WISCONSIN MANUFACTURING IN THE GLOBAL ECONOMY:

ITS PAST, PRESENT AND FUTURE

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ABSTRACT

In this paper, I briefly sketch how the New Economy forces of globalization and technology have affected Wisconsin's manufacturing in the recent past, and I note the challenges these forces will pose in the future. The first step in recognizing these challenges is to understand if there really is such a thing as a New Economy, and if so, whether it has openings into which a set of Old Economy industries can be plugged in order to become a part of it. Specifically, can a state like Wisconsin use its traditional industries as stepping stones to join the New Economy and enjoy its benefits? My view is that it can because in many instances it is the Old Economy that provides the market for New Economy products. While Wisconsin will face difficulties in overcoming the challenges posed to it by the New Economy, Wisconsin is better positioned than many states to use its Old Economy industries to meet those challenges.

I give most of my attention to the large and volatile machinery industry, which provides over half of Wisconsin's exports and which is the sector most sensitive to export fluctuations and import competition. I describe what Southeast Wisconsin might be like if it remained the hub of some Old Economy machinery industries, but operated in the New Economy mode of entrepreneurial venture capitalism while developing new technologies for its traditional industries.

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Wisconsin Manufacturing in the Global Economy

In this paper, I briefly sketch how globalization and technology have affected Wisconsin's manufacturing sector, and I note some of the challenges these forces will pose in the future. While Wisconsin's manufacturing sector is quite diverse, I give most of my attention to the large and volatile machinery industry, which provides over half of Wisconsin's exports and which is the sector most sensitive to export fluctuations and import competition . Different industries face different problems and opportunities, of course, but the effects of globalization and technology are likely to be quite similar across Wisconsin's major exporting industries.

My intent is to provide an understanding of the challenges and opportunities that Wisconsin manufacturing will face in the "New Economy." The two features of the new economy that I emphasize are (1) It is global; and (2) It has been -- and is being -- re-organized by technological progress, and in particular by developments in information technology. The interplay of these two forces will change the nature of Wisconsin's manufacturing in coming years.

The Historical Roots of Wisconsin Manufacturing

Wisconsin's specialty is the manufacture of machinery, an industry that requires workers who are skilled in the metal trades. The percent of Wisconsin's workforce employed in the manufacture of non-electrical machinery (SIC 35) is the largest of any state in America. This industry and the major industries that supply it, such as the foundry industry, consist of a group of small to medium sized firms concentrated in Southeast Wisconsin, and spread across Northern Illinois and neighboring states.

At the close of the 19th century, Wisconsin was already an important site for the manufacture of agricultural machinery, an industry whose location roughly parallels that of today's machinery belt. When automobile manufacturing sprang up in the early 20th century, it became quickly concentrated in the Detroit and surrounding areas. Many firms in the Midwest became suppliers to both of these industries, as technology that was developed for one often found applications in the other.

As markets for other metal-based industrial and consumer goods developed, the Midwest became the logical place for firms in these new industries to locate because it had the cheapest source of metal, a good transportation network, workers skilled in the metal trades, and also because it was closest to the suppliers of high quality components.

By mid 20th century, the Midwest had become the home of an interdependent network of firms that comprised the largest and best complex of metal-based manufacturing in the world. While the fortunes of this complex rose and fell with that of the U.S. economy as a whole, its fortunes differed from the rest in two important ways. (1) Because the purchase of durable goods can be easily postponed, the metal-based industries suffered more than average in recessions. And (2) Wages paid in manufacturing industries were far higher than wages in non-manufacturing industries.

The Global Challenge to U.S. Manufacturing in the 1970s

The 1970s marked the transition to a global economy. Until 1970, many firms in the machinery industry had not faced serious competition from abroad. But in the decade of the 1970s, the share of U.S. imports and exports doubled from about 5 percent of GDP to about 10 percent. In contrast, each of these components had made up about 4 percent of the total economy in 1950. Imports at a level of 4 to 5 percent of GDP did not constitute a threat to American manufacturing.

