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**Update on  
Critical Success Factors for  
Knowledge-Based Industrial Clusters  
in Wisconsin**

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# **Critical Success Factors for Knowledge-Based Industrial Clusters in Wisconsin**

## **Contents**

Introduction.....	1
Configuration of Clusters: Ten Existing, Emerging Drivers .....	3
Outline of Critical Success Factors: Nine Difference Makers .....	12
Analysis of Clusters: What’s Working, What Isn’t .....	15
Broad Recommendations for Wisconsin .....	25
Appendix 1: Description of Critical Success Factors .....	29

## **Introduction**

The ever-changing economic topography of Wisconsin requires a fresh look as we plan ahead from the year 2001. Even beyond the nasty down-turn of 2001, there is a great sense of unease in the state about Wisconsin's long-term competitive position.

The two most distressing indicators are the brain drain of many of our best and brightest graduates to more dynamic economic centers and the persistent gap in Wisconsin personal incomes below the national average. Wisconsin loses about 4 in 10 of its college graduates to more dynamic parts of the US and the world, and our per capita income trails the US average by more than 4%.

The sub-par incomes, along with high state taxes, have had the cumulative effect over time of dropping Wisconsin into a trailing position for wealth per capita. At \$13,862 in assets per capita, Wisconsin citizens are well below the US average of \$20,864. Indeed, we are in the bottom five states.

To turn the drain, which aggravates our labor scarcity, into a gain of graduates, and to move our incomes to premium levels, we have to heat up our economy. One device for analyzing how to super-charge business activity is the use of Michael Porter's concept of industrial clusters. In this paper we identify existing and emerging industrial clusters (e.g., machinery manufacturing, printing, information technology) and critical success factors (e.g., availability of skilled labor, venture and seed capital, infrastructure) underlying those clusters.

A variety of sources suggest that states' economies can typically be broken down into clusters around which certain types of firms affiliate and have common needs for successful operation. In many states, certain clusters have been identified as the "engines" or "drivers" of the economy. It is also apparent that a diversified economy, healthy in numerous areas, leads to more long-term sustainability and overall economic health. Wisconsin has such balance.

Our evaluation of the critical success factors in the context of each cluster indicates strengths and areas that can be addressed for accelerated economic growth. Because of the comprehensive assessment of clusters that are generally located in defined regions, our paper fosters a blueprint for future economic development in Wisconsin.

The paper begins with a review of the ten clusters. The choice of clusters was based on data and expert knowledge of what makes Wisconsin tick. Many business sectors that are also important, such as retail and other derivative business sectors, are not covered, since they are dependent on the good health of the primary clusters. Many sectors are included under one or more cluster heading.

The most important common denominator is that all the clusters rely heavily on intellectual capital. Indeed they are "knowledge-based industrial clusters." They could also be regarded as technology-based, unlike many other segments of the economy.

Critical mass for a cluster requires a mix of assets—human, financial and physical. Some clusters in Wisconsin, like Manufacturing/Materials, have reached critical mass and need sustaining support. Others, such as Biomedical Technology/Informatics, are gaining momentum, but need additional support and stimulation.

The second part of the paper briefly reviews nine critical success factors. Many of the success factors are necessary for all clusters, such as the availability of skilled labor. Others are more pivotal for individual clusters.

The third section of the paper contains an analysis of the critical success factors in the context of the industrial clusters. In this section, specific recommendations are offered for each cluster. The paper concludes with a set of general recommendations that build upon the specific suggestions for each of the clusters.

## **Configuration of Clusters** **Ten Existing, Emerging Drivers**

The 10 primary clusters driving the Wisconsin economy are:

- Agricultural Business/Food Processing Cluster
- Biomedical Technology/Informatics Cluster
- Business Services/Supply Chain Management Cluster
- Finance/Insurance Cluster
- Health Care Cluster
- Information Technology/Data Processing Cluster
- Machinery Manufacturing/Automation Cluster
- Manufacturing/Materials/Plastics Cluster
- Papermaking/Forest Products Cluster
- Printing Cluster

### **Agricultural Business/Food Processing Cluster** **One of Wisconsin's Largest, But Challenged**

The agricultural business cluster has been one of the most vibrant in the state since its founding and continues to be a driver of Wisconsin's economy. About 70,000 people are employed at Wisconsin farms and 1200 firms. This cluster includes not only the growing of foods, but also the processing of agricultural products. It includes food processing, such as dairy products manufacturing, animal slaughtering and processing, bakeries and breweries.

This cluster is definitely part of the "old economy," but it is being transformed mightily by higher technology. Advances in water management, biotechnology, telecommunications and satellite navigational technology have helped increase farm productivity so much so that less than 2% of Wisconsin's population now lives on a working farm.

While Wisconsin's percentage of US agricultural business income has been slipping, it still remains a global business that helps lead the state in the export world.

Consolidation at the farm level and at the processing level continues, as global forces mandate larger operations.

Wisconsin dairy farmers, the largest segment in the cluster, have seen their market share slip to second behind California and its "milk factories." Of late, California has targeted the specialty cheese market, long a stronghold of Wisconsin. The state loses about three dairy farms a day, suggesting that new business models are necessary.

This cluster has long been supported by the outstanding life sciences facilities at the University of Wisconsin-Madison, including the new veterinary school, and UW-River Falls. The strength in bio-sciences has resulted in a substantial number of hybrid seed companies in the state, like Dairyland Seed in West Bend and Renk in Madison. New innovative technologies aim to produce and deliver pharmaceuticals through foodstuffs and milk from transgenic cattle.

There is also an overlap with the Machinery Manufacturing/Automation Cluster, which includes companies like CNH and Gehl.

A strength of this cluster is the presence of market-leading companies, such as Schreiber Foods, Sargento, Miller Brewing, American Foods Group, Kraft, Silver Springs, Land O' Lakes, Chiquita, Nestlé and Sentient.

### **Biomedical Technology/Informatics Cluster** **Major Opportunity; Major Commitment**

Though data on this emerging cluster is difficult to assemble, Wisconsin is among the leading states for biomedical technology research and start-ups. This is a cluster that revolves around research institutions. So the new BioStar initiative, which will establish four new bio-science research centers at the University of Madison for \$317 million over the next ten years, and the new genetics research lab at the Medical College of Wisconsin in Milwaukee demonstrate a major state commitment to stay in the lead. The Marshfield Clinic has been a prime contractor for the human genome research project.

In terms of jobs, the bio-tech portion of this cluster is small at 6,300 positions spread over an estimated 300 firms. The medical devices and medical informatics portion is much larger at 42,000 knowledge workers and more than 1800 firms. The start-up rate for new companies is impressive, especially at Madison where there is critical mass. In the ten years from 1989 to 1998, 122 biotech companies were started there, with the pace of business creation accelerating sharply in recent years. One study ranked Wisconsin 10th in the US in growth of bio-tech firms from 1990 to 1997. Other rankings have placed Wisconsin in the top five for R&D activity.

The cluster includes Medical Biotechnology, which deals with weapons to fight disease, such as therapeutics, vaccines, diagnostics and gene therapy; Agricultural Biotech, which deals with genetically manipulated seeds and plants; Environmental and Industrial Biotech, which deals with eliminating waste streams and sustainable development.

The Bio-informatics field is an important emerging part of this cluster. It marries biotech research with IT expertise, so state-of-art computing can help unlock the mysteries of human genetics. MSOE, MCW, UWM and UW-Parkside are already offering baccalaureate and advanced degrees in this field. Several technical colleges offer two-year degrees.

Led by GE Medical Systems, the \$8 billion king of the medical imaging business, this cluster offers high-end jobs in a rapidly growing arena of the highest of technologies. The presence of a market-leading, pioneering company is one of the hallmarks of a successful cluster, since it stimulates the creation of supporting vendors, spin-off technologies and companies, and supporting firms offering a variety of business services.

A wide range of medical devices are produced in Wisconsin, including MRI machines, CT scanners, X-ray machines, bone density measuring devices, blood and oxygen flow measurement systems and emergency room monitors. Also included in this cluster are laboratory apparatus, surgical and medical instruments, dental equipment and supplies, and orthodontic goods.

A new segment of this cluster is Medical Informatics, also known as Health Care Information Systems (HCIS). This is the use of information technology to collect, organize, analyze and convey digital images and medical records about individual patients and sets of patients. This connection between digital devices and the HCIS world is a golden opportunity for Wisconsin.

GE Medical, for example, already is collaborating extensively with UW-Madison, MCW, UW-Milwaukee, Marquette and MSOE for research and development of new technologies, applications and products. Degrees offered in the related disciplines offer a stream of needed, appropriately skilled graduates for this cluster.

The purchase by GE Medical of SEC Inc., a developer of clinical information systems for patient records and images, and other firms in the field is a harbinger of good things to come in this cluster.

### **Business Services/Supply-Chain Management Cluster** **Fastest Growing in Wisconsin**

As the fastest growing part of the state's economy, the business services cluster offers relatively high paying jobs in a dynamic part of our economy. It is made up of a wide range of service firms that support the mainstream activities in the balance of the economy. Included are consultants, accounting firms, law firms, environmental management companies, advertising and public relations agencies, marketing firms, temporary help and search firms, system managers, credit collection operations and a host of others.

In one sense, this is a cluster of infrastructure organizations that allows mainline companies to out-source functions that are outside their core competencies. Often, the business services companies are heavily involved in information technology. This cluster accounted for almost 55,000 people employed at about 7400 firms.

Included is supply-chain management, a new and rapidly evolving business that is increasingly outsourced by many companies. Several firms, like Schneider Logistics, an offshoot of Schneider National, the largest trucking company in the country, and Banta, a printing company, have moved into this rapidly growing field.

The borderline between manufacturing and service companies is somewhat bridged by firms in the business services cluster. Product companies of today could not operate without them. Indeed, manufacturing companies are concentrating more and more on a few core competencies and contracting out for the rest.

In other examples of expansion in this cluster, state law firms are expanding the services they offer to corporations beyond pure legal representation. And accounting firms in the state are often expanding their array of services beyond old-line auditing and accounting services.

Intellectual capital, the knowledge and expertise of employees, is the major output of this cluster.

## **Finance/Insurance Cluster** **Many Big Start-Ups Lead the Way**

Though Wisconsin is a long way from Wall Street, or other major financial centers of the world, it has a pronounced cluster in the finance and insurance arenas. Indeed, it is the second largest cluster in our study, with over 77,000 people employed in about 5,000 firms. Included in this cluster would be management of other financial assets, such as real estate.

A drive up either I-43 or US Highway 41 from Milwaukee to Green Bay takes one past numerous insurance headquarters. Companies like Wausau Insurance, Sentry Insurance and American Family also loom large in the make-up of the economy in the central part of the state. Steady growth over many years at companies like West Bend Mutual Insurance Company and Heritage in Sheboygan has resulted in their emergence as strong regional players. The good news about these kinds of companies is that the headquarters have remained in Wisconsin.

