanced Manufacturing Industry Divisions, 2000–2003

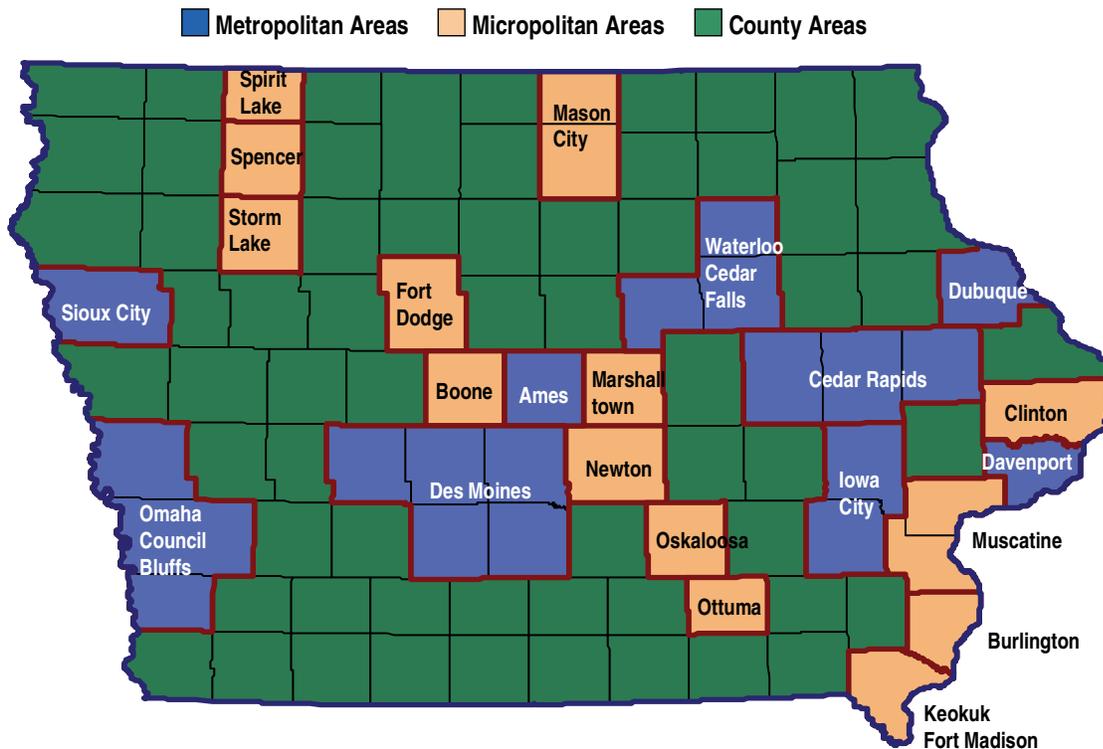


Source: Battelle calculations based on ES-202 from the Iowa Employment Statistics Bureau, 2000-2003
 Note: Bubble size indicates employment base

Advanced Manufacturing Geographic Distribution

Estimating the geographic distribution of Iowa's advanced manufacturing base demonstrates the diverse economic impact that it has on the state. The spatial allocation of employment and establishments across metropolitan, micropolitan, and county areas illustrates that different regions of the state specialize in different aspects of the advanced manufacturing base (Figure ES-4).⁶ Recognizing the distribution will better enable economic development professionals to structure initiatives to target the advanced manufacturing base in Iowa.

Figure ES-4: Iowa and Associated Metropolitan and Micropolitan Areas



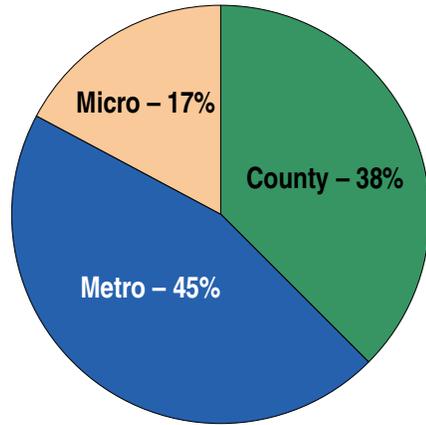
Nonmetropolitan areas in Iowa account for more than 50 percent of the state's advanced manufacturing base (Figure ES-5). According to county-level data obtained from ES-202 data from Implan, Iowa's micropolitan areas combined with the state's remaining non-metropolitan areas account for 55 percent of total advanced manufacturing employment. This represents more than 54,000 workers.

⁶ Metropolitan statistical areas or micropolitan statistical areas each contain a recognized population nucleus and adjacent communities that have a high degree of integration with that nucleus. Each metropolitan statistical area must have at least one urbanized area of 50,000 or more inhabitants. Each micropolitan statistical area must have at least one urban cluster of at least 10,000 but less than 50,000 population.

