Manufacturing: Winning the New Production Economy

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Mike Klonsinski
Executive Director
Wisconsin Manufacturing Extension Partnership
Madison, Wisconsin

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1. Introduction

As Wisconsin enters the 21st century, some have suggested that the manufacturing strength that has served the state so well will be an albatross in the "New Economy." They point to slow industry job growth and visible closings of some large manufacturing plants as evidence of an industry in decline.

They are wrong.

Manufacturing is alive and well in Wisconsin although undergoing a transformation. At one time, manufacturing consisted of a factory-centric model that had raw material coming in the front door and finished goods out the back. Today, production is an enterprise-wide process that involves many manufacturing firms, a sophisticated service sector, a supportive training and assistance infrastructure, and a legion of technology developers.

Manufacturing – the art and science of transforming raw material into product - is the best wealth creation vehicle in the state today. More importantly, it is this "new production economy" that offers the best chance for Wisconsin's economic success in the future.

In this paper, we suggest that Wisconsin build on its core competitive advantage in manufacturing, emphasize production economy leadership as a goal, and use the new economy tools to create a production economy powerhouse.

2. Wisconsin Manufacturing Today – A Competitive Advantage

> From 1992 to 1999, in a period when the economy as a whole grew by 29%, the Federal Reserve's index of manufacturing output climbed 42%. In the same period, durable goods production – which includes tough-to-make high-ticket stuff such as computer equipment and motor vehicles – was up by an even greater 73%. Not bad for a supposedly postindustrial society. Fortune. October 2, 2000.
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> … every $1 of a manufactured product sold to a final user generates an additional $1.19 of intermediate activity. Manufacturing's multiplier effect is greater than the general multiplier effect of 94 cents for all industries. It is far greater than that of the service sector, which generates only 77 cents of intermediate activity for a $1 sale to final users. Source: U.S. Department of Commerce, Bureau of Economic Analysis, input-output tables. Cited in NAM online.

One of the biggest myths today is that flat manufacturing employment equates to a stagnant industry. In fact, looking only at employment growth masks the impressive productivity gains of the industry and the intermediate impact that manufacturing has on the rest of the economy. If employment were the indicator of industry strength, then China would be the global manufacturing leader.

Fortunately, that is not the case. U.S. manufacturing is the dominant player, doubling Japan's output and exceeding by a third the combined output of France,

Germany, and the U.K. Manufacturing's investment in technology over the past ten years is the biggest reason why American manufacturing productivity tops the world. Manufacturing drives cutting edge advances in technology by conducting 57 percent of all research and development in the U.S., according to the National Science Foundation.

American manufacturing leads the world, and Wisconsin is its crown jewel.

- Wisconsin's 10,000+ manufacturers employ over 619,000 people.
- Manufacturing provides over $43 billion to the Gross State Product – over 31% of the Total Private Industry contribution. This ranks second in the nation. (Bureau of Economic Analysis)
- Manufacturing contributed 35% of the growth in the Wisconsin economy between 1992 and 1998 (Bureau of Economic Analysis).
- 24.7% of the state's employment is in manufacturing compared to the national average of 16%. (Ludeman)
- Wisconsin has added over 76,000 manufacturing jobs in the past decade. (Wisconsin Policy Research Institute)
- The average manufacturing job in Wisconsin pays over $35,647 and approximately ¾ of manufacturing workers make over $25,000 per year – a higher percentage than any other industry except government. (Wisconsin Policy Research Institute).
- Manufacturing in the non-urban areas of the state provided 55% of the state's manufacturing employment growth since 1991, bringing higher paying jobs and benefits throughout the state. (Wisconsin Policy Research Institute)
- Wisconsin's manufacturing strength is not dependent on any one industry.

It is not a coincidence that this manufacturing strength is correlated with our high quality of life. The Corporation for Economic Development ranked Wisconsin third nationally in Economic Performance and second in the Equity subcategory, which measures poverty rate, income distribution, income distribution change and rural/urban disparity.

Wisconsin's manufacturing is strong but this does not mean that the industry as it exists today will continue to succeed in 2010. The drivers of the New Economy introduce new pressures that threaten the viability of traditional manufacturing. Fortunately, Wisconsin is well positioned to make the transformation from a traditional manufacturing sector to an enterprise-wide production economy.

3. Drivers of the New Economy

Before we can propose any recommendations on how Wisconsin can succeed as a production economy in the 21st century, we have to understand what new pressures and opportunities have been created by this new economy.

Unquestionably, the biggest driver of the new economy is information technology. The ease with which information can be collected, analyzed, distributed, and packaged has made the world smaller, customers smarter, and employees more valuable. It has fundamentally changed the nature of competition and business success. Four "new realities" are highlighted.

Globalization. The world is a closer place. Customers and competitors that were once considered too remote are now making purchases or taking business away from local firms. The globalization of business is well underway and the impact will only increase.