Spectacular start-ups and spin-offs are still occurring in this field, such as American Medical Security in Green Bay, which started within the last decade and now employs more than 2000 people. Another remarkable example of entrepreneurial activity was MGIC, the national leader in mortgage insurance. Another is Wausau Benefits in Marathon County.

There are offsets to the generally positive growth story, such as a loss of insurance headquarters after consolidations. AAL in Appleton is the most recent example after its merger with Lutheran Brotherhood of Minneapolis.

Entrepreneurial energy is also present in the mutual fund and money management industry in Wisconsin. It is marked by leading national firms, such as the Strong and Nicholas Funds. A host of other funds are based here. Some of them have been started by or acquired from major firms, such as Northwestern Mutual, which has a family of funds in addition to being the largest life insurance company in the country.

The banking sector in Wisconsin has been marked in the last decade and a half by the exodus of major corporate headquarters, such as Marine Bank and Firststar, mostly as the result of consolidations within the industry. Rapid movement of money around the globe makes this an increasingly international cluster.

The flip side of the consolidation is the entrepreneurial growth of community banking operations all over the state. A good example is Hometown Bank, started in Fond du Lac by officers who left a large bank and now manage more than \$70 million in assets. This story can be told repeatedly across the state.

The exponential growth of financial assets has resulted in many start-ups that help individuals and companies manage funds. They range from wealth management operations, like those at Johnson Bank, to family offices with 5 to 20 employees that provide financial planning to a broad array of citizens.

Connected to this cluster, but included in the IT/Data Processing Cluster, are firms that serve financial and insurance companies, such as Metavante, Deluxe and Fiserv, which process financial transactions. Another example is De la Rue in Watertown, which makes money counting and changing machinery.

## **Health Care Cluster** **A Growing Exporter of Services**

Major hospital and medical research institutions in Wisconsin have acted as a magnet for outside patients and grants, hence becoming a cluster in the sense that they are exporters of services. Michael Porter identified exports as a requirement for an economic sector to be delineated as a cluster.

Health care is now about 14% of the Gross National Product in the nation and in Wisconsin. And it is rising as a percentage of the economy. Much of health care is delivered locally; therefore, that portion does not qualify in the sense of clusters. It is an important part of the economy, but local health care is dependent upon the health of the drivers in the economy.

However, hospitals like St. Luke's, Sinai-Samaritan, St. Joseph's, Froedtert, Children's, St. Mary's and Columbia in Milwaukee all treat patients from outside the region for specialized medical care. The same is true of the Gundersen Clinic based in LaCrosse and the Marshfield Clinic, which covers the central and northwestern part of the state.

In addition, Wisconsin is blessed with two large medical colleges: The Medical College of Wisconsin (MCW) in Wauwatosa and University Hospital in Madison. These two institutions do an enormous amount of research and are beginning to collaborate on some projects. MCW has risen as a research institution to the point where it is attracting about \$100 million a year in grants. UW-Madison is one of the biggest research institutions in the county, drawing in \$350-\$400 million a year in grants, much of it in the life sciences and at University Hospital.

This cluster overlaps with the Biomedical Technology/Informatics cluster, but is differentiated in that the health care cluster delivers services to individual patients/consumers, while the Biomedical cluster produces products for that cluster and others.

The health care industry is characterized by a shortage of technical personnel, especially nurses. The educational institutions in the state are ramping up their offerings in this cluster, a positive development, because the wages for health care workers are way above average.

The aging of the population means that the number of dollars spent in the health care cluster will continue to rise. Also, the rapid advance of technology in health care in America means that foreigners will be increasingly attracted to institutions here for advanced treatments. In some parts of the country, powerful health care institutions, like the Mayo Clinic, become the nucleus for health care clusters that drive the economy of that area.

## **Information Technology/Data Processing Cluster** **Misunderstood; Source of Strength**

It is hard to get a handle on the exact dimensions of the Information Technology cluster in Wisconsin. But, it is clearly undersold, understated and under-appreciated. In the 1999 Milken Institute Report on "America's High-Tech Economy," neither Milwaukee nor Madison is ranked in the top 50 high-tech metro areas. This is an omission, perpetrated by categorizations that don't properly include the IT operations that are part of established manufacturing or service companies.

M&I Bank, for example, has more than 3,000 data processing jobs in its Metavante subsidiary. The TYME system, another example, was developed in New Berlin inside A.O. Smith Corp., then spun out and sold to Deluxe Data Systems. It still employs hundreds of high-tech professionals in the Milwaukee metro area. The Strong Funds is a market leader in on-line investment offerings. Rockwell Automation uses pioneering IT systems in its products. The market leader in selling school supplies over the Internet is School Specialties of Appleton. Plexus of Neenah produces electronic boards, but also sells a variety of IT design and engineering services.

The list goes on and on. The statistics, however, do not reflect this robust and thriving cluster in Wisconsin. For example, Business Services, identified by the 1997 Wisconsin Jobs Commission as the fastest grower in the state, is heavily IT based.

Statistical imprecision notwithstanding, during the 1990s, the Milwaukee area gained at least 12,000 jobs in IT sectors out of 66,000 total new service jobs created. Data suggests the statewide IT percentage would be higher.

The Chippewa Valley, long a hub of very high-end computer development because of Seymour Cray and his super-computer company, remains a vital part of the IT/DP cluster in Wisconsin. This sub-cluster accounts for more than 6,600 jobs in Chippewa and Eau Claire counties. It is home to high-tech companies, such as Hutchinson Technologies, SGI, Celestica, W.L. Gore/3M, Honeywell/GE and others.

Another cutting edge is the advanced work being done in Biomedical Informatics, which is included in the emerging Biomedical Technology cluster.

Jobs in IT/DP are the better part of the 94,000 identified as high-tech by the Milken Study in 1999.

It is a cluster that is spread all over the state, less regional than others, and almost endemic to many other industries and clusters. Contrary to popular misconceptions, this cluster in Wisconsin is not a source of weakness, but a strength.

### **Machinery Manufacturing/Automation Cluster** **Old-Line Strength; New Opportunity**

The manufacture of machinery has long been a centerpiece of the Wisconsin economy. In one sense, machinery making is part of the overall manufacturing industry. But, to better understand our economy, it is separately delineated as the machinery manufacturing/automation cluster.

This cluster includes some 1300 firms and approximately 86,000 skilled workers.

This strength has been amplified in recent years by the marriage of metal working with information technology. Virtually all machines today are driven by computers and electronic controls, and those technologies are abundant in Wisconsin, especially the eastern side of the state.

Companies such as Rockwell Automation, Trane, Harley-Davidson, Giddings & Lewis and PCM in Green Bay are major players in the global machinery market. Universities and engineering schools in the state are attuned to this vital cluster and provide a steady flow of graduates to fill its skilled labor needs.

The long-term scarcity of labor in Wisconsin and global competition have been driving a need for ever-higher productivity in the factories. Hence there is a huge emphasis on automation to save labor. The term “lights out factory” is becoming a more compelling goal.

Furthermore, computer-driven machines in today’s factories are linked closely to the old supply-chain management disciplines, which are also computer driven. It is a marriage made in heaven for Wisconsin.

Whereas Silicon Valley is the center of software technology and Austin is the center of semiconductor technology, Wisconsin has every right and reason to claim itself as the mecca of machinery making. This includes tool and die design and manufacture, of which metro Milwaukee is a hub.

General-purpose machinery includes ventilation, heating, air conditioning, and commercial refrigeration manufacturers, metalworking machinery manufacturers, and engine, turbine, and power transmission equipment manufacturers, among others.

### **Manufacturing/Materials/Plastics Cluster** **Defies National Shift**

Wisconsin, particularly the east side of the state, has long been a dominant center of manufacturing of both durable and consumable goods. It continues to be one of the top states in the nation for percentage of workers employed in its manufacturing cluster at more than 20% of all workers. This defies a national shift away from manufacturing, despite a loss of 30,000 jobs in this cluster since a recession began in manufacturing 13 months ago.

Increasingly, this cluster is using “new economy” technology, systems and processes to turn out goods. In addition, the factories in Wisconsin increasingly are moving up the value-added ladder to produce more complex, higher quality products.

The assembly lines and businesses requiring low skills have been gravitating out of Wisconsin and the United States to low-cost manufacturing centers, often in third-world countries. The factories that are surviving and thriving are the ones that have added more technology in both processes and products.

Of Wisconsin’s 2.6 million workers, more than 574,000 are employed in the manufacturing cluster. In this paper, some of these activities are covered under other cluster groupings, such as machinery, printing and papermaking/forest products. Even with those taken out, manufacturing remains a dominating influence on the state’s economic topography.

The state is blessed with several world-class corporations in both the consumable and durable goods arenas. Companies like S.C. Johnson, Kohler and Johnson Controls lead the way in breaking into new global markets and higher value-added products. Other leaders are Trane, Mercury Marine, and Phillips Plastics, Bemis, General Motors, Daimler Chrysler and Delphi.

The state is a large supplier of consumer goods and components to OEM durable goods manufacturers, such as the auto and appliance industries located in other parts of the country.

High-pay manufacturing jobs of today require a high level of skills. More automated factories require digitally fluent technicians to run complicated machines and systems. Production workers earn almost \$39,000 per year, above the US average.

Compounding the need to automate and rapidly raise productivity to be competitive against low-cost manufacturing centers is the labor scarcity in Wisconsin. With an unemployment rate that is usually below 4%, there is no alternative but to either automate low-skill positions or move them to parts of the world where there is a labor abundance. This trend toward automation augers well for the Machinery Manufacturing/Automation Cluster.

Even modern methods, though, have failed to save commodity manufacturing from the onslaught of foreign competition. The machine tool industry has been particularly hard hit by imports from China and Canada.

Another requirement is advanced materials. Wisconsin is a leader in the production of plastic parts and products and in the development of hybrid materials, such as composites and plastic laminates, that allow for lighter, stronger, less expensive products.

### **Papermaking/Forest Products Cluster** **Number One in US**

Paper mills have dotted the banks of Wisconsin rivers for more than a century. The number one papermaking state, Wisconsin produces 4.9 million tons of paper and more than 1 million tons of paperboard. Overall, it is 11% of the US total.

The state's mills have provided 53,000 high quality jobs. Pay is 65% more than the state's average. Papermaking is about half of the overall cluster, which employs a total of 102,000 people. This cluster is the largest employer in 28 of the state's 72 counties.

Forest products companies include furniture, building materials, and windows and doors.

In this cluster, especially in papermaking, consolidation is rampant at the global level. This has resulted in the departure of corporate headquarters from the state. Ten paper companies headquarter here today, versus 13 in 1990. The plants will remain, because of the proximity to the forests of the Upper Midwest. But can headquarters and, just as importantly, the corporate research labs be retained?

Productivity increases in the paper cluster have been stunning. In 1980, it produced 121.5 tons per employee; in 1998, it produced 180.4 tons, almost a 50% jump. Part of this increase can be attributed to computerization of papermaking operations. Similar automation has sustained other wood-based companies, such as door and window manufacture.