Iowa's metropolitan areas possess the largest single share of advanced manufacturing employment, according to Implan ES-202 county-level data. Iowa's metropolitan area counties employ 44,768 people. This is 45 percent of statewide total advanced manufacturing employment. This is not surprising given that metropolitan areas accounted for 54 percent of the state's population in 2003.⁷

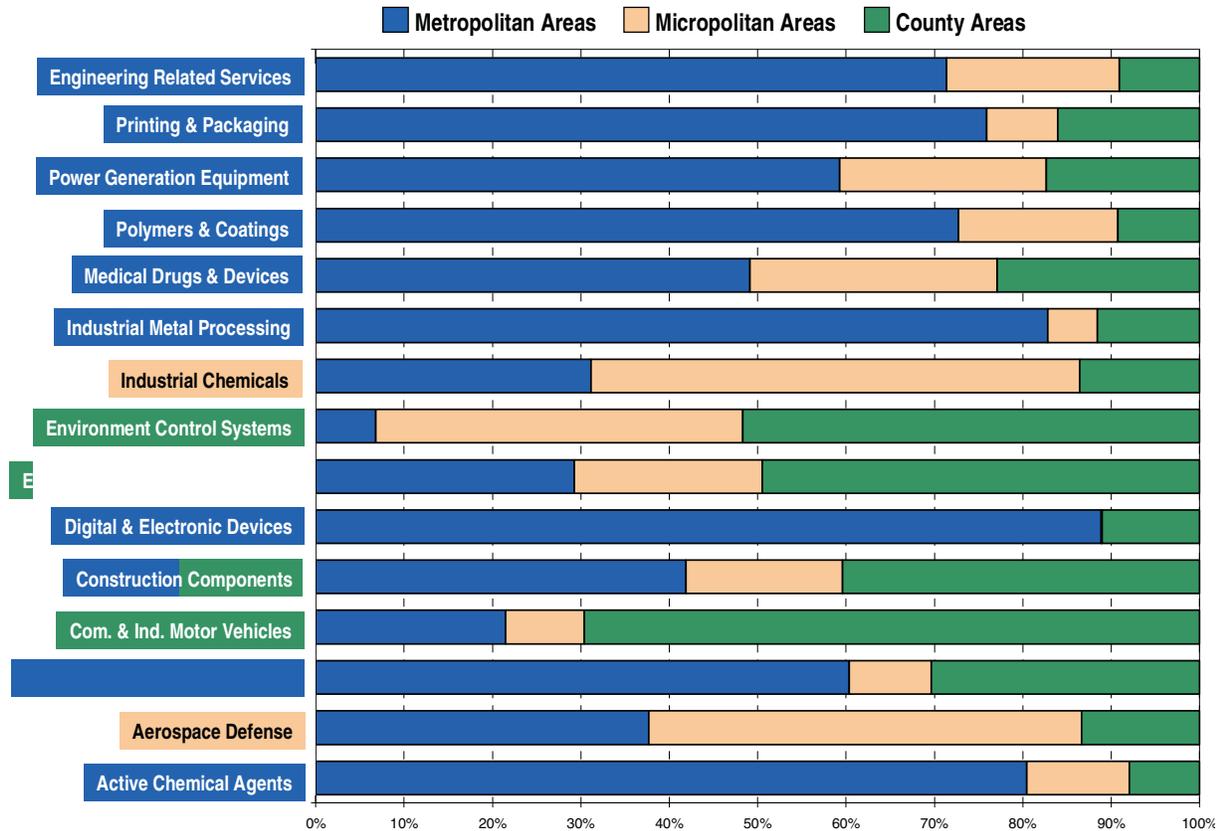
Although the metropolitan areas represent the largest single share of total advanced manufacturing employment, each region possesses its own unique industry strength. In fact, some of the state's primary advanced manufacturing strengths are found in nonmetropolitan areas (Figure ES-6).

Figure ES-5: Advanced Manufacturing Employment Distribution across the Regions of Iowa



Source: Battelle calculation based on ES-202 data from the Minnesota Implan Group, 2003

Figure ES-6: Distribution of Industry Division Employment across Iowa, 2003



Source: Battelle calculation based on ES-202 data from the Minnesota Implan Group, 2003

⁷ Annual Estimates of the Population for Counties of Iowa: April 1, 2000 to July 1, 2004 (CO-EST2004-01-19). Source: Population Division, U.S. Census Bureau, April 14, 2005.

Though the majority of advanced manufacturing industries are based in Iowa's metropolitan areas, six of the state's top performing industries are concentrated in nonmetropolitan areas. Micropolitan areas account for 55 percent of the industrial chemicals industry division and 49 percent of aerospace and defense employment.

Counties outside of major urbanized areas control the majority of employment for environment control systems, electronic and computer hardware, and commercial and industrial motor vehicles. "Un-urbanized" regions also possess a significant amount of construction components employment. Each of these industry divisions are part of the state's advanced manufacturing foundation. The indication is that Iowa's rural areas play a pivotal role in the state's overall competitiveness.