By 1970, not only had Germany and Japan recovered from World War II in the sense of re-building their capital base, but in many areas they had completely closed the technology gap as well. Furthermore, the greater attention paid to quality in both Germany and Japan gave them an advantage over U.S. firms in many markets.

The rapidly changing volume of trade flows in the 1970s led the major industrial nations to adopt flexible exchange rates as the way to stabilize their trade balances. Flexible exchange rates help maintain an equilibrium in the trade balance as follows: Because domestic costs must be paid in domestic currencies, exporters typically base their international prices on their domestic costs. Then an increase in the value of an exporter's currency will lead it to raise its price in terms of the depreciating foreign currency in order to cover its domestic costs. The higher international price will make the exporter's products less competitive abroad, which will slow the growth in its foreign sales. Through this process, if one country's exports begin to grow more rapidly than those of the rest of the world, the growth in its exports can be slowed by an increase in the value of its currency.

During the 1970s, both the yen and the Mark had to be revalued regularly to slow the increase of German and Japanese exports to the U.S. By the end of the decade, foreign penetration into many U.S. manufacturing markets had become so substantial that many Midwestern firms had to close. The terms "rust belt" and "snow belt" became common in the press at that time. The bad news was that many firms had to close; the good news was that because of competition, it was the inefficient firms that closed while the most efficient firms remained in business. Many of these remaining firms had adjusted to the foreign challenge with an aggressive style, and were subsequently dubbed "lean and mean."

Lean manufacturing denotes a mode of production and supply chain management that was developed in Japan, largely by Toyota, and that was responsible in large part for the amazing leaps the Japanese had made in the quality and quantity of their manufacturing output. In response to the Japanese challenge, many Midwestern manufacturing firms sought to adopt this Japanese approach. A lean industry is built around the customer. It produces goods to order in relatively small batches, with great attention paid to quality, as little waste is permitted due to error, and with the smallest possible level of inventory in the pipeline. With fewer inventories, production schedules must respond quickly to changes in consumer demand. As an organizational strategy, lean manufacturing leads a firm quickly to identify any problems in its production pipeline.

The term "mean" reflects a heightened attention to costs. New advances in computers and in

accounting practices permitted firms to do their cost accounting in much more detailed and precise ways than before. It became much easier for a firm to determine where it was fat, either in the price or volume of its inputs, and to determine which functions could be shut down or purchased more cheaply from other firms. Down-sizing, out-sourcing and total quality management became terms of common parlance to describe the ways lean and mean firms improved their competitiveness in the 1970s and 1980s.

Wisconsin fared relatively well in the 1970s, at least compared to the rest of the Great Lakes States. This was due in part to the fact that Wisconsin specialized in machinery rather than autos, and machinery had not been as hard-hit as autos by the huge increase in energy prices. Wisconsin had an auto firm, American Motors, but that firm built small cars, and sales of small cars rose when energy costs rose. But the U.S. auto industry as a whole had huge labor costs and union work rules that it could not run away from, and it had internal organizational problems. Its inventories were huge, and it was slow to identify problems in its production processes. In the 1970s, the auto industry was simply not built around the customer. It had become the opposite of lean and was not able to respond quickly to the challenge from abroad.

While autos typified in many eyes the problems of U.S. manufacturing and of the Great Lakes "Rust Belt" states, not all capital goods firms shared in these difficulties. Many capital goods were already being built in small batches, some being built to order, and as a result, many machinery firms already had close relationships with their customers. As the dollar fell in value during the 1970s, though not by enough to protect the auto industry, Wisconsin's capital goods manufacturers were given a temporary respite from foreign competition. In 1979, an article in the Wall Street Journal referred to Wisconsin as the "shining star of the snow belt."