This cluster suffered a major loss in the mid-1980s, when the headquarters of Kimberly-Clark were moved to Texas. This was due in part to the view by CEOs, including Darwin Smith of K-C, that Wisconsin's business climate was hostile to corporations. Much has improved on that score, as shown in more recent surveys of CEOs.

Also in the mid-1980s, the state lost the Institute of Paper Chemistry, an Appleton research organization that granted PhDs, to Georgia, the same state to which K-C had shifted major operations. Clusters, to be thriving, depend on research labs, so the loss was severe. The industry is supported by a 4-year degree in the field at UW-Stevens Point.

A wide range of companies in both goods and services supports this cluster. Consulting firms in the Business Services Cluster, for instance, have substantial offices in the state to serve papermaking.

### **Printing Cluster** **High Concentration; Solid Growth; Revolutionary Technology**

This Printing Cluster, though one of the oldest and most mature in Wisconsin, continues to offer solid growth in a high paying industry. The cluster is being revolutionized by new digital technologies.

Hourly rates for operators of multi-million presses, which are driven by several computer systems, exceed \$20 an hour. The same is true for experts in the pre-press part of the business.

Over 44,000 people work in more than 1,200 firms across the state. Employment increased by more than 20% from 1990. Total shipments in this cluster in 1999 were more than \$6 billion, placing Wisconsin 8<sup>th</sup> among the 50 states and one of the top for percentage of a state's total workers.

The industry has a high technology component; it relies heavily on information technology and telecommunications. Digital graphic files now move freely all over the globe via intranets and the Internet. The industry has been an early adopter of web-based business systems. As a result of rapid technology advances, old job classifications are disappearing, and new ones, such as "cybrarian," are being created.

Many firms in the state support the printers, such as manufacturers of inks, films, plates and printing machinery, as well as a host of providers of various services. Substrates from paper to plastics are often sourced from Wisconsin vendors.

# Outline of Critical Success Factors

## Nine Difference Makers

These nine factors are more critical than others for the success of the dynamic clusters that drive an economy. (Appendix 1 is a more detailed description and evaluation of each factor.)

### **1. Availability of Start-Up Capital**

Relative to neighbors in the Midwest and nationally, Wisconsin does not receive a high amount of venture capital funding. In at least two recent reports (see Appendix 1), six Midwestern states together received less than 5% of the total U.S. venture capital lending, with Minnesota and Illinois getting the lion's share. Concerning IPO funds, a recent report (June 2000) by the Technology Administration, *State Science and Technology Indicators*, ranked Wisconsin 34th in IPO funds raised from 1997-1999. In terms of Small Business Investment Company awards, the same report also ranked Wisconsin 22<sup>nd</sup>. From 1996-1998, Wisconsin averaged \$39 million per year in venture funds. Since the Wisconsin Economic Summit last year, early stage angel investing has taken off, with six groups in various stages of launch. Several have made their first investment.

### **2. Research & Development Capabilities**

This factor represents the amount of R&D funding, public and private, provided in a given state or region per year. The paper brings together Wisconsin and its neighbors (IL, IA, MN, IN, and MI) and generated a series of benchmark comparisons from NSF data (see Appendix 1). In brief, Wisconsin ranks higher on a per capita basis in only one category: Academic R&D. A close second, however, is Industry R&D, in which Wisconsin ranks 19th in the US. Compared to Wisconsin's Gross State Product (GSP) ranking for the same year, 19, it should also be considered a strong sector of Wisconsin's R&D funding. UW-Madison is a research powerhouse with annual grants approaching \$400 million. Meanwhile, the Medical College of Wisconsin has grown its research grants to \$100 million.

### **3. Availability of Skilled Labor**

This factor is defined as the number and quality of educated workers in a given state or region. From a variety of data sources, a series of benchmark comparisons were generated between Wisconsin, its neighbors, and the US. In terms of secondary education, Wisconsin scores well nationally: 88% of its residents have a high-school diploma or equivalent, compared to 82.8% nationally. In terms of post-secondary education, however, Wisconsin fares worse: 22.3% of its citizens have BA degrees, compared to 24.4% nationally. Wisconsin ranks 13th in Science and Engineering degrees awarded, thereby outperforming both its population size and GSP rankings. It also meets or outperforms in terms of graduate and post-doctorate students in Ph.D. granting institutions. This, by and large, reflects Wisconsin's strong public and private universities. Wisconsin scores near the top in the K-12 sector on most standardized tests, including SAT and ACT scores.

#### **4. Training/Education Infrastructure**

This factor measures the state of Wisconsin's public and private institutions of higher learning. In terms of total institutions of higher learning, Wisconsin, with 66 colleges and universities, is more tilted toward larger, state-supported campuses ranks than other states. Per capita investment in education, including higher education, ranks very high. Wisconsin scores fairly well in terms of student-faculty ratios by being at or near national ratios for public 2-year and private 4-year institutions. The average pay for full-time faculty in both public and private schools is \$49,325, with the former (\$50,747) paying substantially more than the latter (\$43,320). Wisconsin is about on par with the national average for public institutions (\$50,303) and falls short for private by almost \$9,000 (\$52,112). Wisconsin ranks high for investment per capita in K-12 and higher education. Its system of 16 technical colleges is responsive and highly regarded.

#### **5. Energy, Transportation, and Information Infrastructure**

Wisconsin's industrial and commercial electricity rates are better than its neighbors, although residential rates are higher. Natural gas prices in Wisconsin are at the median of its neighbors and lower than the US generally. Economic growth has led to an increasing demand for power in Wisconsin. Many of our power plants are old and must be updated or replaced. Further, Wisconsin has limited capability to import electricity into the state because of inadequate high power transmission lines. Natural gas reserves are located in lands that are not open to exploration. Additionally, almost every new power plant that has been proposed uses natural gas for its fuel. With rising gas prices, that is not a good omen. In terms of transportation, the physical condition of Wisconsin's highways has declined since 1995. Roadways are the most significant aspect of Wisconsin's transportation infrastructure because of the predominance of motor freight transportation in the state (see Appendix 1). In terms of zip codes with high-speed bandwidth, Wisconsin (55%) underperforms the US (59%) as well as Indiana (63%), Michigan (68%) and Minnesota (58%). In terms of high-speed lines in each state, Wisconsin's performance also drops. State government has been ahead of the curve in adopting standards and "wiring" its operations.

#### **6. Presence of Market-Leading Companies**

The presence of market leading firms is important because industrial clusters often form around large magnet or anchor firms (e.g., consider Microsoft's role in the Redmond/Seattle area or Dell's role in Austin). Wisconsin ranks fourth in total industries with more than 500 employees in the Midwest region. Two industries comprise the largest share of market-leading companies: Manufacturing (56%) and Health Care & Social Assistance (21%). In terms of Inc. 500 companies residing in-state in 1999, Wisconsin ranks 26th, with 7 establishments. In terms of the Deloitte & Touche Technology rankings of companies residing in-state in 1999, Wisconsin ranks 31st, with 1 firm. In this, it outperforms only Indiana (0 firms). Illinois was ranked 26th (4 firms), Iowa 27th (1 firm), Michigan 32nd (1 firm), and Minnesota 13th (13 firms).

#### **7. Entrepreneurial Climate**

This factor brings together an array of data on the incentives offered to small-businesses and inventors as well as on the actual entrepreneurial activity in-state. The Appendix describes the specific rankings in more details, but a summary overview suggests Wisconsin meets or exceeds national averages on the indicators identified from recent data. For example, in terms of business

incubators, Wisconsin ranks first in the nation. Wisconsin ranks 18th in patents issued from 1996-1998, with an annual total of 1,643. In terms of establishment births, Wisconsin ranks 29th, with 626 technology establishment births. (Wisconsin had 11,597 births in all industries and sectors.) Only a few entrepreneurial or technology transfer networks exist in the state.

## **8. Business Climate**

This section includes such factors as business creations, manufacturing jobs as a percentage of employment, and Internet registrations (see Appendix 1), although several indicators of business climate have been indirectly addressed under some of the other success factors (e.g., R&D, Availability of Start-Up Capital, Infrastructure, Entrepreneurial Climate). Across these dimensions, it is evident that Wisconsin has many strong points (university and tech college system, energy costs, manufacturing base, availability of graduate and post-doc workers, qualified high-school graduates, and academic R&D). However, it must address its critical economic weaknesses (brain drain, low faculty salaries, lack of venture and seed capital, lower-than-average per capita income, low export share, lagging transportation and communication infrastructures, and high personal tax rankings) if it is to secure and augment the success it has enjoyed in the last ten years.

## **9. Quality of Life**

Competitive Wisconsin, Inc., in its 1999 report *Measuring Success*, has identified a number of factors that contribute to the quality of life in Wisconsin, and in all but one Wisconsin is performing well in relation to national and regional benchmarks. These include its low rate of uninsured citizens, low levels of violent crime, its recreational appeal, low poverty rates, high home ownership rates, and other dimensions. The data suggest that Wisconsin has a high quality of life in general, and that it must address two major factors in order to increase worker retention and to attract more residents: increase its per capita income and increase national awareness of the many positive qualities Wisconsin can offer its citizens.

# **Analysis of Clusters** **What's Working, What Isn't**

## **Agricultural Business/Food Processing** **Evaluation vs. Critical Success Factors**

This cluster, much broader than the state's vaunted milk and cheese production, depends heavily upon technological advances developed in our university system. It also is dependent on an excellent network of primary and secondary farm-to-market roads, since the product is bulky and involves major logistics.

The availability of labor, including skilled labor, is just as large an issue for this cluster as it is for the other dynamic growth clusters in the state's economy. The shortage of labor requires farms to automate even beyond the high levels of productivity already achieved. This requirement lends itself greatly to a synergy with the Machinery Manufacturing/Automation Cluster.

The loss of three small dairy farms a day in Wisconsin points to the need for a new business model with larger herds and more automation.

Another challenge for the agricultural economy in the state is the disappearance of good farmland to urban sprawl. The new "smart growth" law in the state will help municipalities to stem that process and preserve choice lands for essential farm purposes. The development of a system of PDRs (Purchase of Development Rights) by municipalities, with state and federal help, is a major necessity if farmlands are going to be reserved for their original purpose. This would make it possible for young farmers to purchase and operate farms without paying prohibitive prices for land and property taxes.

Young farmers have a pressing need for capital to enter the field, since land and equipment costs have both risen sharply. Purchase of PDRs would fill part of that gap.

A difficult issue for farmers is the inheritance taxes on passing of the family farm from one generation to the next. That issue needs to be resolved at the federal level, since Wisconsin moved more than a decade ago to eliminate the negative effect of state death taxes.

The state is blessed with market-leading companies in food processing.

