

An Assessment of Wisconsin's Infrastructure for the New Economy

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"The New Economy is all about efficiency."

**Prepared for the
WISCONSIN ECONOMIC SUMMIT
November 29, 30, and December 1, 2000**

Summary

Wisconsin's infrastructure for both the New Economy and the old economy consists of its highways and roads, its railroads, its electric power supply, its airports and subsequent air service, and its telecommunications facilities. Although the relative role of these services changes between the New and old economies, they still are essential to the economy of the state. Fortunately, most are pretty well provided: they are not a major inhibitor to the growth of the New Economy in the state.

But if Wisconsin is to fully participate in the New Economy, it must take several steps. First, the state should reinvest in surface transportation to keep people and goods moving efficiently. Second, the state must create an environment that induces privately provided, widespread, competitive, state-of-the-art telecommunications services. The state is relatively well served by fiber optic networks, but high-speed local connections are not as common as they should be. Third, another critical element is hub air service. Mitchell Field must be expanded and more direct flights must originate there. And fourth, the electric power supply must be made more adequate through a combination of conservation and additional construction.

Introduction

This paper offers an assessment of Wisconsin's competitive position with regard to "infrastructure" and the state's quest to be competitive in the developing "global, knowledge-based economy," referred to hereafter as the New Economy. One of the main roles of government is to help to insure that the infrastructure is in place upon which the private sector can build. If the infrastructure is inadequate to transport raw materials, finished products, services, or persons involved in the production of goods and services, then goods and services are less likely to be competitively produced in the state. If the state is less competitive, fewer jobs and lower incomes will be produced in the state.

If government accepts this role, a critical issue is what should be included in the definition of "infrastructure." The term has expanded over recent decades. The historic definition includes such items as railroads, roads and highways, electric power supply, and airports (that have both passenger and air cargo services). More recently the definition has enlarged to include telecommunications, especially fiber optic networks. All of these have a physical component.

But some persons have expanded the definition even further. Infrastructure today can include universities, especially research universities; professional services, such as skilled and experienced lawyers who know how to structure new firms, new financial arrangements, and intellectual capital protection; and financial services that can easily serve the wider range of capital needs that New Economy firms seem to have. New Economy firms are harder to start and nourish without access to such services.

Some analysts go even further to include the availability of knowledge workers as part of the infrastructure. In places where such workers are hard to attract, it is even more critical to have them produced in place, so that recruitment is less of a challenge. But that creates a classic chicken and egg problem: the production of such workers is necessary but insufficient to ensure their employment and retaining them until they are needed is very difficult. Knowledge workers must be available for the new economy to flourish.

Yet another infrastructure element is the government itself. Several commentators have asserted that if a community is to be attractive to businesses as a home for New Economy activity, the governments must be run with the use of the Internet, and businesses must be able to deal very efficiently with the government through the Internet.

To proceed, we should decide just how much we want to include in our definition of infrastructure. To aid this discussion, we will limit the definition to the more traditional, physical items that include telecommunications. The education and workforce components are covered in other white papers for the Economic Summit.

Physical Infrastructure

An economy that has a limited infrastructure is going to be limited in its production of goods and services. If materials, persons, and ideas cannot move easily and quickly, the ability, much less the costs, are going to be compromised. With a high proportion of all business travel done by surface transportation, it is important that an economy have a reasonably serviceable system of roads and highways. If heavy goods are included in the New Economy, then railroads will continue to be an important component. If energy costs continue to rise, railroads can become an even more important component for moving both goods and people, provided that the railroads also increase their efficiency and the speed with which they can deliver their cargo.

Air service, both passenger and freight, is becoming an ever more important asset, as goods and services must move with greater speed and over greater distances. Not only must communities have air service, that service is more appealing when it includes non-stop flights to major destinations. Airline hub cities are likely to grow more rapidly in the new economy than cities that must rely heavily on transfers.

A force that counters some of the need for physical movement is telecommunications. If movement of ideas and services can be done by telecommunications, less of the traditional, physical infrastructure will be needed. This certainly is a trend. Where it will take us is not yet known. But examples of individuals telecommuting abound, as do examples of jobs being done in one location for execution at another. And services, such as mortgage lending, are now being provided completely by telecommunications, with no physical contact between lender and borrower. Increasingly what matters is the availability of high-speed, secure telecommunications. Communities must be networked into the nation's fiber optic lines, preferably into lines that have a surplus capacity. And all communities must be served by wireless technology as well.