The Challenge to Wisconsin's Machinery Industry in the 1980s

The bottom fell out of the U.S. machinery industry in the double dip recessions of 1980 and 1981-82. Capital investment of all kinds collapsed as interest rates soared. Between 1979 and 1983, Wisconsin lost over 100,000 jobs in durable manufacturing, an amount equal to five percent of its entire workforce. The tepid recovery that followed brought further problems for Wisconsin's export sensitive industries because the recovery was accompanied by very high interest rates that led to a strong appreciation of the dollar and to a massive trade deficit. This time the dollar went up, though not because foreigners were trying to buy increasing amounts of U.S. exports. It went up because they were buying increasing amounts of U.S. securities in order to earn the record high interest rates available in the U.S.

International capital markets had become sufficiently integrated by the early 1980s that differentials in national interest rates could lead to substantial changes in currency values, and because those changes in currency values were not driven by changes in domestic costs or productivity, they could wreak havoc with foreign trade. Rather than view the changing value of the dollar as a stabilizing force, it became a source of instability to exporters. Indeed, ever since the mid-1980s, fluctuations in currency values have been related to more trends in capital markets, such as interest rate differentials, than to changes in the relative costs of traded goods. In the new global economy, because of the way exchange rates are set, it is fluctuations in international capital flows that drive the competitiveness of manufacturing exports.

In the recovery that followed the recession of the early 1980s, foreign firms captured a growing share of America's machinery market. This meant that Wisconsin's recovery from the recession would be slow. Meanwhile, the continued, relentless competition from abroad forced firms to change the way they did business. In many cases, the Japanese emphasis on quality became instituted in U.S. firms as ordinary business practice. In addition, costs were scrutinized in new, rational ways and many functions were out-sourced.

In some cases, the assembly process itself was outsourced. Manufacturing firms became importers of their own products. Firms that outsourced production and ended up importing their own products were referred to as "hollowed out." These corporations continued to add value to their own products, of course, in the form of management, technology and design, and also in the brand names they could attach to the products they imported. But assembly was often outsourced, typically to Asian firms.

One Japanese method proved difficult to copy at first. This was "Just-In-Time" inventory management. In lean manufacturing, the lowest possible level of inventory is obtained by producing each component of a product just when it is needed. This method was developed in post-war Japan where it was especially attractive because a shortage of capital and space made it difficult to finance and store inventories that had not already been sold. In the Japanese system, goods were "pulled" from the manufacturing system by consumer orders, rather than "pushed" into the system by firms' production plans. In Japan, an assembly line of a complicated product might be located in a central building with the manufacturers of the components in small buildings just across an alley from the assembly line. Components would be shipped across the alley on dollies "just-in-time." No warehousing, loading or unloading would be needed, which saved a lot of money. The difficulty with this system is the extreme precision it required in the co-ordination of production between assembler and suppliers, and also in the atmosphere of trust and co-operation that was necessary for success. But once the system was mastered, the discipline required for the synchronization of production yielded other benefits, including an emphasis on quality.

In contrast to Japan, Midwestern factories were already spread across the landscape. Factories of suppliers were linked by trucks and trains to central warehouses that stored components for a set of assembling factories. Capital and space were abundant so there was no financial or physical imperative to shift to the Just-in-time method. But a shift was sought nonetheless on the belief that it would greatly improve product quality and productive efficiency.

Wisconsin's Response to The Global Challenge of the Early 1980s

How could the Midwest move to a just-in-time method of inventory management with factories so widely dispersed? An answer to this question was found in information technology. A problem raised by globalization was solved by the other dominant feature of the New Economy, Information Technology.

The advent of the cell phone and the placement of a cell phone in each truck was the crucial development that allowed factories and shipments to be linked together in a single complicated

system. Rather than dollies moving across an alley, semi-trucks moved across the entire Midwest. It was not proximity that made the Japanese system work, but predictability of arrival time at the destination. Today shipments leave one factory on a precise schedule, proceed to a destination hours away and arrive just in time. One truck pulls up to the loading dock just as the preceding truck pulls away.