### **Recommendations**

- Stand up for farming in Wisconsin by passing "Right to Farm" laws.
- Continue to develop the life sciences that benefit this cluster through university research.
- Speed up implementation of the "smart growth" law from ten years to five years, complete with a program of PDRs for choice farmlands.
- Create agricultural zoning for prime lands.
- Fix the inequities in the federal milk pricing system.
- Continue to invest in our primary and secondary road systems at the state and local level, so products can get from the farm to the factory and from the factory to store.
- Push for the elimination of federal inheritance taxes on small businesses and farms.
- Educate non-farmers on the need for a vibrant farm economy.

## **Biomedical Technology/Informatics**

### **Evaluation vs. Critical Success Factors**

Some of the more important critical success factors for nurturing this cluster are a steady flow of skilled graduates coming out of the state's colleges and universities; reasonable environmental regulations; pure water; reliable sewage facilities; and reliable power sources since power outages, even short term ones, adversely affect living micro-organisms.

Because this cluster employs a high percentage of women, quality of life issues, like the quality of K-12 schools, looms large as a retention and attraction issue.

Readily available seed and venture capital are crucial, since many of the start-ups spring from the research labs as pure concepts at the outset.

Entrepreneurial studies and mentoring via networks of experts on business and technical issues are also part of the necessary mix.

Wisconsin has moved on several fronts to propel this cluster, not the least of which was BioStar. Other key elements are the existence of three research parks, the University Research Park at Madison, the site of more than 80 biotech companies, and the Milwaukee County Research Park near MCW and the Stout Technology Park at UW-Stout. Each is home to a business incubator that gives young enterprises and big leg up.

The new Mason Wells Biomedical Fund, targeted at \$75 million, is a plus for this cluster, as is the new CAPCO source of venture funding. An angel group for biotech deals has been formed in Madison, another big step forward, and a new angels group in Milwaukee, called Silicon Pastures, is also entertaining biotech deals. Funds from the State of Wisconsin Investment Board have been committed to venture, and Venture Investors of Wisconsin has become a player.

Technology business initiatives have been proposed around the state in such places as LaCrosse, Marshfield, the Chippewa Valley and the Chequamegon Bay area.

It is essential to keep heavy-hitters, like GE Medical, headquartered and operating in the state. That will depend, in part, on the general business climate in the state and its quality of life.

TechStar has recently been funded by the state at \$1.5 million to encourage more technology transfer from the higher education institutions in the Milwaukee Metro area. Some of the transfer will be in the biotech arena.

Research collaborations and partnerships for technology transfer, patent and licensing interactions are critical. So are linkages and cooperation between leading research institutions, such as the newly developing ties between the Medical College of Wisconsin and the UW-Madison Medical School.

### **Recommendations**

- Follow through on BioStar.
- Find state and private support for initiatives in the state that will stimulate new knowledge-based businesses.
- Consider a state tax credit of 5% of R&D spending, similar to what Texas enacted in 1999.

- Establish Biomedical Informatics as a specialty for Wisconsin; advanced degrees are already being offered in the field. Emphasize initiatives in the areas of opto-electronics, software development and computer component manufacturing.
- Keep environmental regulations scientifically based and rational, despite emotional reactions in other parts of the world.
- Increase prudent portions of public and private pension funds flowing into the venture funds serving the state.
- Promote more angel groups across the state so a network of seed capitalists is readily available for biotech concepts that can be commercialized.
- Expand collaboration between companies in cluster and major universities, both in research and education.
- Increase the flow of IT graduates in all colleges and universities in the state.
- Increase the flow of seed and venture funds to start-ups in this cluster.
- Improve the business climate with single sales tax factor and further lowering personal income taxes.
- Fund and implement TechStar and other collaborations to increase technology transfer in this arena.

## **Business Services/Supply-Chain Management**

### **Evaluation vs. Critical Success Factors**

The critical success factors for this cluster start with the availability of skilled labor, since it is largely a knowledge industry. Because of its rapid growth, this is one cluster that has helped to reverse our brain drain of graduates from our colleges and universities. The skills required often include a professional degree or certification beyond a bachelor's degree. It requires high levels of expertise in the various service niches, such as accounting, law, marketing, advertising, inventory control, scheduling, and logistics management. Supply-chain management, for example, uses sophisticated IT and statistical disciplines to link production processes from raw materials through to retailing.

The removal of the property tax from computers in the late 1990s was a boon for this cluster.

Since many of these firms operate on a national or international basis, another boon would be a move toward the single sales factor in apportioning corporate income taxes.

The high quality of life in Wisconsin is a plus for recruiting and retaining the experts needed by the businesses in this cluster. A negative has always been the high personal income tax rates in the state. Highly paid professionals in this cluster can work anywhere.

There is a critical mass of firms across the state, with the biggest concentration in the Milwaukee metro area. The availability of multiple employers in a field helps in recruiting and retention.

### **Recommendations**

- Increase the depth and variety of IT, logistics, and telecommunications offerings at the two-year, four-year and graduate levels at all Wisconsin colleges and universities.
- Improve the business climate by moving to the single sales factor on corporate income taxes.
- Develop a university center for supply-chain management.
- Get out of the top 10 tax states by further lowering personal income taxes.

## **Finance/Insurance**

### **Evaluation vs. Critical Success Factors**

The finance/insurance cluster is subject to heavy regulatory activity on the state and federal levels. Therefore, it must be expertly and reasonably monitored if it is to prosper.

Labor scarcity exacerbates the requirement to automate and out-source in this cluster.

High paid money managers have the option to go anywhere. This fact of life puts a high premium on the quality of life and a good business climate.

This cluster is heavily dependent on information systems and, therefore, suffers from a shortage of digitally fluent graduates from the state's colleges and universities. Positive examples are UW-Milwaukee, UW-Eau Claire and UW-Whitewater, noted for their strong programs in the areas of accounting, finance and taxation.

National and international in nature, this cluster is dependent on efficient air travel.

### **Recommendations**

- Continue to offer reasonable regulation at the state level. For example, combined reporting of corporate income could have a negative effect.
- Provide an increased flow of IT graduates from the state's educational institutions.
- Make sure the state is positioned on the leading edge of bandwidth development and Internet connectivity.
- Get out of the top 10 tax states by further lowering personal income taxes.
- Continue support of finance, accounting and taxation programs at leading state universities.
- Continue to improve Wisconsin airports to support this cluster, which is thoroughly national and international. Keep and attract airline hubs.

## **Health Care**

### **Evaluation vs. Critical Success Factors**

One of the screaming needs in this sector is the continuing supply of skilled labor. Technicians in radiology and medical records are always in demand, as are nursing positions. Because these jobs are all higher-than-average pay, it makes great sense for our educational institutions to ramp up their program offerings in these disciplines.

Seamless education is a requirement for this cluster. Students should be able to move from a two-year technical college program into a four-year degree program with little friction. The credits should transfer. Great progress has been made in this state on articulation agreements between the two-year and four-year colleges and universities; more agreements need to be put in place.

Increasing costs of health care are a problem for this cluster, and every other sector of the Wisconsin economy. Therefore, initiatives to better manage the health care industry are critically necessary. Such advances as the development of medical informatics to deliver more information to doctors at the point of care could greatly increase the efficiency of the system. The same is true of better handling of pharmaceutical histories and treatments of patients.

Cutting down on medical errors from both pharmaceuticals and medical treatment needs to be a prime objective that is addressed within this cluster. Not only would that eliminate maltreatment of patients, it would also cut costs for remediating treatments where errors were made in the first instance.

This cluster interacts greatly with the Biomedical Technology cluster. Some of the research is conducted in local hospitals, and then the results of the research are taken into the health care cluster as better treatments, practices and therapies.

This cluster is also heavily dependent on Information Technology, so the strategies for the IT/DP cluster also apply here.

### **Recommendations**

- Ramp up the educational offerings for technical positions in health care.
- Launch a state-wide, “black-belt” quality initiative to reduce medical errors.
- Market the state’s leading health care providers as centers of excellence for out-of-state patients, touting in particular the state’s two medical colleges as alternatives to more famous centers like the Mayo Clinic.
- Tightly link the health care cluster to the advancements being made in the Biomedical Technology/Informatics cluster.
- Lead the nation in developing new models for reducing costs and increasing access in the delivery of health care, such as with Badger Care.

## **Information Technology/Data Processing**

### **Evaluation vs. Critical Success Factors**

Wisconsin is well fortified in the IT/DP area by being well-wired. Bandwidth is adequate, led by state government and its BadgerNet between state agencies and schools at all levels.

An example of the importance of bandwidth infrastructure can be seen in Pewaukee, where Ameritech installed a full grid of fiber optic cables for its DP center. They were soon followed by another large DP operation, including those of Blue Cross Blue Shield, Provantage and Wisconsin Energy.

Even with the economic downturn and the bursting of the dot.com bubble, there are still many open positions in this cluster. Despite a step-up in offerings from technical colleges and 4-year colleges and universities, the number of IT programs remains insufficient to supply the needs of this cluster.

A move in the right direction on the supply side was the creation of more than fifty 2-plus-2 “articulated” IT/DP degree programs between the state’s 16 technical colleges and its 4-year public universities.

Another was the establishment of apprentice-like network technician programs for juniors and seniors at high schools under the auspices of the Cisco Academy. Imagine what a boost it would be for the IT/DP cluster if every high school in the state opened up that option. Just fifteen per high school per year would send out an array each year of more than 5,000 18-year-olds with basic computer proficiency on their portfolios, making them well positioned to move up the IT ladders in school or work.

A positive example is the In Roads program in Milwaukee for 250 high school juniors and seniors who are headed to UWM for computer degrees.

Except for friends and family, seed capital remains scarce for IT start-ups. Venture capital for the next stage is improving, but not abundant. One new angel group specifically for IT ventures has been created in Madison.

The launch of an E-Commerce consortium in Madison was a positive, as was the start-up of two master's degrees in E-Commerce in Milwaukee.

The IT/DP business climate was improved substantially in the late 1990s when the state lifted the property tax from business computers. While the state lacks a Dell, Intel or Cisco, it does have a base of dynamic IT companies, such as Hutchinson Technologies and W.L. Gore/3M in Eau Claire. They need to be prized and retained.

IT/DP companies are very mobile, since they have few fixed assets and can operate in almost any connected area. Therefore, the general business climate and quality of life must be competitive with other states and other countries. High personal taxes remain a challenge.

### **Recommendations**

- Charge every technical college, college, university and graduate school, public or private, with increasing the flow of IT/DP graduates. Availability of skilled labor drives location decisions in this arena.
- Increase IT seed and venture funding, ala the new IT Angels investing group in Madison.
- Establish an IT apprenticeship program in every high school in the state. Business must create apprentice and intern slots in large numbers.
- Get out of the top 10 tax states by further lowering personal income taxes.

## **Machinery Manufacturing/Automation**

### **Evaluation vs. Critical Success Factors**

This cluster is dependent on a steady flow of highly skilled graduates from our engineering schools and technical colleges. At the two-year level, manufacturing technology centers are being established to help students and companies adopt leading-edge methods.

The state has helped to fund such a center at Chippewa Valley Technical College, and another is in the works in the Racine-Kenosha area.