Despite the telecommunications revolution, physical contact is still important, and goods must still be transported: we cannot live on knowledge alone. We need both the telecommunications service to more efficiently participate in the knowledge economy and the more traditional infrastructure to move those services and goods that cannot be transmitted by wire or air.

ASSESSING WISCONSIN'S POSITION

It is impossible to do an exhaustive assessment of where Wisconsin stands with regard to elements of its infrastructure in 12 pages. Only the highlights can be hit. But a cursory examination does reveal where attention needs to be paid.

Highways and Roads

There are various ways to assess the impact of the highway (state) and road (local) system of the state. One is to report on the WISDOT (Wisconsin Department of

Transportation) assessment of the condition of the highways and roads. WISDOT has a system of assessment that grades the current condition of all existing highways in the state on structural adequacy, roughness, and rutting. The measure does not say if there are sufficient miles of highway; it only evaluates the degree to which all existing highways are maintained at recommended condition. WISDOT reports that about 8,250 miles of the 11,800 miles of state highways are in good condition. That means the remaining 3,550, or one third, are deficient.¹ These deficiencies are not egregious; they are miles that do not currently meet state standards. The state has a plan to reduce the number of deficient miles to around 700 by the year 2020.

Wisconsin also has some 4,641 bridges in its state highway system. Their service is critical to the performance of the state highways. Fortunately, only 7% of the bridges in the system require rehabilitation or replacement in 2000. This relatively low backlog in existing deficient bridges reflects the high priority WISDOT places on the preservation of these important links.

Wisconsin has some 100,000 miles of local roads, roads that are operated by the counties, cities, towns, and villages. Unfortunately, no assessment of their condition is currently available. A new reporting system is underway to report their condition, but unlike states such as Iowa, it has not been completed. This information is important, since only a modest portion of all business activity is located on state highways. If the local roads are not as good as they should be, then economic activity will suffer, despite what may be excellent state highways nearby.

A different way of judging the adequacy of the road and highway system is to assess the level of congestion found. Congestion leads to higher costs for all involved. If the new economy is about efficiency, true congestion is an archenemy of the new economy. In 2000, about 7% of the Backbone sub-system, defined as the major highways of the state, are said to experience severe or extreme congestion.² This percentage is expected to increase to 16%, if no additional capacity improvements are made and no changes are made in how the highways are used. These numbers suggest that both capacity and demand should be seriously addressed in the years between now and 2020, if congestion is not to hamper the New Economy or the old economy in Wisconsin.

The utilization of advanced telecommunications may reduce some of the highway demand, but the extent is difficult to predict. In the mid-1990s some 88% (by weight) of the commodities shipped in Wisconsin were shipped by truck. This fact suggests a continued need for highways that will be little affected by telecommunications.

Another way of assessing the roads and highways is to see the degree to which the Interstate highways are affecting the growth of employment in specific industries. If we see, for example, that employment in manufacturing is growing fastest along the Interstate highways, it would suggest that these highways are the keys to manufacturing

¹ Wisconsin State Highway Plan 2020. Madison, WI. WISDOT. February 2000. P. 78.

² Ibid., p. 92.

employment growth. If, on the other hand, there is little relationship between the rates of employment growth and I-road access, it would suggest that at least as this point in time access from all roads is good enough that it is not inhibiting manufacturing employment growth. We take manufacturing because it is clearly dependent upon moving goods and most of those goods and the raw materials used for their assembly move by truck.

What we find in Wisconsin in manufacturing is that there is no correlation between location by type of road, be it two lane, four lane, or Interstate and the rate of employment growth.³ This means that location within the state does not inhibit growth. In fact, one may conclude that at least in manufacturing and probably in most other industries, the current distribution of roads and highways is not inhibiting the state's rate of economic growth. There may be specific communities that would add jobs more rapidly if it were to be better served by the highway system. But overall, there does not appear to be any relationship between type of road service and employment growth rate in manufacturing.

We can conclude that the current network of roads and highways is not inhibiting growth overall. Improvements would likely help at the margins and may influence individual firm location decisions. Maintenance must be done regularly to ensure continued efficient access. But the state is reasonably well served by its network of roads and highways. If continued investments are made, the state should not be inhibited in its participation in the New Economy by its roads and highways.