The new system has many advantages over the system it replaced. Inventory holding and handling costs are reduced, processes vulnerable to breakdown are easily identified and strengthened, and producers can respond much more quickly to changes in consumer tastes. The response of Midwest manufacturing has been so thorough that a buyer of components can now routinely put the entire responsibility for timely delivery of zero defect components on the supplier's shoulders and expect performance. Indeed, more and more responsibility for product performance, including design, is now being put on the shoulders of suppliers, and suppliers have increased their reliability in order to meet the new expectations.

As the distances over which products can be shipped on precise schedules have increased, competition among suppliers has become more intense. If a cross-town supplier cannot meet the new standard, a new supplier in another city can be engaged. This has weeded out the inefficient firms and forced the survivors to get lean and mean. In this way, the cell phone information system has enabled efficient firms greatly to increase their sales. The result is that in the last two decades, the machinery industry has been transformed by the first wave of the information revolution. It should be noted in passing that the de-regulation of the U.S. trucking industry in the late 1970s also facilitated the transformation in Midwest logistics.

Because of the relatively inefficient system of truck transportation in Japan, it is hard for the Japanese themselves to re-copy the Midwest's version of this system. Competition among geographically dispersed suppliers in a just-in-time system requires an excellent highway system. The uncongested Interstate highway system in the Midwest offers it a distinct advantage with the predictability of travel times it permits. Offsetting this advantage is the fact that the distance over which deliveries can be made on a predictable basis is rapidly increasing. Shipping times are increasingly co-ordinated on a worldwide basis. Hence one of the great advantages of the Midwest that led to its resurgence in the last decade and a half will be eroded somewhat in coming years.

Wisconsin's political response to the economic difficulties of the early 1980s was also intense. Notable among the ongoing stream of studies and activities in support of economic development was a major look at the Wisconsin economy by the Strategic Development Commission, which issued its major report in 1984. And following the election of Governor Thompson in1986, Wisconsin paid much more attention to its business climate. In particular the effect that its tax and regulatory system had on the competitiveness of its businesses got new attention in the late 1980s and these systems underwent some major reforms. Some of Wisconsin's subsequent growth was due to a much higher level of effort to attract new businesses into the state, a task made possible once the business climate had been improved.

For the purposes of this paper, then, part of the successful Midwest response to the global challenge of the 1980s should be viewed as a product of the first wave of the information

revolution. The network of cell phones that links the shipments to the factories enabled a huge reduction in shipment, storage and interest costs. Hence, cell phones should be viewed as an input into the manufacture of automobiles and machinery. They -- and semi-trailers -- have replaced warehouses and dockworkers. And within firms, logistics management has replaced old fashioned systems of inventory tracking and verification.

Wisconsin manufacturers have become lean and mean, with an emphasis on quality that might never have occurred without foreign competition.

Wisconsin Manufacturing in the 1990s

The 1990s were a golden age for Midwest machinery manufacturers. More than just the introduction of better management and information technology was responsible for this prosperity. Domestic investment, including the purchase of machinery of all kinds soared in the 1990s. At the same time, purchases of machinery by developing countries, especially those in Asia, also soared. Meanwhile, the dollar had fallen substantially from its mid-1980s peak, and U.S. products were again competitive on world markets.

The huge growth in machinery sales provided the funds needed for the machinery manufacturers to purchase new efficient equipment for themselves. The transformation of the old Midwest manufacturing economy from a group of loosely connected factories into a tightly integrated network of quality-conscious, customer-driven managerial teams was financed by the large profits earned in the 1990s from booming sales.

The Midwest durable goods manufacturers have become a more tightly woven network than ever before. Transport costs have fallen as the management of fleets has become more efficient. Whole new industries of supply chain management have emerged, led by the trucking firms who specialize in minimizing the costs of co-ordinating production activities over great distances. That is, many of the lean and mean manufacturing firms routinely outsource their logistics problems to firms that specialize in these activities.