Summary

Manufacturing is a large, specialized industrial sector in Iowa and a major economic engine that has consistently demonstrated an above average economic performance. The advanced manufacturing base is the foundation of Iowa's overall manufacturing competitive position. The state's advanced manufacturing base is composed of detailed industries that demonstrate the productivity potential, size, and technology inclination to enhance the position of the state's manufacturing sector. These economic indicators clearly illustrate the innovative capacity of the advanced manufacturing base. Key findings include the following:

Iowa's advanced manufacturing base has outperformed the United States and remains a stable platform contributing to Iowa's economy. The innovative nature of the advanced manufacturing base in Iowa is demonstrated by its strong economic performance. The advanced manufacturing base represents a substantially specialized, large share of employment in Iowa. Although not growing, the industry experienced greater economic success than the U.S. trend.

Iowa's top performing industry divisions hold a preeminent position in the United States. Industrial metal processing, automation precision machinery, and environment control systems are highly specialized, surpassing the national trend, and pay wages nearly equal to or higher than the national average. These industry divisions not only represent the strength of the state's strategic base, but also hold a preeminent position in the United States. The economic success of the advanced manufacturing sector is rooted in the cluster of these industry divisions.

Iowa's transitional industries demonstrate competitive characteristics, though falling behind the U.S. trend. Construction components, power generation equipment, and digital and electronic devices demonstrate strong regional employment specializations and pay high average wages in Iowa. Iowa's transitional industries are extremely competitive, though falling behind the U.S. trend. Developing a vibrant, competitive manufacturing sector requires a strategic base of industries such as these to cultivate the entire advanced manufacturing base.

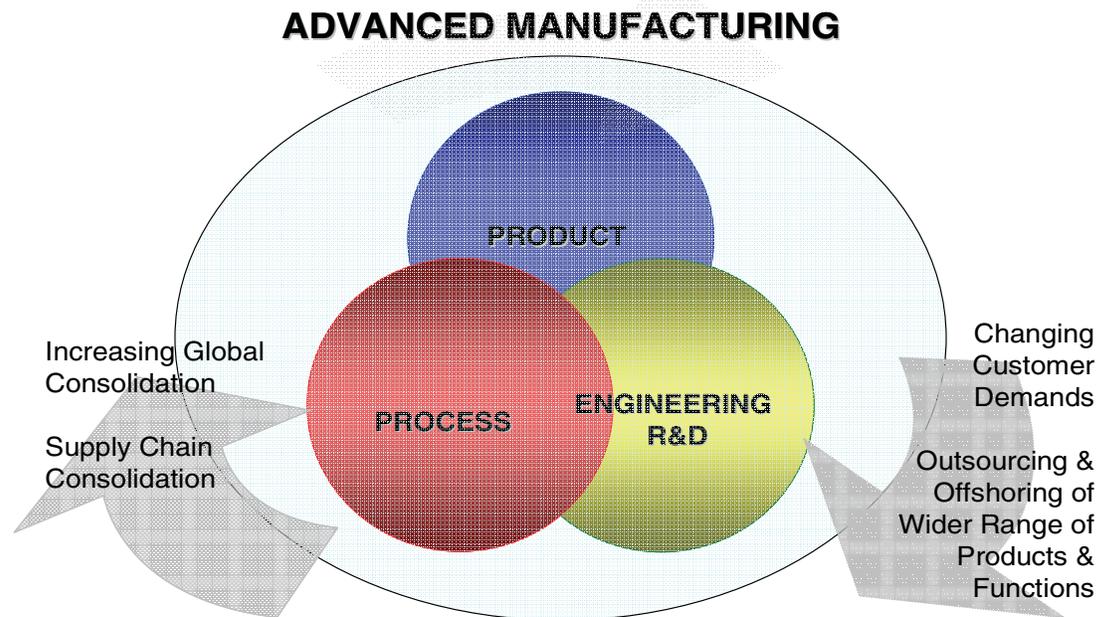
The regional distribution of the advanced manufacturing base in Iowa presents an opportunity to enhance every corner of the state. Each region of the state is positioned to benefit from a strategy focusing on the advanced manufacturing base. Although some industry divisions are more concentrated in some areas than others, this diversity allows the state to focus incentives where a critical mass of economic activity exists. This makes it possible to have a more meaningful and longer-lasting impact on Iowa as a whole.

SITUATIONAL ANALYSIS OF IOWA'S ADVANCED MANUFACTURING SECTOR

This section presents an analysis and insights regarding the composite strengths, weaknesses, opportunities, and threats facing Iowa and its advanced manufacturing sector. These issues have direct bearing on efforts to retain and grow the state's advanced manufacturing base. Identifying the most critical issues is therefore an important preceding step in developing strategies and initiatives that will address the right issues.

To put this analysis in context, it is helpful to present the set of trends and dynamics that are at play across Iowa's advanced manufacturing sector. These issues and forces cut across industries, from the production and delivery of agricultural equipment to windows and doors. Figure ES-7 shows the challenges surrounding the internal interplay of the products, processes, and engineering research and development (R&D) of advanced manufacturing.