One good example of what needs to happen in Wisconsin is the new Applied Manufacturing Technology Center being erected by Moraine Park Technical College in West Bend. This 42,000 sq. ft. facility will attract up to 5000 students and participants in classes and seminars each year. They will learn the latest software and hardware advancements necessary to drive the machinery industry. That includes advanced tool and die and CNC machining. It also will include all the other disciplines necessary for modern manufacturing, such as quality engineering and management; supply-chain management, which includes scheduling and inventory control; lean manufacturing; and automation technology.

The West Bend facility is a pilot for similar applied manufacturing centers to be built at the other 15 technical colleges in the state.

The presence of leading-edge companies in this field helps create a dynamic mix of players that will keep Wisconsin at the forefront of the machinery world.

Other important success factors for this cluster are reliable, competitively-priced energy sources; ample bandwidth for the movement of CAD files and other data between suppliers and customers; and an entrepreneurial climate that encourages new companies in this field with an ample supply of seed and venture capital to get them going. Good examples of such start-ups are Gruber Tool & Die in West Bend, which has grown to 85 highly paid employees over the last 10 years, or MGD, a Menomonee Falls firm that has had even faster growth in the same field.

### **Recommendations**

- To fill skilled labor shortages in tool and die and other manufacturing disciplines, follow through on establishing manufacturing/automation centers at two-year colleges.
- Develop regional technology centers, such as TechStar, as a way of spreading machinery and automation disciplines from engineering research labs into the commercial world.
- Build up the network of angel groups in the state and venture capital funds to help launch start-ups.
- Increase supply of IT graduates at two- and four-year colleges and universities.

## **Manufacturing/Materials/Plastics**

### **Evaluation vs. Critical Success Factors**

The formula for successful factories in Wisconsin today is what could be called “the high road”—high value-added product; high productivity; high quality; high levels of just-in-time delivery; high use of technology, processes and systems—which requires high levels of investment in machinery and high levels of investment in education and training of workers to handle those complex operations. In turn, this allows higher levels of pay for the technicians driving the system and the general high standard of living and quality of life in the state. There is no “low road” strategy left in the manufacturing arena.

Scarcity of labor looms as the largest long-term threat to growth of manufacturing in Wisconsin. Indeed, it already is a constraint on some businesses, which have chosen to locate elsewhere to tap into available labor. Prior to the down-turn, of the openings in Wisconsin in this cluster, more than two-thirds are for skilled positions at higher levels of pay. There continues to be a mismatch between the unskilled parts of the population that lacks the skills for high-end manufacturing and the jobs that would be available to them if they had the requisite education and training.

While the state’s engineering and business schools do a good job training a flow of graduates for the manufacturing world, there is no preeminent institution clearly devoted to manufacturing disciplines.

A new applied manufacturing technology center being built as a part of the Moraine Park Technical College in West Bend is an example at the two-year level of what could be established at the four-year and graduate level at a university in the state. Such centers can offer disciplines, such as production and inventory control, supply-chain management and logistics, machine tool and die, program management, manufacturing accounting, as well as human resource management systems necessary for a team-oriented manufacturing environment.

Start-up and venture capital levels for manufacturing breakthroughs are available, but are not in abundant supply in the state.

A critical success factor for this cluster is reliable energy at competitive prices. An energy gap looms if new generation plants and transmission lines are not brought on line.

Wisconsin has been blessed with an entrepreneurial climate in the manufacturing sector ever since the late 1800s, and that entrepreneurial climate still exists. This accounts for the concentration of manufacturing in the job base today. Many of the start-ups occurring in the state deal with systems, processes and controls that support the state's manufacturing sector.

The state's manufacturing cluster was given a boost in the mid-1970s, when the Legislature approved removal of manufacturing machinery and equipment from the property tax base and computers in the mid-1990s.

While the general business climate for manufacturing is excellent in Wisconsin, there are several impediments, such as the failure of the state to align itself with other states on the single sales factor way of apportioning income taxes and the persistent position in the top five states for personal income tax.

Critical mass exists in Wisconsin in the manufacturing arena. The state must capitalize on that by continuing to push research and training that stimulates support for this cluster.

### **Recommendations**

- Push the marriage of "new economy" technologies within the manufacturing sector to compete with low-cost manufacturing centers in third-world countries. Manufacturing research centers at colleges and universities, such as MSOE, UW-Madison's School of Engineering, UW-Platteville and UW-Stout, need to raise their profiles as institutions where state firms can go for technological help.
- Stimulate technology transfer and start-ups at the intersection of manufacturing, information technology and materials development.
- Get out of the top 10 tax states by further lowering personal income taxes and adopt a single sales factor formula for apportioning corporate income tax.
- Continue to develop the state's education and training infrastructure, so that every adult in the state can become an employable worker.
- Take the necessary steps to assure a supply of reliable, competitively priced energy. One of the more obvious moves is a transmission line to the northwest to tap into the generation plants that rely on the hydro power and coal fields to the west. New generation plants are needed in the state to replace the near-archaic and heavy-polluting existing plants.

### **Papermaking/Forest Products**

#### **Evaluation vs. Critical Success Factors**

This cluster depends heavily on good roads and rail systems, as well as on a reliable supply of competitively priced energy. Like other dynamic clusters, it depends on an ample supply of skilled labor. The papermaking industry is increasingly automated and controlled via information technology, so a strong pool of digitally fluent workers is a major need.

The general business climate continually needs to be toned up to avoid the set-backs of the mid-1980s.

The paper cluster needs a paradigm shift to collaborative regulation of the environment, rather than the command-and-control approach so favored today by regulatory bodies. The synergism of the joint efforts to develop technology to improve and eliminate waste streams is there to be exploited, if such a philosophical sea change can take place. Command-and-control achieves only minimum standards; collaboration can go much farther.

Capital investments in mills are huge, so investment of angel and venture funds often do not come into play. However, start-ups do occur in smaller operations supporting the major players.

### **Recommendations**

- Add power-generating plants and transmission lines to stabilize and increase Wisconsin's energy supply.
- Universities and colleges must continue to graduate skilled workers, especially in papermaking disciplines and IT.
- A research center in the technologies of papermaking should be re-established at a major university in the state. A paper chemistry institute belongs here.
- Collaborative approaches to improving the environment between business, regulators and researchers need to replace command-and-control methods.
- Improve business climate by further lowering personal income taxes to get out of the top 10 tax states.
- Develop a university center for supply-chain management.
- To move this cluster's bulky products, continue state's heavy investment in its road and rail infrastructure.

## **Printing**

### **Evaluation vs. Critical Success Factors**

Capital is readily available for the printing industry, largely because printing presses and related equipment are solid assets that are easily leased or financed conventionally. However, venture and seed capital for technological innovations is in short supply, as in other clusters in the state.

Most printing innovations are coming from other countries, such as Israel in digital printing, or Germany and Japan for high technology presses. In the flexographic printing sector, machinery is made in Wisconsin, such as at PCM in Green Bay. That should be the model.

Part of the deficiency in the development of leading edge technologies for this cluster can be traced to the absence of any university or research facility that focuses in printing advancements. Quad-Tech, a division of QuadGraphics, does high level engineering to enhance its presses and bindery equipment, and that accounts in no small measure for its domination of the magazine printing sector. But Quad is an exception to the general pattern.

The Rochester Institute of Technology in New York would be an example of a research university that has specialized in serving printers. The question arises as to why there is not a competing institution in Wisconsin.

Because of its relatively high wages, the printing industry historically has not had a problem finding skilled labor. Today, though, printers are struggling to find enough skilled and even unskilled people. Entry-level wages have risen to more than \$8 an hour for unskilled and more than \$10 to \$12 an hour for beginning operators.

A bright spot in the support of this important cluster has been the 2+2+2 response of the Wisconsin Technical College System and the Universities of Wisconsin at Stout and Platteville. Seven of the state's 16 technical colleges have established two-year degrees in printing and publishing disciplines. And all seven have established 2-plus-2 programs with Stout or Platteville in which the two years of technical college credits count fully toward four-year Bachelor of Science degrees in graphics and communication technology management.

A recent marriage of programs at Waukesha County Technical College and UW-Stout in a new WCTC printing institute is a prime example of responsive educators moving decisively to fill a glaring need in a dynamic arena.

Another very positive move in the same direction is the proposal for the new Milwaukee Tech High School for a printing concentration, which would be linked to tech colleges.

These programs and linkages are a strong example of what an education infrastructure ought to look like for supporting a key cluster. Over time, they should prove an attraction for printers looking for new locations. The availability of skilled labor is the number one determinant in relocation decisions, according to a recent survey by Forward Wisconsin.

The business climate for printers has improved dramatically over the last two decades. Changes in nexus rules for inventory and the removal of the property tax from equipment and computers helped to make this cluster more competitive. Lowering personal income taxes also has helped in retention and recruiting. Yet Wisconsin remains in the top ten states for total taxes.

Though the DNR has become more approachable, regulatory issues remain an inhibitor of printing profitability and expansion. For example, every plant, bucket of ink and piece of equipment is heavily regulated in a three-tier command and control system. Southeastern Wisconsin is especially constrained, because it has been designated as a severe non-attainment area for air emissions. Plant expansions, therefore, have gone elsewhere. Collaborative approaches to controlling emissions would work better.

### **Recommendations**

- Establish a research facility at one of the state's public universities to take a lead in new printing technologies.
- Make more "angel" and venture capital available for entrepreneurs in this cluster.
- Move to collaborative regulation of emissions instead of the outmoded command and control approach. Establish one tier of regulations on printing plants instead of three.
- Get out of the top 10 tax states by further lowering personal income taxes.

## **Broad Recommendations for Wisconsin**

Based on our analysis of the individual clusters and the critical success factors that are present or absent, a number of recommendations have emerged from experts around the state. Some of these recommendations are specific to individual clusters; others rise to the level of general policy for the whole state. This last chapter of the paper deals with the broad recommendations that need to be implemented on a statewide basis.

- **Emphasize Education, Training**—As recommended by the Jobs 2000 Commission for Wisconsin several years ago, education and training have long been a competitive advantage for Wisconsin. Heavy investment in our schools at all levels and by private industry will continue to give Wisconsin a competitive advantage in a knowledge-based economy. As the leading economic developer for Austin, Texas said, “You supply the skilled work force and the jobs come.” In other words, “building the field” for the new economy means building the education and training infrastructure.
- **Collaborate to Stem “Brain Drain”**—In one sense, Wisconsin does not have a problem on the supply side of bringing college graduates to the marketplace. Our “brain drain” robs us of one out of ten of our graduates. Our economy pulls in enough skilled workers from other states to reduce the net loss to one out of four graduates. Wisconsin has a problem on the demand side. We need to heat up our economy so that our best and brightest graduates will want to stay, rather than emigrate to more dynamic business centers of the country and the world. That means all sectors of society, particularly our universities and colleges, must mutually engage in collaborative partnerships to build the new economy for the state. Collaboration between business, labor, government and education is an absolute requirement to make clusters work dynamically.
- **Expand Internships, Apprenticeships**—One of the best ways to educate young people and to retain them for our state is to offer them the opportunity for a work experience in a real job while going to school. Business employers, as well as public sector employers, must do a much better job of opening internships and apprenticeships to high school, college and graduate students. The movement to increase school-to-work experiences accelerated in Wisconsin about ten years ago, but it needs to go even faster. Businesses and public employers must step up to the plate in greater numbers on this score. A state tax credit for employers who take in students should be adopted.
- **Increase IT Graduates**—In one particular part of the New Economy, there has been a seriously short supply of skilled labor, namely IT graduates and workers, in the state. Every educational institution in the state, including all 66 centers of higher education, must realign and redeploy their assets to make sure that their graduates are digitally fluent. Every young person, no matter what cluster they are headed for in their careers, must be proficient with computers. This is not to downplay the importance of general, liberal arts education; it is to say that general and technical education must go hand-in-hand.