While outsourcing reduces employment within manufacturing, it should not be confused with a decline in the importance of manufactured products in the economy. There is no decline in the value of automobiles or of machinery as a share of the Gross Domestic Product in the U.S. In fact, there seems to have been a modest increase in the percent of consumer and business spending on the Midwest's traditional products during the 1990s. But there has been a large decline in the share of workers engaged in assembly, which reflects an increase in productivity, and, because of outsourcing, there has also been a large shift of employment out of manufacturing and into the service sector. It bears repetition, however, that the products traditionally made in the Midwest are not declining in economic importance.

As the 1990s came to an end, the only clouds on the horizon for U.S. machinery manufacturers seemed to be that the value of the dollar had again risen somewhat. The opportunity for investment provided by the U.S. stock market in recent years led to a huge inflow of funds into the U.S. causing the dollar to rise in value. As a consequence, a trade deficit emerged that is running at this writing at a rate of over $400 billion per year. Machinery manufacturers are

among those who have suffered the most and it will be difficult to increase machinery exports while the dollar remains high.

The Challenge of the New Economy to Wisconsin Manufacturing

But Wisconsin will be challenged in coming decades by the changing nature of the economy. One symptom of that challenge has been widely publicized, namely, the relatively small percentage of college graduates employed in Wisconsin. Another symptom is the continued purchase of Wisconsin's small and mid-sized companies by firms headquartered out of state, and in many cases, out of the country. Are these two challenges related?

In what follows, I provide a strategic overview of the new economy into which both of these challenges fit. Other problems and possibilities are also identified in the overview. My conclusion is that while Wisconsin will face difficulties in overcoming the challenges posed to it by the new economy, Wisconsin is better positioned than many states to meet those challenges.

The first step in addressing our problems and opportunities is to have a cohesive strategic overview of the new economy. Is there really such a thing as the New Economy, and if so, how does it differ from the Old Economy? Where are the openings into which a set of old economy industries can be plugged into the New Economy? Do these openings provide an opportunity for a state like Wisconsin to enjoy the benefits of the New Economy?

Some Features of the New Economy

Midwest manufacturing overcame the challenge of the early 1980s in several ways, but one of them was to use information technology to lower the cost and improve the quality of its products. A view of this process was provided above, and it provides a way to understand how the New and Old Economies are linked. In that view, the Old Economy buys inputs from the New Economy. In this section, I expand that view and then consider its implications.

In describing how the Midwest met the challenge of the 1980s, the substitution of information technology for warehouses was emphasized. In looking to the future, we must remember that the it is not just information technology whose role is expanding, but that the role of industrial technology is accelerating as well. The automobile I buy differs from the automobile my grandfathers bought in fundamental ways. My car has less steel but better technology. Over the years, brain power has been substituted for both brawn and raw materials, and this substitution has occurred within the individual automobile firms as well as within the Midwest's factory network. The substitution of technology for other inputs is likely to continue and it will remain an important feature of the new economy in many industries.

Technology is but one form of information. Other forms of information are increasing in importance as well. Branding and consumer information is important. The practice of business management is increasingly complex and is dependent on information. And the linking of all these kinds of information through information networks is growing.

Taken together, it is this group of inputs, all based on information, that define the New Economy,

and it is the growing roles of these inputs that will dominate the character of the economy in coming years. To think of them as inputs is the key to understanding the new economy. To say that an automobile is made out of information to a greater extent than it is made out of steel may violate our intuition about the physical character of a product, but it is not misleading in an accounting sense because information now makes up a greater share of the cost of a new automobile than raw materials do. Economists would use the term "value added," and would note that the share of value added in final output that is provided by information exceeds the share of value added provided by physical materials and possibly even of the whole process of assembly.

Because the slice of the economy I have emphasized in this report is the manufacture of machinery, it would take me too far afield to describe information as a final consumer product. But a brief consideration of how little consumers actually spend on information compared to how much they spend on durable goods – their phone bills, their cable TV bills and their Internet connections combined are less than a car payment – tells us quickly that the major role of information in the new economy is to add value to the whole pipeline of production, rather than to be a consumer product itself.