Railroads

Passenger rail service in the state is limited. Milwaukee-Chicago has six trains a day. Kenosha is served by Chicago's commuter railroad, METRA. And the state has a limited-service Amtrak train that goes from Chicago to Sturdevent to Milwaukee to the Twin Cities and on to Seattle. That is it. The Governor has talked of expansion of this service and speeding up the trains. But today the service is limited. Whether this inhibits growth of the New Economy remains to be seen. Arguments can be made on both sides. The key will be whether expanded rail service can compete with auto and air for price, time, and frequency. Whether there will be enough individuals who want to travel between the communities that will be served will likely only be determined by experimentation. At this juncture, however, it is hard to conclude that lack of this service is inhibiting development of the New Economy in the state.

Freight service is more dispersed across the state, but thousands of miles of track have been abandoned in recent decades. What is available today is a shadow of what was once available. Traditional geographic areas are still served. Few new firms have sought rail service. The New Economy is not heavy industry, except to the degree that electric power is generated by coal-burning power plants, and some 51% of rail shipments in the

³ Sammis B. White, "The Link Between Interstate Highways and Employment Growth in Manufacturing," presented at the American Collegiate Schools of Planning Conference, Fort Lauderdale, FL, November 1998.

state are coal. Only 3% by value and 7% by weight of state shipments are carried by rail.⁴

If the New Economy is more about ideas or new, light-weight products, rail service is not a critical element of this economy. If the New Economy includes traditional industries that will operate ever more efficiently, rail may still play an important role. Service to existing businesses is marginal. In recent months rail shippers have complained of two and three month delays. If these delays can be eliminated, then the service may be deemed adequate for the foreseeable future. There is some flexibility in the system, so if greater demands are made, the system is capable of handling most, if not all, of them.

Air

One of the most critical infrastructure elements for the New Economy is air travel. Air travel is also critical to the old economy: between 1990 and 1996, 72% of new or expanded manufacturing businesses located within 10 miles of a public-use airport.⁵ But even more important today, a community must have easy, frequent, inexpensive access to hubs of New Economy activity. Milwaukee firms, for example, can work more easily with Silicon Valley firms than can Madison firms because Milwaukee has direct flights to San Francisco. Of course, Minneapolis and Chicago have many more such flights, so they are likely to prosper even more from those relationships. But it suggests that the smaller communities in the state that have air service are a step ahead of those that have none. But they are also a step or two behind those that have direct flights to major centers of the New Economy.

Wisconsin does benefit from being the home of Midwest Express and related Skyways airlines. Their coordinated service to many smaller communities helps to make the rest of the world reasonably accessible. The ideal would be direct flights to other major cities, but that is not likely in the foreseeable future. But having the hub in Milwaukee helps the rest of the state. What Milwaukee County must realize is that its reluctance to expand the number of gates at Mitchell Field for Midwest Express has forced the carrier to move flights to other hubs. This is limiting the appeal of Southeastern Wisconsin as a place to do business because it now has fewer direct flight options than it otherwise could have. Direct flights to other hubs are critical to the state's growth.

On the other hand what is also advantageous for some portions of the state is the ease of access to the international airports in Chicago and Minneapolis. These two airports have much larger traffic volumes than Milwaukee and provide direct flights to a wide number of communities across the nation and world. Wisconsin is fortunate to have a sizable portion of its population and employers within driving distance of these airports. It provides advantages that sections of Illinois and Minnesota do not have. But southeast Wisconsin would be even better off if it had more direct flights out of Milwaukee.

⁴ Freight Transportation in Wisconsin. Bureau of Transportation Statistics. October 1996.

⁵ Wisconsin Aviation Activity 1999. Wisconsin Department of Transportation. 2000.

A related point that should also be noted is that it is not only access but the cost of that access that is important. Certain air routes are expensive. Milwaukee, for example, could have more numerous ties to the New Economy in the Twin Cities, if consistently inexpensive air service existed between these cities. But since this service is often expensive, it discourages development in Wisconsin that would be synergistic with the economy in Minnesota. Monopolistic service to particular hubs, such as Minneapolis and Detroit, is detrimental to Milwaukee's growth, especially since these two economies do contain significant elements of the New Economy.