- **Expand Power Generation, Transmission**—The energy infrastructure of the state is somewhat in limbo between the old regulated models and the new deregulated world. The result is that Wisconsin is in danger of being caught short of energy within two years. Many of the clusters in Wisconsin depend upon a reliable, cost-effective supply of electrical power. Some plants in Wisconsin are more than a half century old. The licenses on our two nuclear power plants run out within the decade and may not be replaced. The government of the state, including the Public Service Commission, must make timely decisions in the near term to guarantee that new generation plants are built in Wisconsin and that new transmission lines are opened up, particularly a new transmission line from central Wisconsin to Minnesota to tap cheaper sources of hydro and coal power in the northwest. It should be noted that the new plants have much lower levels of pollution than some of the out-moded plants in use today.
- **Stay Ahead on Bandwidth**—In terms of digital bandwidth, the state is in relatively good shape. But it is at best on a par with its neighbors. Experts in the field believe that Wisconsin is not at a competitive disadvantage for bandwidth, but the requirement for big pipelines for digital data continuously needs to be monitored and addressed to make sure we stay on at least a level playing field. A good example of proactive management has been accomplished by the State of Wisconsin in setting up BadgerNet, making it one of the most advanced states for IT standards and protocol.
- **Invest in Highways**—The highway system in Wisconsin is increasingly challenged. In some ratings, we are falling behind our neighboring states in terms of highway repair. The I-94 system coming into Milwaukee is particularly congested and in need of upgrade. The majority of the state's commercial traffic goes through the Milwaukee system on its way to national and international markets. Continued investment in the state's highway system, with both federal and state funds, is a necessity for many of our ten dynamic clusters. Wisconsin is a manufacturing intensive state, and many of the products it moves to market are bulky and heavy and, therefore, require a modern highway system.
- **Air Transportation Vital**—Most of our clusters are thoroughly global in nature. Therefore, they require an efficient air transportation system. All Wisconsin's airports must be continually upgraded. The regional airports in the state are crucial for moving product in the just-in-time manufacturing world and must be upgraded to allow direct, fast, just-in-time delivery. We must attract and retain the hubs of major airlines.
- **More Angel, Venture Capital**—Many of the clusters require attention from venture capitalists and angel investors. Wisconsin has always seriously lagged in funding to get new businesses up and running. The state has been improving on that score in the last decade, especially in the last few years. The new angel groups that have started up in several parts of the state need to be replicated in every major population center of the state, so that all the clusters can be served with capital for entrepreneurs. The angel groups across the state then need to be stitched into a network, so they can cross-invest and cross-pollinate deals. The growing venture capital funds in the state need to work with each other and the angels to grow new companies. If you look closely at Wisconsin's economy, many of our most dynamic firms have been the result of start-ups in the last couple decades. Examples are QuadGraphics, Phillips Plastics, Marquette Electronics, GE Medical Systems, KI, MGIC, Metavante, Anchor Foods, Fiserv, Strong Funds, American Medical Systems and Schneider Logistics. In short, many of the leading companies in our state have grown up here. Conversely, Wisconsin has never been very successful attracting large, greenfield operations. We need to grow our own.

One of the best sources of venture funds is the public and private pension pools in the state, which often can put a small, prudent portion of their portfolios into venture. Successful business people who have cashed out of their companies need to be encouraged across the state to become angels. This activity could be encouraged by universities or chambers of commerce within clusters across the state. Also, east and west coast venture capitalists need to be encouraged to set up offices in Milwaukee or Madison.

- **More Research Facilities**—Wisconsin is blessed with a high level of academic research, largely at the University of Wisconsin-Madison. The University of Wisconsin-Milwaukee, the Medical College of Wisconsin and the Marshfield Clinic are emerging as major research players. However, the state suffers from the absence of any large federal research facility. Landing such a facility should be a major goal of our congressional delegation. On the state level, the research gap can be partly filled by additional state facilities in applied research to serve specific clusters. The new Applied Manufacturing Technology Center in West Bend is a prime example. Such applied technology centers need to be extended to the other 15 technical colleges across the state to serve the clusters in their regions. There also is a need for focused, dynamic research centers at the university level in some of the clusters, such as printing, papermaking, machinery manufacturing and materials production.
- **Accelerate Technology Transfer, Collaboration**—Technology transfer has been picking up in Wisconsin, particularly at UW-Madison with the help of WARF. The new WiSys, an extension of WARF, is a very positive move for the state. Other technology transfer collaborations, such as TechStar in southeastern Wisconsin, need to be developed and encouraged. The Medical College of Wisconsin, now the third largest medical school in the country, has stuck with the leadership in its areas of expertise in biotechnology, informatics and medical devices. Partnerships and collaborations with market-leading companies, such as GE Medical Systems, Schneider Logistics, or Rockwell Automation, must be expanded to ensure the success of the ten clusters that are the drivers of our economy. The 20 industry consortia for research are another model that needs expansion.
- **Entrepreneurial Networks Needed**—Wisconsin was a hotbed of entrepreneurial activity in the late 1800s and early 1900s. That resulted in the creation of a strong economy, which withstood most of the down cycles that more severely affected other parts of the nation's economy. Perhaps because of that success, entrepreneurial activity was less needed and, therefore, less promoted in the state during the middle 1900s. The New Economy requires a fever of entrepreneurial activity. That often works through networks of contacts that include people wanting to start businesses, dealmakers, lawyers, accountants and venture capitalists. Entrepreneurial studies programs should be offered at every college and university in the state, mainly in after work hours to accommodate adults trying to start businesses. Additionally, our universities and colleges are ideally situated to foster and cultivate the necessary entrepreneurial networks in conjunction with chambers of commerce. The Wisconsin Venture Fair serves as one such model. High-tech incubators, such as the one at the Madison Research Park, are another way of creating a supportive, networked environment.

- **Toward Collaborative Regulation**—The general business climate is heavily affected by the attitudes and philosophies of the state’s regulators. Many of the clusters rely upon reasonable, rational, scientific standards for business behavior. Several clusters, such as agricultural business, printing and papermaking, desperately desire a paradigm shift to a collaborative, systemic approach to regulations, rather than the current, often punitive, command-and-control system.
- **Out of Top Ten for Taxes**—In the New Economy, knowledge workers can pick up their PCs and move anywhere. The same is true of many technology companies, such as those in information technology, data processing and biotechnology. They can locate anywhere. Accordingly, the general business climate of the state is hugely important in retaining growing enterprises and their people. One major refrain heard over and over again in the listening sessions for the Wisconsin Economic Summit was that Wisconsin must get out of the top ten for personal income taxes. Great strides have been made over the last few decades in lowering the personal income tax in Wisconsin and in making neutral the effects of the inheritance tax. And, in recent years, Wisconsin has dropped several places from the top of the personal income tax rankings in the country. The best way to get out of the top ten would be to further lower Wisconsin’s personal income taxes. In another matter, the combination of subsidies, tax credits and tax rates must be further adjusted to make sure the working poor have incentive to raise their skill levels and move up the pay ladder where they work. The best way to retain corporate headquarters in Wisconsin is to address its high tax ranking.
- **Outcome of Summit**—An outcome of the Summit must be a charge to stakeholders in the state to take on the strategic initiatives that come from these recommendations and others elicited by the process. For instance, WMC and state chambers of commerce could take the lead on creating angel networks. The University System must step up on the need for IT graduates. Then, there must be a review every six months by the summiteers on progress against those initiatives, a public review so accountability is high. Also, the recommendations from the Summit must be included in the state’s economic strategy now being drafted by an inter-agency task force in Madison. This group must go out to the players in the clusters and find out what they need to grow and prosper.

# Appendix 1

## Description of Critical Success Factors

### Availability of Venture and Seed Capital

#### Venture Capital

For this factor, we quantify and analyze the amount of capital actually provided to WI businesses. PriceWaterhouseCoopers, LLC (PWC) compiles quarterly data on the lending patterns of US venture capital firms.<sup>1</sup> Using their data, we generated a number of critical benchmark comparisons between WI, its closest neighbors (IL, IA, MN, IN, and MI), and the US for Q2 venture capital (see Fig. 1).

Wisconsin's neighbors straddle two of PWC's geographical classifications: Midwest (IL, IN, KY, MI, MO, OH, and PA) and North Central (MN, WI, ND, IA, and NE). For our purposes, we have created a category by totaling the VC funds for MN, MI, IL, IA, IN, and WI, which we then compare to PWC's figures for the rest of the nation.<sup>2</sup>

For Q2 2000, Wisconsin and its neighbors, with \$951M in VC lending, would rank ninth in total VC funds, behind Silicon Valley (\$6894M), New England (\$2609M), the Southeast (\$1536M), the Midwest (\$1260.2M), DC/Metroplex (\$1099M), NY Metro (\$1099M), Texas (\$1090M), and LA/Orange Cty. (\$1039M). This lending amount represents a 4.8% share of total US funds.

However, VC funds are distributed quite unevenly among Wisconsin and its neighbors, with the great majority of funds going to Minnesota and Illinois (see Fig. 2). These two states take home 82% of the VC funding (\$780.04M), while Iowa, Indiana, Michigan, and Wisconsin divide the remaining 18% (\$171.11M).

Other than Iowa (\$1.15M), Wisconsin receives the smallest share (\$22.7M), only 40% of Michigan's \$56.4M and 25% of Indiana's \$90.86M. In addition, only Iowa had fewer deals (2) closed than Wisconsin, which had 4 in Q2. By contrast, Indiana had 6; Michigan, 14; Minnesota, 26; and Illinois, 41. Further, these four states each closed at least one deal that surpassed Wisconsin's total VC share.<sup>3</sup>

When we factor in the percent share each state represents in population and Gross State Product (GSP), the discrepancies in VC lending patterns become even more apparent (see Fig. 3).

As the data show, the GSPs of Wisconsin and its neighbors are proportional to their population share, as we should expect. But except for Illinois and Minnesota, these states receive a far lower share of VC funds than their populations or GSPs would merit. Illinois and Minnesota, in contrast, both have VC fund shares almost twice their population and GSP shares.