Figure ES-7: Challenges to Advanced Manufacturing



Internally, successful firms adapt, drawing upon core competencies to develop, manufacture, and market new products as well as utilize new processes to add value and compete in their markets. Engineering and R&D functions—provided through a combination of internal and external resources—provide support to the products and processes of the firm.

Iowa's advanced manufacturing firms and operations are responding in various ways to the increasing globalization of manufacturing. Firms and clusters of firms operating as integrated supply chains compete in this context. Thus, the strengths and weaknesses cited below are not absolute but relative to this context. For example, having a supply of reliable, high-quality labor is interesting, but becomes more

significant in the context of the need to change, continuously improve, and respond to new opportunities in the global marketplace.

Iowa's Competitive Advantages—Strengths

- The quality of Iowa's workforce is a key differentiating asset. Hard-working, dedicated, well-educated, and inventive—Iowa's workforce provides a keen competitive edge for employers.
- Iowa is geographically well located for manufacturing firms to access substantial national markets, population, and industrial centers. While this is true generally, it is especially true for products that serve a wide range of agriculture-related markets.
- Iowa has a very strong set of large and well-established national and multinational advanced manufacturing firms that bring to the state substantial manufacturing, supplier development, and R&D and product development capacities. These firms include, but are not limited to, John Deere, Pella, Vermeer, Cargill, Guardian Industries, HNI, Fisher Controls, Winnebago, Maytag, Rockwell Collins, and Lennox.
- Iowa's safe and "family-friendly" environment is an attractor and anchor for more established, family-oriented skilled professional and technical staff.
- Iowa has a high-quality and responsive community college system that, when combined with some very innovative state workforce training programs (the 260 series), provide a significant workforce development and training capacity for new and rapidly growing firms.
- Iowa has a tradition of interfirm collaboration, both statewide and in some regions. This can be leveraged and further extended.
- Iowa has a history of invention and product innovation, a legacy on which to build.

Strengths

- Quality of workforce
- Geographic location
- Presence of national and multinational advanced manufacturing firms
- Family-friendly environment
- High-quality and responsive community college system
- Tradition of interfirm collaboration
- History of invention and product innovation

Iowa's Comparative Disadvantages—Weaknesses

- The biggest challenge facing advanced manufacturing firms in Iowa is the lack of adequate workforce. This involves finding sufficient entry-level workers; replacing workers nearing retirement; and finding workers to fill special needs and skills, many in traditional areas.
- While steps have been taken to address regulatory issues, some manufacturing firms expressed the view that the regulatory environment in Iowa is not always perceived to be conducive to manufacturing operations. Topics such as the permitting process and time frame for decision making by the Department of Natural Resources (DNR) and workers' compensation were consistently mentioned as being distinct disadvantages for Iowa-based firms as they compete with non-Iowa firms.
- While mentioned as a good source of graduates and workers, universities and their assets in the state were not seen as partners or advantages with respect to product or process development. Universities were rarely mentioned as successful partners; they were described more often as an unaccessed player rather than as a potential source of assistance or help.

- Iowa and its leaders are perceived as being disproportionately oriented toward agriculture versus manufacturing. Whether the topic was the legislature, the executive branch, the media, the tax system, or support services offered by the state, the clear and consistent perception was that Iowa is focused on agriculture and is (at best) indifferent to manufacturing.
- Manufacturers in Iowa are not well networked or linked with each other, lacking opportunities to take advantage of common supplier chains, share experiences and learn from each other, and work in common on needs and solutions.
- Iowa lacks focus in K-12, guidance counseling, and higher education to encourage careers and opportunities in advanced manufacturing.
- A governmental business climate does not fully recognize the special needs and problems of advanced manufacturing in Iowa.
- Entrepreneurship within manufacturing is weak, resulting in insufficient spin-outs and new firms from the state's advanced manufacturing base.

Weaknesses

- Replacing, adding, and attracting talent
- Regulatory environment that has not always been manufacturing friendly
- Limited university/industry partnerships
- State orientation toward agriculture
- Insufficient industry networking
- K-12 not supportive of manufacturing careers
- Business climate issues
- Limited entrepreneurial spin-offs

Opportunities

- Iowa needs to consider the development of a comprehensive supplier system to offset its global cost disadvantages by building on its supplier strengths and encouraging stronger linkages among firms, with government serving as the catalyst and linker. There is a strong opportunity to aggregate demand and connect it with Iowa-based supply and thereby strengthen the links with in-state suppliers to the state's major OEMs.