Telecommunications

Telecommunications is an industry that is undergoing rapid and profound change. The industry is no longer defined by the local telephone company. Voice transmission is only part of the service. Much more critical today is data transmission. Services now can include local telephone service, national and international telephone service, Internet access through telephone lines, over the air, through cable and cable modems, or through dedicated lines, and wireless services. Services are now provided by traditional phone companies, wireless phone companies, cable (TV) companies, Internet service providers, fiber optic network providers, and variations on all of the above. It is a whole new world.

One of the key infrastructure ingredients in the New Economy is state-of-the-art telecommunications systems. Many observers indicate that access to these systems is very similar to access to the railroads in the last century. Communities that are on the system are much more likely to thrive than those that are not. The same can be said for businesses, whether they are New or old Economy. Forecasts predict that business-to-business e-commerce transactions for all sectors will reach \$2.78 trillion by 2004.⁶ The issue for the state is whether all of Wisconsin is well served or soon will be well served by the latest in telecommunications. Assessing where Wisconsin is today is the charge of this section.

Ingredients

There are a number of elements that should be in place to be competitive in the New Economy. Any places where larger call and data volumes are likely need to be served by fiber optics. Copper wire can work for many users. But if the volume of information is larger, then fiber optics are critical. Since much of the New Economy depends on digital data and large volumes of digital transmission, the availability of fiber optic lines is central. These fiber optic lines need to connect places in the state to one another and to the rest of the nation. The fiber optic lines also need to connect local users to central office switches and to interconnect telecommunication providers' switches.

⁶ Troy Oxford, "B2B's Boom." *The Atlanta Journal and Constitution*, September 20, 2000. P. 3H.

Fiber optic lines come in varying sizes and capacities. Smaller lines, such as an OC-3,⁷ serve individual users such as UW-Milwaukee or smaller geographic areas with less traffic. A large data user, such as Metavante (the name to be given to M&I Data Systems), is currently hooked to an OC-48 cable. The major trunk lines across the US have an OC number that is in excess of 500 or more than ten times the size of the cable serving Metavante. Capacity is determined both by the size of the cable and the systems employed for sending and receiving signals. The capacity of any line has been quadrupled in the last two years by new developments in how signals are transmitted through the cable. Further enhancements are under development because it is far less expensive to upgrade the multiplexing transmission systems than to lay new fiber.⁸

The ideal system would have fiber optic lines to all homes and businesses. But that is still too expensive and unwarranted by levels of demand. A modest improvement over the present is what is termed ISDN (Integrated Services Digital Network), a service that still relies on copper wiring but that is faster than the traditional, voice line service. A bigger step up is a combined copper and fiber optic system called DSL, Digital Subscriber Lines. DSL is four times faster than traditional copper lines with 56K modems. DSL is a service that combines feeder fiber optic lines that join the central offices to geographically distributed distribution points that link to subscribers by the traditional copper cable. These distribution points are modest physical structures that house the interface between the fiber from the central office and copper lines from area subscribers. These distribution points are needed because DSL service does not work more than 10,000 feet from a distribution point or a central office.

The wide spread availability of DSL service means that many more businesses and residences can participate in the digital age. Feeder fiber from the central office to numerous distribution points allows expansion of DSL service without the more costly construction of central offices or the widespread deployment of fiber.

If DSL technology is to serve more locations, then more exchanges with DSL technology must be in place. So not only do we need the fiber optic feeder cables, we need the distribution points in the neighborhoods and the service technicians able to make the connections to the customers.

Another critical ingredient for businesses that rely on digital data transmission is the opportunity for alternative pathways for their signals to travel. This is done for safety and reliability. Signals must make timely and consistent travel to and from sites. If a direct line between points A and B is severed, say by a back hoe, that data stream must be capable of being rerouted instantaneously to site C or site D and then on to site B. This alternative path routing is termed a "SONET" ring. SONET stands for Synchronous

⁷ An OC-3 line has a current transmission capacity of 155.52 million bits per second. An OC-48 line has a current capacity of 2.5 billion bits per second. An OC-192 line has a current capacity of 10 billion bits per second.

⁸ The latest mode of increasing the capacity of each fiber of fiber optic to carry data is what is termed Dense Wavelength Division Multiplexing (DWDM). This process makes it possible to slightly vary the wavelength of light being transmitted, so that 160 different data streams can move through the same single piece of fiber at the same time. This laser-based process greatly expands the capacity of all cables.