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<sup>1</sup> All data used in this section can be found on-line at [www.pwcmoneytree.com](http://www.pwcmoneytree.com) or in print in the *Money Tree US Report: Q2 2000 Results*.

<sup>2</sup> For simplicity's sake, we will often refer to WI, IL, IN, IA, MN, and MI as the "Midwest Region", despite the different meaning it has in PWC's report.

<sup>3</sup> **IN:** eSkye.com Inc. (\$48.5 M) and Allegiant Technology Group (\$27.1M); **MI:** BullsEye Telecom (\$25M); **MN:** Optical Solutions (\$73.7M), Dantis (\$31.6M), and Novopoint.com (\$30.3M); **IL:** Looking Glass Networks, Inc (\$200M), Packtion Corp. (\$53M), Telensius Inc. (\$50M), and NetGov.com Inc (\$23M).

Wisconsin's shortage of VC funds poses a serious problem for the WI economy, and not simply in so-called "high-tech" sectors, but across the board. Especially when taken in concert with the present lack of R&D funding (see next section), Wisconsin's share of VC investment will be crippling when the US economy cools. While the economy is hot—and while VC investments are at all time high levels—Wisconsin must attract VC investment. PWC reports that on average, \$13.4M was invested in 16 companies each day by venture capitalists in the second quarter of this year—a total of \$215M a day. Second quarter US totals were up 43% from Q2 1999, and both the Midwest and North Central regions have enjoyed increases in VC funding since Q4 1999 (64% and 33%, respectively), the former topping the billion-dollar mark for the first time.

Recent developments in E-venture capital lending, which bring together private investors, patent holders, and entrepreneurs on-line, are being developed and launched specifically to reach underrepresented VC markets like Wisconsin. They are a way to circumvent the usual barriers to VC lending: geographic isolation, the conservatism of traditional VC firms, and the faddishness of the VC market overall.

#### Angel Investing

Though formed only recently, Wisconsin has three "Angel" groups working to provide seed for very early stage deals. Several more are forming in various regions of the state.

#### IPO Funds

A recent report (June 2000) by the Technology Administration, *State Science and Technology Indicators*, ranked Wisconsin 34th in IPO funds raised from 1997-1999. In this respect, it outperformed Iowa (35) and Indiana (41). Illinois (18), Michigan (20), and Minnesota (29) all outperformed Wisconsin.

#### SBIC Funds

The same report also ranked Wisconsin 22nd in Small Business Investment Company awards. From 1996-1998, Wisconsin received \$38.8M per year on average. In this respect, it outperformed Illinois (24), Indiana (36), and Iowa (42). Both Minnesota (12) and Michigan (7) surpassed Wisconsin in this regard.

### **Research & Development Capabilities**

For this factor, we quantify and analyze the amount of R&D funding (public and private) provided in a given state or region per year. The National Science Foundation (NSF) compiles data annually on the amount and type of R&D funding and obligation in the US by state. We brought together Wisconsin and its neighbors (IL, IA, MN, IN, and MI) and generated a series of benchmark comparisons from the NSF's data (see Fig. 4).<sup>4</sup>

As Figure 4 shows, Wisconsin ranks higher than its population in only one category: Academic R&D. This reflects the strong public and private commitment to the state university system. A close second, however, is Industry R&D, in which Wisconsin ranks 19th in the US. Compared

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<sup>4</sup> Unless otherwise noted, all data in this section comes from the NSF's *State Profiles* (3/21/2000), available online at [www.nsf.gov](http://www.nsf.gov).

to Wisconsin's GSP ranking for the same year (19), it should also be considered a strong sector of Wisconsin's R&D funding.

Wisconsin's mixed R&D performance is not atypical in the Midwest. Even a state as economically strong as Illinois scores poorly when its R&D funding is compared to its population (5) and GSP (4) ranking: it underperforms in every category, as does Indiana. Iowa underperformed in three of four categories, only surpassing its GSP and population ranking in Academic R&D. Only two states posted strong overall R&D rankings: Minnesota outperformed its GSP and/or population ranking in two categories (Total R&D Performance and Industry R&D); Michigan in three (Total R&D Performance, Industry R&D, and Academic R&D).

While a state like Illinois can overcome its weak R&D showing in other ways, such as its lion's share of regional VC funds (56%), Wisconsin has no such recourse. As a result, it is critical for all sectors of the Wisconsin economy to boost the state share of public and private R&D funding. The Wisconsin University system is doing well in this regard; businesses and the legislature need to do more. Whether through increased lobbying for federal funding or through a redoubled effort to attract private investment, the Wisconsin economy cannot sustain the prosperity it currently enjoys without increasing its non-academic R&D funding.

### **Availability of Skilled Labor**

For this factor, we quantify and analyze the number and quality of educated workers in a given state or region. Using data from the Bureau of Labor, the Census Bureau, and the NSF, we generated a series of benchmark comparisons between WI, its neighbors, and the US.

In terms of secondary education, Wisconsin scores well nationally: 88% of its residents have a high-school diploma or equivalent, compared to 82.8% nationally. In terms of post-secondary education, however, Wisconsin fares worse: 22.3% of its citizens have BA degrees, compared to 24.4% nationally.

In terms of graduate education, the results are mixed. As Figure 5 shows, Wisconsin ranks 13th in Science and Engineering degrees awarded, thereby outperforming both its population and GSP rankings. It also meets or outperforms in terms of graduate and post-doctorate students in PhD-granting institutions. This, by and large, reflects Wisconsin's strong public and private universities.

However, Wisconsin underperforms in terms of Doctoral Engineers (22) and Scientists (22) residing in the state. This suggests that, although Wisconsin does a good job training skilled workers, it does a poor job of keeping them in the state. Some of its neighbors do a better job of keeping and attracting highly educated workers: Minnesota and Michigan meet or outperform their population and GSP ranks in both Doctoral Scientists and Engineers. Some of them do as badly or worse than its 4/3 differential between population/GSP and number of Doctoral Scientists and Engineers: Iowa has a differential of 1/3 for Scientists, 4/7 for Engineers; Indiana a 9/8 for Scientists, 11/10 for Engineers; and Illinois a 2/3 for Scientists, 4/5 for Engineers.

Once again, states such as Illinois can afford to underperform in some areas because their sheer size and economic diversity allow them to prosper even during cool economic periods. Wisconsin, however, cannot rely either on size or diversity to support it when the US economy cools.

Minnesota, roughly the population of Wisconsin, has used the prosperity of the last nine years to diversify and strengthen its economy. Despite its size and location, it consistently outperforms its population and GSP rankings in many CSFs, as we see throughout this report.

### **Training/Education Infrastructure**

This factor measures the state of Wisconsin's public and private institutions of higher learning. Data was taken from the National Center for Education Statistics' (NCES) November 1998 report, *State Comparisons of Education Statistics: 1969-70 to 1996-97*, unless otherwise noted. We have brought together statistics for Wisconsin on a wide range of educational indicators and compared them to its neighbors.

In terms of total institutions of higher learning (Fig. 6), Wisconsin (66 schools) ranks above only one state, Iowa (59). When we take into account its population rank (18), Wisconsin only underperforms one state, Minnesota, which has 106 schools but ranks 20th in population.

If we compare the percentage of US schools each state represents and compare it to each state's percentage of the US population (Fig. 7), Wisconsin is still a bit underrepresented. It makes up 1.78% of total US schools, less than its population rank of 1.91%. Compared to the two other underperforming states, Wisconsin did better than Michigan (-.64% differential) but worse than Indiana (-.05% differential). Minnesota, Iowa, and Illinois all outperformed their population percentage, with Minnesota the leader (+1.13% differential).

When we turn to breakdowns of schools by type in Wisconsin (Fig. 8), we see that its higher educational resources are split 54/46 between private and public schools. On the public side, furthermore, there is a discrepancy between 2-year (26% of total) and 4-year (20%) institutions; on the private side, the split is less even: 4-year schools outnumber 2-year schools almost six-fold.

Wisconsin scores fairly well in terms of student:faculty ratios (Figure 9). We meet or fall below national ratios for public 2-year and private 4-year institutions; we exceed them for public 4-year and private 2-year. Our public 2-year schools have lower student:faculty ratios than all our neighbors; and only Illinois has a lower ratio in private 4-year schools.

Finally, in terms of full-time faculty salaries (Fig. 10), Wisconsin's results are mixed. The average of both public and private schools is \$49,325, with the former (\$50,747) paying substantially more than the latter (\$43,320). Wisconsin barely surpasses the national average for public institutions (\$50,303) and falls short for private by almost \$9,000 (\$52,112). Compared to its neighbors, Wisconsin ranks third, after Michigan (\$54,248) and Illinois (\$52,548), in combined public-private average salary. Since 1985-86 (Fig. 11), Wisconsin's average faculty salaries have risen 57.9%, just above the national rate of 56.9%. Its neighbors, however, have done quite a bit better: Michigan's professors enjoyed a 64.2% increase; Illinois' and Indiana's 60% each; and Iowa's a hefty 68.8% climb. Only Minnesota did worse, growing almost 6% behind the national average.

## **Energy, Transportation, and Information Infrastructure**

### **Energy**

Wisconsin outperforms its state population and GSP ranks (18 and 19) in three critical energy benchmarks (Fig. 12): average total (12), industrial (13), and commercial (12) electric prices. Its residential electric prices are higher (19), but still on target. Further, 1998 electric prices (\$15.94 per million Btu) were below 1985 levels (\$16.85).

Natural gas prices in Wisconsin (\$5.28 per million Btu) are the median of its neighbors<sup>5</sup> and lower than the US generally (\$5.78). Rates in 1998 were also lower in Wisconsin than in 1985 (\$5.33).

Our economic growth has led to an increasing demand for power in Wisconsin. Many of our power plants are old and must be updated or replaced. Wisconsin has limited capability to import electricity into the state because of inadequate high-power transmission lines.

### **Transportation**

The physical condition of Wisconsin's highways has markedly declined since 1995. Then, the Federal Highway Administration ranked 41% of Wisconsin's highway miles in its top two categories; in 1998 only 28.8% were rated this highly. In this respect, Wisconsin lags behind Iowa (50.5%), Minnesota (49.5%), and Michigan (35.8%), as well as the US as a whole (48.6%).

Roadways are the most significant aspect of Wisconsin's transportation infrastructure because of the predominance of motor freight transportation in the state (Fig. 13). Motor freight transportation and warehousing comprise 71% percent of Wisconsin's total transportation establishments. In contrast, air and water transportation make up 2% each.<sup>6</sup> Passenger transport and transportation services comprise the remaining share (25%).

In terms of employees, motor freight transportation comprises an overwhelming majority of the Wisconsin transportation industry (Fig. 14). Its 66% share is more than three times that of the next closest sector (passenger transportation) and nearly five times that of the rest of the transportation sectors.

Furthermore, of the \$143.3B worth of shipped-goods that originated in Wisconsin, 84% (roughly \$120.3B) were shipped by truck (Fig. 15). Air accounted for 1%, rail 3%, and USPS, parcel, and couriers 9%.