This tells us that from the perspective of the Wisconsin economy, the threat of the New Economy is not that consumers will stop buying lawn mowers made in Wisconsin and start buying "information" made in California. The threat is that an increasing share of the cost of a Wisconsin lawnmower will be the cost of California information, while a shrinking share will be spent on Wisconsin-made inputs and workers. New, more intelligent ways to make lawn mowers will reduce the cost of lawn mowers and improve their quality. The question for Wisconsin's future is whether the college graduates who contribute to these new information systems will live in Wisconsin or somewhere else.

Economies of Scale in Information

An important feature of the new economy is that there are enormous economies of scale in the field of information. An investment in technology is just as expensive if it will be used to produce one thousand or two thousand farm tractors, but the cost of the invention per tractor will be half as large if production is twice as large. Technology, branding and systems of management are forms of information that have large economies of scale.

This insight predicts that a consequence of the growing importance of information will be a drive toward large scale production in all industries, as companies try to expand in order to spread their information costs over a larger volume of production. One way to expand is to export -- better to sell on two continents than to sell on one. Hence the growing importance of information is one of the forces driving the move toward a global economy. Foreign producers will feel these same forces, of course, and they will try to expand into U.S. markets.

A second way to spread information costs over a larger volume of production is for firms to combine. This insight suggests that we will see a continued move toward consolidation of many manufacturing companies in the new economy. This consolidation will take place on a worldwide basis. This means that mergers and buyouts will continue to be a feature of

Wisconsin's economic news in coming decades. Wisconsin's machinery manufacturers will be a target for foreign buyers who need to spread their technology costs over a larger volume of production. Because of the growing importance of technology, and because of the economies of scale in the development and application of technology, consolidation can be expected to accelerate in the future.

In terms of consolidation, other industries are further along than the machinery industry. This may be because the scale of production in machinery is small enough that automation has not been as economical in machinery as it has been in some other industries. For example, while a single auto assembly plant may turn out 300,000 copies of the same car each year, the entire market for farm tractors in the U.S. is only about 100,000 per year, and this is divided among several brands, each offering many models with enormous variations in size and specifications. In many machinery industries, volumes have remained small enough and the variety of products large enough that skilled hand work has remained a major input. Because of the low volumes and necessary hand work, the assembly costs are likely to remain high in the machinery industry in the future, so that even after machinery feels the full impact of the information revolution, manufacturing cost will remain a relatively substantial part of the final costs of the product. But despite the importance of assembly costs in the machinery industry, it remains the case that an important effect of the increasing role for information as an input will be a strengthening of the forces of consolidation.

To gain insight into the possible structure of the machinery industry in a mature knowledge economy, it is helpful to note the organizational patterns of some other industries in which knowledge is a larger share of the final costs than it is in machinery. Three industries in which information plays a moderate, large and dominant role respectively, are autos, pharmaceuticals and Internet technology. These three industries have large dominating clusters of activity in Detroit, New Jersey and Silicon Valley respectively. Each can tell us something about the complicated interactions among regional economies, industrial clusters and the forces of consolidation in the New Economy.

Industrial Clusters: Autos, Pharmaceuticals and Internet Technology

Detroit became the headquarters of auto manufacturing in the first decade of the 20th century when manufacture and assembly was the most advanced sector in the economy. The clustering of manufacturing activity reduced the supply lines and increased the transfer of manufacturing skills and expertise across firms. As the volume of production of a single model increased to the extent that more than one assembly plant was needed, plants were spread across the country to be near consumers in order to minimize transportation costs. But with the proliferation of models over the last few decades, volumes no longer justify several plants for the same model, so coastal plants have been closed and assembly returned to the Midwest, again to minimize transport costs, but also to be near the engineers and laboratories, as the importance f technical information has grown within the auto industry.