Opportunities

- Leverage the purchasing power of the state's OEMs
- Transition existing supply clusters into production clusters
- Provide access to a wide-range of training services
- Attract national and international populations to build the next generation of skilled manufacturing workers
- Tap Iowa companies' international expertise to help other companies enter global markets
- Leverage the R&D strengths of Iowa's universities to help firms with new process and product development
- Educate and inform public and citizenry on Iowa's prowess in advanced manufacturing

- A number of supply clusters in the state (e.g., hydraulic systems, material-handling design/ maintenance/operations, construction-related components, and process automation) could grow into significant production clusters.
- Small and medium-sized manufacturing firms need more economical access to a wide range of training services such as lean manufacturing and new product market development.
- Iowa needs to use its very attractive quality of life and affordable cost of living to recruit a new generation of Iowa manufacturing employees. More diverse and international populations are a major source of these employees. These people will need to be formally and explicitly targeted and recruited.
- Significant companies in Iowa have impressive access to international markets and deep distribution systems. There is a clear opportunity not only to help them expand their

existing markets, but to leverage their knowledge and market access to help other manufacturing firms sell products globally.

- Other opportunities involve technology and product innovation that can leverage R&D strengths in Iowa's higher education system.
- Public officials need to be educated and informed about advanced manufacturing in Iowa today, its importance, its potential, and the state's leadership role in the nation and world.

Threats

- Iowa has a significant number of large firms that are part of a national and international system of branch plants and supply firms.
- Iowa's manufacturing sector is vulnerable the increasing tendency to source products abroad because of lower labor and other costs.
- Other countries and industries may outwit and outdo Iowa manufacturers in product design and development, particularly in times of cost austerity. New product and process development is increasingly important to the manufacturing sector, especially small and medium-sized firms.
- Iowa lacks an identity and image as a viable manufacturing location.
- Worker labor shortages may cause firms to move outside the state, start up elsewhere, or not move to Iowa, reducing job opportunities and wealth creation for the state.
- Air service costs are high, and access and availability in many parts of the state are limited.

Threats

- Significant number of branch plants and supply firms
- Vulnerability to increasing tendency to source products abroad
- Competition in new product design and development
- Lack of identity and image
- Worker labor shortages
- Air service costs and availability

STRATEGIES AND ACTIONS

The manufacturing sector is a vital source of current and future economic strength for Iowa as a state. In contrast to many other manufacturing-focused states, manufacturing firms are broadly spread within Iowa and are thus a significant source of income and well-paying employment for a majority of Iowa's counties. When adjusted for Iowa's population size, the relative economic importance of Iowa's manufacturing sector is greater than all but six other states. The following four strategies and 15 actions are designed to increase the competitiveness and growth potential of Iowa's manufacturing sector:

- **Strategy One:** Raise the profile and support of Iowa manufacturers
- **Strategy Two:** Increase the capacity and collaboration of manufacturers and leverage the purchasing and R&D power of the state's major OEMs
- **Strategy Three:** Encourage innovation of Iowa manufacturers
- **Strategy Four:** Support the creation of a series of manufacturing workforce attraction, recruitment, and development initiatives.

Table ES-1 summarizes the strategies and actions proposed in this Roadmap.

Table ES-1: Summary of Proposed Strategies and Actions

Strategy	Action	Priority	Time Frame
STRATEGY ONE Raise the profile and support of Iowa manufacturers	Action One: Appoint a Manufacturing Advocate in the Governor's Office	Critical	Immediate
	Action Two: Create a statewide Iowa Advanced Manufacturers' Council (IAMC)	Critical	Immediate
	Action Three: Target Iowa Values Fund investments to support the development of the advanced manufacturing sector	High	Short-Term
STRATEGY TWO Increase the capacity and collaboration of manufacturers and leverage the purchasing and R&D power of the state's major OEMs	Action Four: Leverage the purchasing, R&D, and marketing strengths of Iowa's major manufacturing OEMs through the strengthening of a series of vertical manufacturing supply-chain initiatives.	Critical	Short-Term
	Action Five: Create manufacturing clusters among targeted segments of Iowa's manufacturing firms that are producing similar or related products.	High	Short-Term
	Action Six: Expand Iowa's Manufacturing Extension Partnership	High	Mid-Term
	Action Seven: Create a large-scale, statewide Lean Manufacturing Institute	High	Short-Term
	Action Eight: Organize a set of working conferences and subsequent support services targeted at the small and medium-sized firms that exist in Iowa's outlying, nonmetropolitan counties	High	Short-Term

Strategy	Action	Priority	Time Frame
STRATEGY THREE Encourage innovation of Iowa manufacturers	Action Nine: Scale up rapid prototyping efforts of the Iowa Business Council	High	Mid-Term
	Action Ten: Provide matching grants for new product and process development	Critical	Mid-Term
	Action Eleven: Encourage use of the Small Business Innovation Research (SBIR)/Small Business Technology Transfer (STTR) Program to stimulate innovation in the supplier base	High	Mid-Term
STRATEGY FOUR Support the creation of a series of manufacturing workforce attraction, recruitment and development initiatives.	Action Twelve: Increase the capacity of the community college system to respond to manufacturing workforce needs	Critical	Short-Term
	Action Thirteen: Create a community college application tools and advanced manufacturing equipment fund to support the purchase of appropriate manufacturing-related training materials	Critical	Short-Term
	Action Fourteen: Build multicounty leadership teams to inform teachers, guidance counselors, school administrators, parents, and especially students in middle and high schools about the opportunities of careers in manufacturing	High	Long-Term
	Action Fifteen: Undertake a significant long-term campaign to attract individuals from out of state willing to become manufacturing employees in Iowa, targeted initially at the state's outlying counties	High	Long-Term