Optical Network that refers to a design standard that provides high-speed transmission over fiber optic lines. Businesses that hope to move data swiftly and reliably must be served by SONET ring service. Lines must be laid in “loops” or ring formations, so that alternative data paths are available.

Beyond fiber optic lines, local number portability, known as Signaling System 7, is an essential signaling capability. This signaling system allows users to change their telephone service provider without changing phone numbers. Thus, a company that has used one provider for years can accept an offer for less expensive service from another provider, without having to also pay the additional expense of notifying customers of a change in phone number. Such availability allows competition to exist. By reducing costs, this service makes a region or state more competitive.

Assessment

Wisconsin, on the whole, is served quite well by state-of-the-art telecommunications. This is detailed below. The state is almost where it should be in terms of basic fiber optic infrastructure. Some individual locations are being short-changed, and some businesses cannot get the level of telecommunication service they want at this point in time. But most sections of the state are served. However, once we look at the more fine-grained distribution of bandwidth (the carrying capacity of a circuit, where higher means greater capacity) service at the local level, we see that only a limited number of businesses and homes outside the downtown concentrations are served. Many potential customers appear close to being served, but they are not yet capable of being hooked up or served with the bandwidth they desire.

Fiber optic lines cover much of the state. Less populated areas have fewer and smaller cables serving them, and much less competition exists among the telecommunications service providers there. But fiber optic lines serve all of the metro areas and most of the non-metropolitan areas. This is not the big issue any longer. What matters more are: the size of the optic lines, the multiplexing systems used to send and receive data, the number of competing fiber optic providers, the availability of local fiber for distribution, and the availability of high speed switches, SONET rings, DSL capability and, where higher level service is not available, ISDN. Each is discussed below.

Fiber Optic Lines

Wisconsin is well served by fiber optic networks. The state has between seven and ten private providers of fiber optic networks.⁹ Not all networks are extensive, but there is a good deal of competition in all of the larger population centers. The Chicago-

⁹ No one contacted could say for certain how many fiber optic line providers there are in Wisconsin. Those who could list specific providers could usually name seven, but they were seldom the same seven. Thus, we come to the estimate of seven-to-ten such providers on a statewide level. There are many more providers within major population centers. Their focus is the local market, most commonly the local business market.

Milwaukee-Madison-Eau Claire-Minneapolis corridor is especially well served. All of the major actors offer SONET rings, an essential capability that is described above. Capacity is not a barrier at this point. Companies are expanding both the size of the cables and the capacity to send signals through the cables. One national provider is now installing OC 192, a large fiber cable, as its backbone. It started this replacement process as soon as its last cable reached 50% capacity. Traffic on the lines is growing by multiples every year. It appears that the providers are staying ahead of the demand curve, but it is with a combination of more fiber and better technology with which to increase the number of signals carried in each fiber, not just more fiber.

One common question is whether there are price advantages to being near a major hub such as Milwaukee or Madison. The answer is that if an end user is close to even a mid-sized city, the service should be competitively priced. Virtually all of Wisconsin's mid-sized cities have what are termed "points of presence" or POP. That is a place where a central data exchange takes place and is well served by the fiber network. Of course, if there are more providers in an area, the cost of service should be even lower.

There are advantages to those users that are located in Southeastern Wisconsin. Many more service providers have fiber optic lines there that can be utilized. There are similar advantages to those communities on the Chicago-Milwaukee-Madison-Twin Cities corridor. Users can send messages across several providers' lines and not only get the security and safety of optional lines, they can also get lower pricing through the increased competition. The further one is from a population center or major corridor, the less likely there is competition among telecommunication service providers.

SONET

The Public Service Commission (PSC) asked in 1998 just how available SONET was in all geographic parts of the state.¹⁰ Service providers responded that SONET was available in about 75% of the state. If one is located in or near a population center, SONET is available. The areas not served are largely farmlands, wetlands, or other low population density areas. But there were areas of St. Croix County near the Minnesota border, parts of Dane County, and parts of Brown, Kenosha, Racine and even Milwaukee Counties that surprisingly were not served. Service may well be provided today. We'll have another PSC assessment in 2001. Three-fourths coverage in 1998 is pretty good, but SONET coverage was not quite where it should be.