Industry	% reporting that more than ¼ of business is conducted with partners headquartered overseas
Aerospace	25%
Automotive	20%
Chemicals	41%
Consumer Deliverables	15%
Consumer Packaged Goods	16%
Industrial Machinery & Equip	22%
High Tech	42%
Pharmaceuticals	31%
Printing and Publishing	9%

Supply Chain Survey: Industry Week/Ernst & Young 2000

- Customers. The largest untapped markets are overseas and the Internet is bringing those markets closer for American products. The manufacturer that is not active in foreign markets not only misses the opportunity for new business but also loses out on the product and partnering knowledge obtained by working with customers in a different culture.
- Competition. In the not-too-distant past, natural barriers (e.g. geography and distance) and "man-made" barriers (e.g. patents and tariffs) provided some protection from foreign competition. In a new economy of Internet auction sites, product life cycles measured in months, and multi-site plant locations, those barriers become less relevant. The volume and pace of competition accelerates. Manufacturers that believe they are insulated from out-of-state competition are destined to be losers in the new economy.
- Capital. Between 1994 and 1998, U.S. manufacturing companies invested over $147 billion abroad. During the same period, $209 billion

was invested in American manufacturing from foreign sources (Fortune). Today, 46% of Wisconsin firms with more than 500 employees are owned by entities located outside the state of Wisconsin (Wisconsin Manufacturers and Commerce data). The reality of increasing foreign and multi-site ownership is that there is less loyalty to a region due to ownership. Productivity performance becomes the sole factor of whether a company stays, expands, or closes in a region. Regional economies must recognize and react to this new reality.

The customer is king … more than ever! Better, faster, cheaper has always been the mantra of the marketplace. In the new economy, you can add *customized* to the list. Quality and ever improving productivity gains are a standard expectation for today's firms, which is why lean manufacturing is the hottest management solution in manufacturing today. The new economy expectation is that the customers get what they want when they want it.

Dell Computer was an early standard setter by building expectations that a customer can get a computer with their choice of options delivered within three days. The Kenworth Truck plant in Renton, Washington offers trucks with100 different options and order-to-delivery time is three weeks to accommodate the increasing expectations of their customers. All companies in the new economy can assume that their customers will demand similar customized options.

Information and knowledge management is survival. In today's economy, one-on-one customer marketing and fulfillment, real-time process tracking, and communicating instant order changes throughout the supply chain are operating requirements. The ability to manage information and turn it into value is increasingly important during this time of information overload. Reliable information and knowledge management systems, information savvy employees, effective e-business operations, and new types of "infomediaries" (people and organizations that can turn the vast amount of data into usable information) become a competitive advantage.

Waste Not. Demographics, social and political concerns, and cost are forcing firms to pay more attention to the amount of waste that ends up in the landfill or in the air. Manufacturing enterprises that are "lean and green" open up market development opportunities overseas and preclude regulatory and behavioral backlash at home.

Related to the environmental concern is the need for manufacturers to address energy usage. Energy costs continue to rise and public resistance to the development of new power generation sources is always high. The 21st century production firms that implement technologies and techniques to improve energy productivity will gain a competitive advantage in cost and support social concerns regarding energy production.

These economic realities change the nature of manufacturing and create fundamentally new challenges for those in the production business.

The Committee on Visionary Manufacturing Challenges, a group of public and private manufacturing experts led by former UW-Madison Dean of Engineering John Bollinger, looked at these new realities and identified six grand challenges facing manufacturing in the 21st century.

Grand Challenge 1. Achieve concurrency in all operations.
Grand Challenge 2. Integrate human and technical resources to enhance workforce performance and satisfaction.
Grand Challenge 3. "Instantaneously" transform information gathered from a vast array of diverse sources into useful knowledge for making effective decisions.
Grand Challenge 4. Reduce production waste and product environmental impact to "near zero."
Grand Challenge 5. Reconfigure manufacturing enterprises rapidly in response to changing needs and opportunities.
Grand Challenge 6. Develop innovative manufacturing processes and products with a focus on decreasing dimensional scale.
Source: Visionary Manufacturing Challenges for 2020.

Addressing these grand challenges will allow manufacturers and a production economy to win in an information rich global economy with sophisticated customers. The real trick is to design and implement solutions to these challenges.

4. What are the keys to winning in the new economy?

The challenges of the new economy are substantial and there are hundreds of suggested solutions. But the winners in the production economy will be those manufacturers that master the following core competencies.

People – The most underutilized resource

> "[People] are the crown jewels … and they know it. Brain power can't be tallied on a ledger sheet, but it's the prime factor driving the New Economy. More than ever in history, huge value is being leveraged from smart ideas – and the winning technology and business models that they create. So the people who can deliver them are becoming invaluable, and methods of employing and managing them are being transformed." *Business 2.0 The 10 Driving Principles of the New Economy*.

The industries that use production employees as little more than low maintenance assembly robots have largely moved offshore. These industries do not ask the workforce to add value, but only to reduce cost by working cheaper. Eventually, those industries replace people with technology or move the plant to another country that provides even lower price labor.