Today, Detroit has a bigger share of the development of auto technology than it has of auto manufacture. Many foreign auto manufacturers have opened labs in Detroit to take advantage of -- but also to contribute to -- the cluster of engineering talent and technology that are growing in

Detroit and whose role in the auto industry has increased in importance in recent years. Technology has become so important and so large a share of costs in the auto industry that firms the size of Saab and Volvo are no longer able to afford to develop their own technology. This is the major reason why the number of auto manufacturers has shrunk in recent years. The major auto firms are now demanding a similar rationalization from their suppliers, which is leading to a consolidation at that level. Competition among suppliers who sell relatively uniform products to manufacturers is likely soon to be organized through auctions on the Internet.

Pharmaceuticals are a more information intensive industry than autos are, and perhaps even more can be learned about how the knowledge economy will affect industries in the future by looking at how the pharmaceutical industry is organized today. In pharmaceuticals, the ratio of the costs of technology to the cost of manufacturing is extremely high. In such an industry, large volumes of sales are essential if development costs are to be recovered. The important part of the pharmaceutical company for a region to attract is its headquarters and its research and development labs, not the factories that manufacture the pills. Pharmaceutical research centers have enriched New Jersey, while the pills are made in Puerto Rico. Software is an even more knowledge intensive industry than pharmaceuticals, and it provides an extreme example of the same economic force. Seattle has Microsoft's headquarters and its major research and development center. Where the disks or CD's are burned and put into mailers -- the physical part of software manufacture -- is not the valuable part of the software industry for a region to attract.

Networks of Business Professionals

A final feature of the new economy, the functioning of a vigorous professional network, can best be observed in Silicon Valley. Young engineers move to Silicon Valley because that is where the jobs are, and firms move to Silicon Valley because that is where the engineers are. Employee turnover is high and firms seem to divide and re-combine around new functions quite rapidly. Corporate structures are fluid. Networking among these engineers and their employers provides an important source of information flow. The glue that holds this cluster together are the economies that derive from having one job market instead of two, and the more rapid rate at which information flows through a local network than through distant networks, possibly because of the rapid rate of employee turnover.

While most analysts of the new economy emphasize the flow of information among the scientists and engineering of Silicon Valley, it is important to remember that the valley is also the home of a thriving network of business professionals who staff not only the headquarters of the corporations located there, but who also include entrepreneurs and venture capitalists, along with a group of lawyers, accountants and bankers who specialize in financing the information technology industry.

Note that it is the latter group who decide where the money will go, which means they decide which ideas are to be developed, which new products created, which companies are to merge, which new ventures can be spun off from existing companies, etc. In the new economy, capital is directed decentrally by a network of legal and financial professionals and entrepreneurs, typically outside the walls of any manufacturing company. A truly vigorous industrial cluster requires not only a network of engineers and scientists to work on the technology, but also a

strong network of business professionals and venture capitalists to provide direction to the industry. Corporate headquarters of medium to large sized firms, and the business professionals who provide expert advice to those headquarters, provide an important breeding ground for these professionals and potential entrepreneurs.

Machinery in the New Economy

The same forces that drive autos, or even pharmaceuticals and software, are at work in the machinery industry, though their implications to date have been softened because the costs of assembly of machinery remain relatively high. Wisconsin should learn the lesson, however, that global consolidation of machinery manufacture is likely because consolidation will spread the cost of information and technology over a larger volume of production and in this way increase a firm's competitiveness and brand image. This is probably the force that lies behind the purchase of many of our machinery companies by foreign manufacturers. This force is likely to accelerate with the increasing importance of information as an input.