Packet Switching

All land-based telecommunications require not only lines but switches. Switches transfer data from one line to another. For high volume users, a key new ingredient is what are called "Packet Switches." They speed the transfer of large amounts of data, data that are usually put together in quantities called "packets" with a specific address. The

¹⁰ Wisconsin Public Service Commission, Status of Investment in Advanced Telecommunications Infrastructure, Madison, December 1999.

ideal for large volume users is that these switches are nearby. But fortunately for some, they need not be nearby, as long as potential users can be hooked up to them directly.

Packet Switches are available in a very limited number of metro areas of the state. Basically, as of 1998, they were in Milwaukee, Madison, Eau Claire, Wausau-Stevens Point, the Fox Valley, Green Bay, Kenosha, Marinette, and a few other smaller areas. But if users elsewhere have fiber optic lines, they can be hooked directly to these switches. So, despite their limited availability to date in the state, the existing "packet switches" do serve a somewhat more geographically dispersed population of businesses. But to truly offer this service to all that may want it in the state will require further investment in this technology.

SS7 (Signaling System 7 or Local Number Portability) Availability

SS7 is an essential signaling capability for advanced telecommunications services. It is not as advanced as "packet switching," but it is a step up from the past. The good news is that the state is well served: in 1998, some 88% of the exchanges in the state had SS7 service. The percentage has probably increased since then. All of the population centers are served, as are virtually all but the least developed parts of the state.

DSL

DSL lines are appealing because they are a relatively inexpensive way to increase the speed with which data can be sent and received by individual users. If smaller volume users want broadband service, this is the next logical step up. Unfortunately, DSL lines have some downsides, such as their slowness relative to cable modems and some problems with confidentiality. They are slower than cable (TV) for areas that have that option. But they are also more secure than cable. On the other hand, they are not as secure as direct fiber optic. Because the lines are shared, opportunities for security breaches are a greater problem.

Nevertheless, the availability of DSL will help to speed the movement of data and expand access to the Internet. It is estimated that DSL service was available to at most 20% of the area of the state in 1998. It is undoubtedly offered in more areas today. But with the recent difficulty Ameritech has had in meeting basic phone service requests, it is said to be months behind in its installation of DSL lines. While this should not be a long-term problem, it has helped to sour the market for DSL lines and slowed the expansion of the New Economy in Wisconsin.

Wisconsin is moving in the right direction in telecommunications. Fiber is becoming more widespread as are the ancillary components that make it even more effective. This occurs especially where there is competition between or among service providers. We are fortunate to be near Chicago and between Chicago and Minneapolis because of the need for cable between the two and the expanded national and international access points in Chicago. This propinquity yields speed and price

advantages. Competition, however, is not as widespread as one might like. To speed competition, at least a dozen municipalities (some in major metropolitan areas) in the state have been approved as local service providers, often in the hopes that such status will spur the private sector to compete and compete quickly.

Overall, the fiber optic network in the state is not currently inhibiting the state's development. Nor is it likely to do so in the reasonable future. Private providers are staying ahead of demand in terms of "backbone." The area that is lagging is the local service access to the Internet with higher bandwidth: more higher-speed, higher-volume options, such as DSL and packet switching, must be made more universally available.

Electric Power Supply

Inexpensive and reliable electric power is critical for the New Economy because it is the "electron" economy. We may not run as many electric motors as we used to, but we operate many more computers, computers that are highly dependent upon safe, reliable electric service. Brownouts, spikes, and interruptions are the bane of computer operation. Employers faced by unreliable electric service will think twice about starting or growing their operations in Wisconsin if this element is not completely satisfactory. Price matters as well, but cheap unreliable power has no appeal and is a threat to the new economy in the state.

Until two summers ago the state was thought to have at least an adequate supply of electric power at a reasonable price. But summer brownouts and forced cutoffs of power invited a less positive assessment. Wisconsin is still struggling with the issue of adequacy. This past summer, with its lower temperatures, did not test the supply system. Whether the power supply is adequate remains in doubt, but some steps are being taken that should help in the future. It would seem wise to look both at greater efforts at conservation as well as at greater capacity.