IMPLEMENTATION PLAN

This Implementation Plan for Iowa's advanced manufacturing strategy is designed to catalyze public and private sector collaboration, focused on filling "market gaps" that require independent action of the private and public sectors or actions of the two sectors working together. It lays out the major actions critical to success, the immediate action priorities, the resources required, and the organization and structure for moving this Roadmap forward.

But, addressing gaps, while necessary, is not sufficient. The State of Iowa will need a set of public and private sector champions committed to making this strategy a reality in the months and years ahead. This commitment will need to be sustained over the course of the next decade to ensure that the necessary changes are made, gaps are filled, and actions are taken.

It should be noted that the preference throughout the Implementation Plan for this strategy is to use, wherever possible, existing entities and organizations. Their roles and responsibilities may need to be changed to implement the recommended strategies and actions, but it is preferred that existing organizations and programs be reconstituted or used wherever possible in implementing this Roadmap. Stakeholders should be encouraged to use this approach in terms of efficiencies and, equally important, in terms of achieving results.

Critical Actions

To realize the full economic potential of advanced manufacturing that this Roadmap lays out will require that certain critical actions are successfully implemented. Specifically, the ultimate success of the strategy hinges on accomplishing the most critical of the 15 proposed actions. These seven critical actions are the underlying foundation for the eventual success of the other proposed elements and initiatives of this strategy. Therefore, when initial resource allocations are being determined, efforts must be made to ensure that these critical actions receive both funding priority and the most overall attention. The seven critical actions are as follows:

- Appoint a Manufacturing Advocate in the Governor's Office.
- Create a statewide Iowa Advanced Manufacturing Council.
- Leverage the purchasing, R&D, and marketing strengths of Iowa's major manufacturing OEMs through the strengthening of a series of vertical manufacturing supply-chain initiatives.
- Create manufacturing clusters among targeted segments of Iowa's manufacturing firms that are producing similar or related products.
- Provide matching grants for new product and process development.
- Increase the capacity of the community college system to respond to manufacturing workforce needs.
- Create a community college application tools and advanced manufacturing equipment fund to support the purchase of appropriate manufacturing-related training materials.

Immediate Priorities

Immediate work plan priorities are steps that should be undertaken in the first 12 to 18 months of strategy implementation regardless of how critical they are to the overall strategy. Several immediate priorities can

be implemented right away, while others will need to be planned and allocated funds before they can become fully operational. The following six actions should be undertaken in the first 12 to 18 months:

- Create and fund an Advanced Manufacturing Advocate within state government.
- Form an interim Advanced Manufacturing Council from the Steering Committee and explore how it should be formed, with whom, etc.
- Review requirements of the Iowa Values Fund and determine ways to encourage advanced manufacturers to take advantage of its programs, and assess infrastructure (e.g., scale up facilities) that may need to be planned to meet industry needs in one or more industry segments.
- Develop an advanced manufacturing image and brand for Iowa through aggressive marketing, public relations, and signature events with the assistance of IDED and local economic development groups and the Council.
- Leverage the Iowa Career Consortium in conjunction with the State Workforce Investment Board and IDED to attract to Iowa advanced manufacturing talent.
- Begin planning for the Lean Manufacturing Institute by assessing industry demand and the market for this effort, in conjunction with the state's universities and community colleges.

Resource Requirements

For each action, Table ES-2 indicates the time frame; breaks out state funding needs into two 5-year phases; provides the estimated one-time costs; and, indicates the anticipated external leverage. Overall, costs to the state government from general fund appropriations would require total investments of \$160.4 million over 10 years, broken out as \$85 million in the first 5 years and \$75 million in the second 5 years. Twenty-one million dollars of this total would be direct private funds and \$139 million would be public funds. These funds would additionally leverage federal, philanthropic, and industry funds; but, the precise amount cannot be determined. Higher education investments will bring in additional tuition and fees, and industry would finance the IAMC as well as two-thirds of the costs of the Lean Manufacturing Institute.