Machinery is likely to develop into an industry where a few large firms in each industry have assembly operations on all continents, but a headquarters in one of them. To become a local assembler is to accept a role that is likely to diminish in importance in coming years. Wisconsin's strategy should be to see that the corporate headquarters and the research function remain here for a large percentage of its firms. Far better for Wisconsin, for example if Case had bought New Holland than that New Holland bought Case. Far better for Wisconsin, for example, if Giddings and Lewis had purchased the machine tool division of Thyssen than that Thyssen bought Giddings and Lewis. How to retain corporate headquarters in Southeast Wisconsin remains part of the challenge of the New Economy to Wisconsin manufacturing.

A Vision for Milwaukee for the 21st Century

Imagine Milwaukee as the Silicon Valley of the machinery industry. As a worldwide hub, it would include in its region not only the headquarters of some newly consolidated worldwide firms, but it would also include many small entrepreneurial firms -- perhaps spinoffs from the larger companies -- revolving around a few bright inventors, who would sell specialized components or licenses to the original equipment manufacturers or who might consult with them or work jointly with them on special projects. There would be excellent links to basic university research on materials science, hydraulics, and electronics. Perhaps a large independent lab with public/private funding on machinery-related science would be nearby. Sematech in Austin provides the best example of such a lab.

The engineers of both the small and large firms would be networked, perhaps through their professional associations, perhaps through their links to university faculty, or perhaps through their accountants and consulting firms. A vigorous professional network would have all three of these links, possibly more, and it would provide enough information about job vacancies to support employee turnover of the kind that would bring the most able brains to work on the most rewarding problems. A network of this kind would offer exciting opportunities to the best young professionals, and would attract many of the best to live in Wisconsin.

This vision suggests that it will not be enough just to keep the factories in Wisconsin, though assembly will remain important in the machinery industry for a long time. It will also be important to sustain an substantial research and development function in Wisconsin as well. A network of the best scientists and engineers moving quickly from assignment to assignment would offer excellent careers to individuals, and it would also provide a formidable hub of technical know-how and fast-moving technological developments that would make Milwaukee one of the best places for a machinery firm to locate on a world-wide basis. How difficult it would be to locate somewhere else and have to compete with Milwaukee in developing new products, or in solving new technical problems, when one's competitors in Milwaukee had access to the world's best talent.

I have argued that it would also be important to keep many of the corporate headquarters in Wisconsin. They, and the outside professionals they use, would provide an important breeding ground of the small businesses who would invigorate the local economy and who would team with the larger firms to develop new products and technologies. Perhaps Milwaukee would relate to Chicago in the way Silicon Valley relates to San Francisco in its use of business professionals. A strong presence of professionals on the ground in Milwaukee would be supported by some of the world's best in Chicago. Southeast Wisconsin needs to have its machinery manufacturers be entrepreneurial and on the prowl for foreign acquisitions rather than just to consider the offers they receive to sell to foreign headquarters. Entrepreneurial Venture Capitalism cannot be sustained without these business professionals. It is in our interest to try to provide a congenial headquarters city for these firms.

And we need not give up on firms that have already sold themselves. If we develop the right environment of exciting new engineering technology, New Holland will find it to be in its own interest to have its technology development remain in Racine. Just as many foreign computer manufacturers have long had labs in Silicon Valley, and just as foreign auto makers maintain labs in Detroit, Milwaukee should seek to become the worldwide center of machinery technology and expertise. This would not only protect its remaining blue collar jobs, but it would provide exciting employment opportunities to Wisconsin's best young engineering students as well.

In my view, we need not even give up on information technology. Granted, Silicon valley would sell many products to a vigorous Wisconsin-based machinery industry. But the pipeline between the two industries can be owned and developed from either end. It is as natural to develop information technology for the machinery industry at the home of the machinery industry as it is to develop it at the home of the information technology industry.

Success at developing an Information Technology industry is much more likely if it is based on a strong vigorous base of customers than if an attempt is made to develop it as an island in competition with Silicon Valley and its many would be imitators. If Wisconsin is to retain and attract its share of highly educated people, it will need to have centers of entrepreneurial activity and centers for research and development. Wisconsin has a base of strength in its machinery industry that others cannot match. The surest future is to build on that advantage.

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