Other Inhibitors

Wisconsin's economic growth is both limited and enhanced by its geographical placement. If travel on the ground is required to eastern Canada or the United States, that travel must go through or around Chicago. Either way, it slows travel and adds to costs. The proximity to Chicago has also inhibited growth in Southeastern Wisconsin. Industries that might have grown in Wisconsin have grown in the Chicago area instead because of Chicago's larger scale, its larger labor pool, its better access to most parts of the country, its much better access to the rest of the world by air or even ship, its critical masses of skilled workers in numerous industries, and so forth. The strength of the pull of Chicago's economy will continue to limit expansion of economic activity in Wisconsin until the boundaries of Chicago's economy expands to include more and more of Wisconsin. Kenosha is clearly in Chicago's gravitational pull already and is benefiting from that inclusion. Racine may be next.

On the other hand, proximity to Chicago enhances airline options and access. It improves access to the largest national and international fiber optic lines and to multiple telecommunication carriers. It creates extremely close markets for goods and services. And with greater efficiencies in travel and information transfer, the distances (actually times) will be further diminished, making this market more accessible. So, unlike the past when the distance between the two mattered, that distance barrier is diminishing and new industries in Wisconsin can benefit from the proximity to Chicago.

On the other side of the state are the Twin Cities. Their pull is not nearly as great as Chicago's. But the fact that they are where they are means that several industries will locate either in Chicago or the Twin Cities and not even consider Wisconsin. When we learn that the Twin Cities already has a distinct advantage and a growing presence of high-tech industries -- the critical mass needed -- it is likely that start-ups and even growing firms are more likely to choose one of the growth poles over the less-well-connected middle ground of Wisconsin. A recent survey of University of Iowa graduates indicated that 27% would choose the Twin Cities as their top choice as a work site; Madison was top for 14%, sixth on the list; and Milwaukee did not make the list. Thus, the Twin Cities has appeal that may subtract from Wisconsin's growth.

Some of the appeal of Chicago and the Twin Cities can be overcome by quality of life and other competitive advantages of Wisconsin, if the transportation and communication infrastructure are in place. But given some constraints or friction of movement, the Twin Cities and Chicago will continue to have greater economic growth.

Conclusion

Wisconsin has several elements in place for competing in the global, knowledge-based economy. But it also faces some strong competition from its neighbors, not to mention several other parts of the country and world. Chicago has numerous advantages in terms of its size, strategic location, and infrastructure. The Twin Cities has some locational advantages and disadvantages. But the Twin Cities area has much more history in the global, knowledge-based economy than Wisconsin. Wisconsin has participated well in the global, industrial economy, but whether it can successfully compete with its neighbors, much less the rest of the world, in the New Economy is not as clear. It certainly will be challenged.

Wisconsin's ability to participate in the New Economy is not greatly limited by the infrastructure, traditionally defined, it can control. There is little evidence to suggest that if Wisconsin were to invest heavily in highways and roads, railroads, airports, electric power, or additional fiber optic networks that its economy would grow any more rapidly or in any radically different industries than it currently is. Location of economic activity is dependent upon numerous factors, not just the infrastructure.

Wisconsin is doing reasonably well in putting in place the larger physical pieces of the infrastructure needed for the New Economy. The state could use a more reliable electric power supply. The state could use more widespread elements of a high-speed

fiber optic and switching network. Wisconsin could use more businesses and consumers being served by DSL and other higher speed Internet access modes. The state could use more direct air transportation to more cities elsewhere. But these are not the largest inhibitors of New Economy growth. The inhibitors have much more to do with economic opportunity, perception of climate, and willingness of the state's citizens to welcome growth, change, and diversity. Last century's model of industrial growth served the state well. But if the state is to continue to prosper, the New Economy must be embraced, efficiencies in all sectors must be realized, and citizens must jump aboard a rapidly moving new railroad, the New Economy.

Basic Steps Wisconsin Should Take

1. **Reinvest in surface transportation** to keep people and goods moving efficiently.
2. **Create an environment for promoting the presence of numerous and widespread, competing, telecommunication providers** throughout the state. These providers must compete to furnish major fiber optic lines and services as well as vastly expanded local access at high speeds to all areas of Wisconsin.
3. **Expand Mitchell Field's gates and possibly runways** so that Midwest Express and other airlines can provide expanded and more frequent direct air service to more communities across the country.
4. Promote greater energy efficiency and conservation and, if necessary, expand production to **ensure inexpensive, reliable electric power**.

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