### **Information**

The FCC has compiled extensive data by zip code of the availability of high-speed telecommunications lines, whether fiber optic, cable, or broadband, as well as the number of providers operating in each zip code area. We culled these numbers and compared Wisconsin to its neighbors and the US on four factors.

In terms of zip codes with high-speed service (Fig. 16), Wisconsin (55%) underperforms the US (59%) as well as Indiana (63%), Michigan (68%), and Minnesota (58%). While our advantage over Iowa (29%) is to be expected, we also outperform Illinois (45%).

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<sup>5</sup> IL: \$5.37; IA: \$5.33; MI: \$4.88; MN: \$4.77.

<sup>6</sup> These do not include private/individual transportation, only commercial/industrial.

When we turn to the total number of high-speed lines in each state, Wisconsin's performance drops (Fig. 17). It is behind Illinois, Minnesota, and Michigan by no less than 15,000 lines (Minnesota); and Michigan by itself has over 60,000 more lines than Wisconsin; Illinois has around 60,000 more. And even if we adjust for state size by comparing each state's percentage share of total US high-speed lines to their population share, Wisconsin underperforms (Fig. 18). Although comprising 1.91% of the total US population, Wisconsin has only .67% of the total US high-speed lines. However, all her neighbors also underperformed the US average.

Finally, in terms of high-speed providers, Wisconsin ranks second to last, with 7 state-wide (Fig. 19). In this, it lags behind Indiana, Illinois, Michigan, and Minnesota.

### **Presence of Market-Leading Companies**

We collected data from the Census Bureau's *County Business Patterns* for Wisconsin industries (by 2-digit NAICS code) that have establishments over 500 employees. We compared these numbers to Wisconsin's neighbors as well.

As we can see from Figure 20, Wisconsin ranks fourth in total industries > 500 employees in the Midwest region. But when we take a more detailed look at the breakdown of market-leading companies in each state, Wisconsin has some distinct advantages over its neighbors.

Within Wisconsin itself (Fig. 21), two industries comprise the largest share of market-leading companies: Manufacturing (56%) and Health Care & Social Assistance (21%). Of the rest, Finance & Insurance, Administrative & Support and Waste Management & Remediation Services, and Educational Services each comprise 5%; Construction and Management of Companies & Enterprises 2% each; and Professional, Scientific, & Technical Services and Transportation & Warehousing 1% each.

In Construction and Health Care & Social Assistance, Wisconsin ranks third among its neighbors (Figs. 22 and 23); it ties Iowa for third in Educational Services (Fig. 24); in Manufacturing, Professional, Scientific, & Technical Services, Management of Companies & Enterprises, and Finance & Insurance, fourth (Figs. 25-28); in Transportation & Warehousing, it ties Minnesota and Iowa for fourth place (Fig. 29); in Administrative & Support and Waste Management & Remediation Services, fifth (Fig. 30); and in Information, Wisconsin ranks last (Fig. 31).

In addition to employment data, we have collected data on the presence of market-leading companies from the Technology Administration's June 2000 report, *State Science and Technology Indicators*. They provide two measures of a state's success in this area.

In terms of Inc. 500 companies residing in-state in 1999, Wisconsin ranks 26th, with 7 establishments. In this, it outperforms Indiana (36th, 4 firms) and Iowa (37th, 2 firms). Illinois (16th, 23 firms), Michigan (18th, 17 firms), and Minnesota (9th, 13 firms) surpass it.

In terms of the Deloitte & Touche Technology Fast 500 companies residing in-state in 1999, Wisconsin ranks 31st, with 1 firm. In this, it outperforms only Indiana (0 firms). Illinois was ranked 26th (4 firms), Iowa 27th (1 firm), Michigan 32nd (1 firm), and Minnesota 13th (13 firms).

## **Entrepreneurial Climate**

This factor brings together an array of data on the incentives offered to small-businesses and inventors as well as on the actual entrepreneurial activity in-state. These are drawn from the Technology Administration's June 2000 report, *State Science and Technology Indicators*.

In terms of incentives, Wisconsin meets or greatly exceeds national averages on the indicators identified by the Technology Administration's report. Wisconsin ranks 20th in patent attorneys and agents, which is an acceptable showing when compared to its population and GSP ranks (18 and 19).

Turning to business incubators, Wisconsin ranks first in the nation. The Technology Administration describes business incubators as, "offering specialized physical facilities at reduced rates, flexible lease terms, shared support services, business assistance services, and management coaching." Its neighbors perform significantly lower in this regard: Illinois is ranked 29th, Indiana 24th, Iowa 38th, Michigan 31st, and Minnesota 19th. Since educational institutions provide many of these incubators, it is not surprising that Wisconsin performs well. One possible factor for the poor performance of its neighbors is that they have ample funds from other sources (R&D, VC, IPO, SBIC) to replace such incentives.

In terms of actual in-state entrepreneurial activity, we examined seven factors. Wisconsin ranks 18th in patents issued from 1996-1998, with an annual total of 1,643: ahead of Indiana (24) and Iowa (27); behind Illinois (14), Michigan (9), and Minnesota (6).

Wisconsin ranks 28th in Small Business Innovation Research Program (SBIR) awards from 1996-1998, with an annual average of 39 awards. In this regard, it is ahead of Illinois (35th), Indiana (38th), and Iowa (49th). Minnesota and Michigan ranked 20th and 21st, respectively. In dollars amounts of these awards, Wisconsin ranks 29th, an average of \$8,151 per award, again ahead of Illinois (37th), Indiana (39th), and Iowa (49th).

Wisconsin ranks 25th in Small Business Technology Transfer Program (STTR) awards from 1996-1998, with an average of 3.3 awards annually. It outperformed Illinois (31st), Indiana (37th), and Iowa (36th), and Minnesota (34th). Michigan topped the Midwest region with 7.3 annual awards (21st). In dollar amounts, Wisconsin's awards ranked 24th, with an average amount of \$729,000. In this respect, it surpassed Illinois (39th), Indiana (35th), and Iowa (33rd), and Minnesota (43rd). Michigan, with \$1.39M average per award, only out-ranked Wisconsin by one place (23rd).

The Technology Administration's report offers two metrics on new business start-ups. Technology establishment births track establishments that were first placed on record during 1996. They also provide information on total establishment births during the same period. Wisconsin ranks 29th, with 626 technology establishment births (WI had 11,597 births in all industries and sectors). In this, it outperforms Iowa (45th) and Indiana (33rd). Illinois (9th), Michigan (24th), and Minnesota (3rd) all ranked higher in this regard.

In addition, the Technology Administration tracks the net technology-intensive business formations in each state (new businesses minus closed businesses) for 1996. Wisconsin ranked 33rd in this regard, with 626 net establishment births. It ranked ahead of Indiana (40th) and Iowa (45th), but behind Illinois (4th), Michigan (24th), and Minnesota (1st).

It is important to notice that in a majority of factors, Minnesota ranks higher than its GSP and population rank in critical economic indicators. Because of the similarities in geography, size, demographics, etc., Minnesota, unlike Illinois or Michigan, is a useful benchmark for Wisconsin. We need to look to its success in meeting or outperforming its larger, wealthier, more centrally located neighbors and try to adopt and adapt its strategies to strengthen Wisconsin's economy.

### **Business Climate**

In Competitive Wisconsin, Inc.'s *Measuring Success* (1999), they present a number of significant benchmarks relating to the strength of business in Wisconsin. Although we have addressed some of their business climate indicators under other CSFs (R&D, Availability of Capital, Infrastructure, Entrepreneurial Climate), we wish to present here the other relevant data on Wisconsin's business climate.

In terms of *business creations*, Wisconsin has capitalized on the strength of the US economy of the past decade. In 1985, there were 7,700 new corporations; in 1998, that number more than doubled to 16,846, reflecting the consistent increase in economic growth Wisconsin has enjoyed.

In terms of *export share*, Wisconsin has performed poorly in the last ten years. It has lagged behind the US (7% total since 1987) and has not performed strongly compared to its neighbors. Overall, it had a slightly lower export share in 1998 (1.59%) it did in 1987 (1.63%).

Wisconsin shows strongly in the manufacturing sector. Its *manufacturing jobs as share of employment* percentage is high (22.7%), almost 8% higher than the US (14.9%), and much higher than most of its neighbors (IL 16.6%; IA 18.1%; MN 17.3%). Only Michigan (21.4%) approaches Wisconsin's strength in the manufacturing sector.

Finally, in terms of *Internet registrations per 100 firms* in the state, Wisconsin (18) ranks in the middle of its neighbors, ahead of Iowa (13) and Michigan (17), behind Illinois (24) and Minnesota (23). It also lags behind the national average of 26.

These figures, when examined in conjunction with data on R&D, educational infrastructure, availability of skilled labor, entrepreneurial climate, availability of capital, and quality of life, suggest that Wisconsin has many strong points (university system, energy costs, manufacturing base, availability of graduate and post-doc workers, qualified high-school graduates, and academic R&D), it must address its critical economic weaknesses (brain drain, low faculty salaries, lack of venture capital, low per capita income, low export share, and insufficient transportation and communication infrastructures) if it is to secure and augment the success it has enjoyed in the last ten years.

### **Quality of Life**

Competitive Wisconsin, Inc., in its 1999 report *Measuring Success*, has identified a number of factors that contribute to the quality of life in Wisconsin, and in all but one Wisconsin is performing well in relation to national and regional benchmarks.

Its rate of *uninsured citizens*, as estimated by the U.S. Census Bureau, was 11.8% in 1997. This is up substantially from 1995 (7.3%) but still below both US (16.3%) and Midwest averages (IL 15%; MI 13.2%). *Violent crimes* in Wisconsin fell from 282 per 100,00 to 249 and we lead the Midwest in this respect (IL 808; IA 312; MI 621; MN 310; US 566). Wisconsin's *recreational appeal* is also strong compared to US and regional benchmarks; since 1990, it has consistently ranked in the seventh decile (top 15 states). Only Minnesota currently ranks higher. *Poverty rates* are also lower in Wisconsin (8.5%) than either the US (13%) or the Midwest region (IL 10.6%; IA 9.3%; MI 10.6%; MN 10%) and are down from earlier levels this decade (8.8% in 1995). In terms of home ownership rates, Wisconsin (70.1%) trails all its neighbors except Illinois (68%) by between 2 and 4 percent. It is comfortably above the US average (66.3%), however. Finally, Wisconsin's per capita income (\$25,079) is its weakest quality of life benchmark. It ranks 23rd nationally, substantially below both population and GSP ranks, and trails Illinois (\$28,873), Michigan (\$25,857), and Minnesota (\$27,520), as well as the US average (\$26,412).

All of this suggests that Wisconsin has a high quality of life in general, and that it must address two factors to increase worker retention and also attract more residents: increase its per capita income at least to its population and GSP rankings and increase national awareness of the many positive qualities Wisconsin can offer its citizens.

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