Table ES-2: Iowa Advanced Manufacturing Financial Plan

Action	Time Frame	Annual Funding by Year: Years 1-5	Estimated One Time Costs	Leverage Ratio of Private and Federal Funds	Comments
1-State Advanced Manufacturing Advocate	Immediate	State: \$500,000 year one rising to \$750,000 in year five	0	0	State supports Action One and industry supports and finances Action Two
2-State Manufacturing Council	Immediate	Private: Starting at \$250,000 rising to \$900,000 by year five		All private	
3-Iowa Values Fund	Short Term	State: Goal of securing \$3 million annually from Fund			No additional state costs other than projected costs of Values Fund
4-Supplier Chains	Short Term	State: \$500,000 per year rising to \$800,000 by year ten		In-kind costs of donated time of firms will far exceed state investment	
5-Cluster Development	Short Term	State: \$500,000 per year		In-kind costs of donated time of firms will far exceed state investment	
6- Expand MEP	Mid-Term	State: \$350,000 per year rising to \$400,000 by year six			
7-Lean Manufacturing Institute	Short Term	Start at \$750,000 in year one rising to \$2.0 million by year five One-third state and two-thirds private/federal		2:1 leverage of non-state to state funds	
8-Rural Manufacturing	Short Term	State: \$100,000 per year rising to \$200,000 annually in year four and thereafter			Philanthropic sources of funding might be possible

Action	Time Frame	Annual Funding by Year: Years 1-5	Estimated One Time Costs	Leverage Ratio of Private and Federal Funds	Comments
9-Scale Up	Mid-Term	State: \$250,000 annually for 5 years	\$5 million to \$10 million		Source of one-time funds might be Values Fund
10-Matching Grants	Mid-Term	State: Start at \$1 m in year one rising to \$5 m. in year two			Can be combined with similar actions in Biosciences and IT strategies into one matching grant program serving all sectors
11-SBIR Support	Mid-term	State: \$250,000 per year		May be able to leverage equal amount of federal funds	
12-Community College Offerings	Short Term	State: \$2 m. per year rising to \$2.25 million by year six		At least 3 to 4 times these costs in tuition and fees paid institutions	
13-Community College Equipment	Short Term	State: \$750,000 per year rising to \$900,000 by year six		3-4 fold annual return in increased fees and tuition	
14- K-12 Focus	Long Term	State: \$350,000 per year rising to \$400,000 in year six			
15-Talent Migration	Long Term	State: \$250,000 per year rising to \$300,000 in year six			

Organization and Structure

State science and technology initiatives are most effective when they are executed on a bipartisan basis, with strong executive and legislative branch support, involvement, and cooperation. States such as Georgia, Arizona, Colorado, and Oregon have been successful with their science and technology investments because their efforts have been broad based, they have mobilized private sector champions behind them, and their initiatives have become institutionalized into the state and regional fabric of economic development.

In the recent legislative session, several steps were taken in Iowa to restructure and address the need for a more focused effort in the biosciences that can also serve to help guide efforts in advanced manufacturing and IT, the two strategies currently being completed. These actions include the following:

- Creation of a Chief Technology Officer to the Governor
- Creation of a Commercialization Specialist at IDED
- Re-establishment of the Iowa Values Fund
- In addition, the Iowa Bioscience Alliance has been formed to move forward the Iowa Bioscience Roadmap, and IDED has established a coordinator position to work across state government to mobilize resources and priority on the biosciences.

For the implementation of this Strategic Roadmap, it is suggested that an Advanced Manufacturing Coalition be formed on an interim basis, composed of the membership of the Advanced Manufacturing Steering Committee. The primary early tasks of this Coalition are to

- Begin the process of forming a private, nonprofit Iowa Advanced Manufacturing Council/Organization including
 - Determining where it should be housed, e.g., existing, new
 - Determining interim source of financing for the Council
- Work with the Iowa state executive branch to create the Manufacturing Advocate whose responsibilities will include monitoring the progress of and overseeing the state's efforts in the implementation of this strategy.

Once these two steps are taken, the Advanced Manufacturing Coalition can morph into the Council, and the Advocate and Council will share the role of overseeing this Implementation Plan.

In addition, efforts should be undertaken by the State Technology Commercialization Officer and Governor's Science and Technology Advisor to connect the efforts underway across the biosciences, IT, and advanced-manufacturing strategy-implementation activities.

Measures of Success and Accountability

The following measures and performance goals are proposed, with actual monitoring undertaken on an ongoing basis to determine to what degree performance objectives are being accomplished. Key measures that could be used include the following:

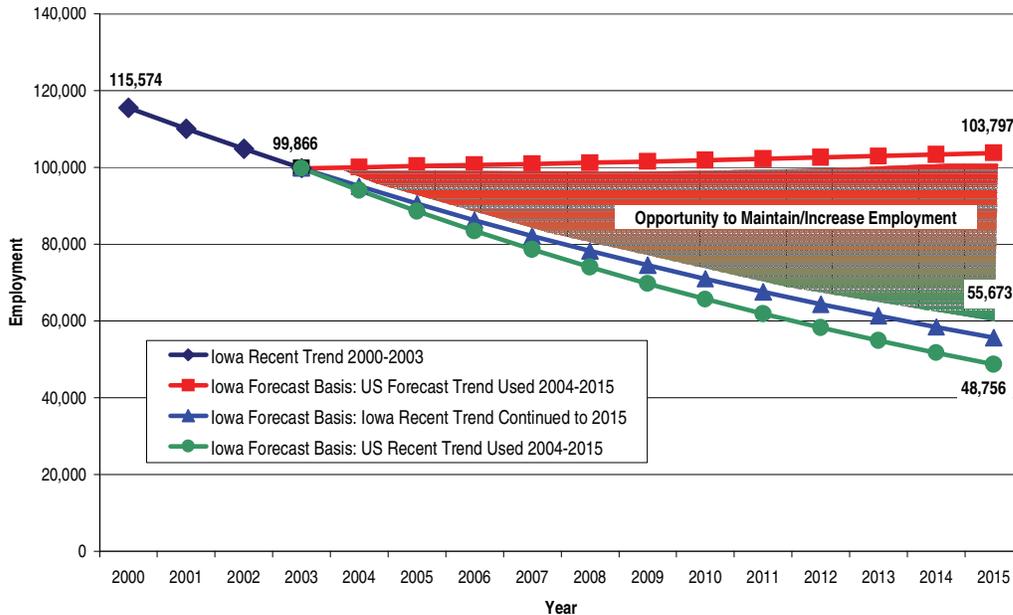
- Maintaining advanced manufacturing employment levels at their baseline 2002 level over the next 5 years
- Increasing the number of advanced manufacturing establishments in Iowa by 3 percent annually over the next 5 years, including an increase in advanced manufacturing start-ups by 50 percent by 2009
- Maintaining each of industry segments now classified as stars by 2009 and moving at least two of the four industry segments classified as emerging into the stars quadrant (see Figure 3).
- Accomplishing implementation progress on the actions outlined in this Roadmap—at least 70 percent with substantial action after 3 years and 90 percent within 5 years.

Economic Impact Potential of Iowa Advanced Manufacturing Roadmap

The 10-year potential economic impact of this Roadmap on the advanced manufacturing industry in Iowa is focused on the efforts to enhance the prospects of existing advanced manufacturing firms to ensure their competitiveness, retain (and, if possible, expand) their Iowa-based employment, and maximize their ability to reach their economic potential. The potential impact of the Roadmap's strategies and actions can be captured in several ways:

- **Potential R&D and Improvement Impacts on Existing Jobs**
 - Approximately 295 firms will be impacted in year one, increasing potentially to 470 firms by year ten. Given the average firm size of 77, approximately 22,500 to 36,000 jobs will be directly and indirectly impacted annually by these Roadmap actions over the next 10 years through firms' participation in improvement efforts.
 - Technology development-related actions, if fully implemented and successful, should impact at least 30 to 40 firms in year one and ultimately reach 120 or more firms by year ten. In turn, these actions should directly and indirectly impact, on average, more than 2,300 workers in year one to more than 9,200 workers by year ten.
- **Potential Retention and Expansion of Existing Firms and Jobs**
 - Baseline employment in 2003 (per the economic analysis) is 99,866. If the recent decline from 2000 to 2003 was continued (using a compound annual rate), by 2015 the state's advanced manufacturing employment level would be an unthinkable 55,673 (Figure ES-8).
 - Based on the U.S. Bureau of Labor Statistics forecast, Iowa's employment would remain fairly steady over the next decade, perhaps increasing by as much as 4,000 jobs over 2003 levels by 2015.
 - The retention opportunity, or the employment loss risk, could be more than 55,000 jobs over this period.
 - This opportunity area consists of some industries that are forecast to decline at the national level as well as some that are forecast to rebound and/or increase over the next decade.

Figure ES-8: Potential Iowa Advanced Manufacturing Retention and Expansion Opportunity



CONCLUSION

Iowa's advanced manufacturing sector has done well in spite of historically declining employment in manufacturing nationally. The state has both strong and large OEMs and many OEM suppliers. Iowa's advanced manufacturers recognize the increased importance of a skilled talent base to their productivity and product innovation efforts. But, the industry faces challenges in attracting, retaining, and replacing talent lost to retirement and attrition. Global competition requires strong supplier networks and constant innovation. Efforts to build functional and networked clusters in key industry segments should be pursued by Iowa. Other opportunities include its efforts to build stronger supplier chains to ensure that OEM work procured to the maximum extent is procured in Iowa rather than elsewhere in the nation and world.

The most immediate threats to Iowa manufacturing firms come from Iowa itself: neglect of this industry sector, lack of leveraging its university assets, and an inability to meet demands for additional workforce. The threat is that Iowa will continue down its present road, which essentially assumes that every firm (especially small and medium-sized firms) can and will resolve their competitive issues on their own, alone and without peers, public sector support, and significant resources. The result is a likely loss of manufacturing employment. The level of strategic, targeted, and significant investment in this sector, as well as collaboration among private sector employers, will have a significant effect on the state's ability to retain and grow this massive economic and employment base.

Iowa is at a crossroad—constant innovation, talented workers, and a customer base accessible from Iowa will determine its advanced manufacturing future.