The industry that remains in the U.S. is the more sophisticated production that creates wealth by incorporating the brainpower of its employees into its products. In these industries, the untapped potential of the human in the production process is a wasted opportunity for adding value to the end product.

Increased entrepreneurship has been suggested as a means to energize a new economy. It is important to recognize that entrepreneurs are not just those individuals that develop new inventions in their garage - there are potential entrepreneurs in every part of the production process. The firms that best manage people - create a climate for internal entrepreneurship, attract and keep good people, invest in training, and design appropriate reward and motivational systems - will gain the key competitive advantage of the new economy.

Partnerships – The Value Network

The grand challenges of concurrency (planning, development, and implementation in parallel) in manufacturing, "instantaneous" transformation of information into effective decisions, and rapid reconfiguration of manufacturing enterprises cannot be met without having effective partnerships in place.

Most manufacturers operate within a supply chain (customers' customer to suppliers' supplier) and a value network of supporting organizations (legal, accounting, transportation, human resource services, training, financial services). As customer demands for product flexibility and delivery speed increase, it becomes imperative that a manufacturer has a trusted, responsive, integrated

supply chain and a close support network. The manufacturing enterprises that solve the partnership management challenge will be those that win in the new economy.

Technology

There is no such thing as a "technology" company. Trying to distinguish between a 'technology' company and a 'non-technology' company is irrelevant. Technology is a tool used by all firms to create better products or services. Companies that adopt technologies to create a value advantage (e.g. Dell Computer) are those that will win in the 21st century.

To meet the challenges of the new economy, manufacturing enterprises must apply 'hard' and 'soft' technologies. 'Hard' technologies - biotechnology, nano-technology, 'green' technology, etc. - are the new sciences that will transform industries by creating dramatically new processes or products. A manufacturer does not have to develop the technology but does need to adapt the technology to their own production processes or product lines. Golf carts that use GPS to calculate yardage, and cows that produce more and better milk thanks to genetics and biotechnology are two examples of "simple" products made more valuable through the application of 'hard' technology.

"Soft" technologies – workforce motivation, concurrent product development, value chain management, etc. – are the technologies that are overlooked in the glitz of the hard sciences but are critical for sustainable economic success. An economy increasingly dependent on people and partnerships needs new methods of maximizing these core assets. Using lean manufacturing to transform a company (Toyota, Dell), creating an entrepreneurial culture (3M), and developing employee "ownership" (Harley-Davidson) are examples of how applied 'soft' technology can produce enduring competitive advantage.

Knowledge and information

The information portion of any good or service is becoming a larger part of the total value. Behind the delivery of a customized Dell computer is the information that tracks customer preferences, links existing inventory to supplier orders, feeds new product development databases, maximizes cash flow, and establishes new marketing targets. The knowledge accumulated from this information collection and management system is a strategic advantage.

Information management is not easy. Most firms do not have the strategies or the systems to collect, analyze, and share information. Small manufacturers find it especially difficult to put in place an information management system that meets their needs and is cost effective. And yet, the management of information will be the most important strategic advantage in the 21st century economy.

5. What can Wisconsin do?

In a world where borders are becoming less important, it might seem that the forces of the "new economy" would make state-based efforts meaningless. While it is true that market forces will dictate the primary successes or failures of a regional economy, there are actions within the control of policy makers that can make a difference whether or not the state can foster a successful production economy.

The recommendations below are intended to accelerate the creation of a world class production economy for Wisconsin. These are not a comprehensive set of recommendations but a guide for gaining a production economy advantage.

1. Demonstrate broad-based leadership commitment to building a world-class production economy in Wisconsin.

   The new production economy depends on the active contributions of many different sectors. A strong production economy cannot exist with a weak service sector, poor infrastructure, or countervailing government policies. For Wisconsin to win in this field, the state's leadership must establish a consistent, high level, visible commitment to achieving the goal of continuing leadership in this important sector.

   Recommendation. In 1994, the Wisconsin Center for Manufacturing and Productivity, Inc was created as a vehicle to improve the competitiveness of manufacturing in Wisconsin. This cross-section of labor, business, academia and government leadership reviews manufacturing competitiveness issues, shares manufacturing support information, and directs the Wisconsin Manufacturing Extension Partnership program. This cross-sectional group should produce a coordinated, strategic plan to achieve Wisconsin production economy leadership.

2. Establish the nation's most responsive workforce training support structure for manufacturing.

   The new production economy depends on a skilled, entrepreneurial workforce.

   People and companies are mobile but the public support structure for training is local or state based. By establishing a training infrastructure that is recognized as one that is most responsive to, and anticipates the training needs of each manufacturer, Wisconsin can provide a state-based competitive advantage for existing manufacturers and an incentive for production enterprises to grow and locate in the state.

Wisconsin is already home to one of the smartest and most productive workforces in the country. The state boasts the best technical college system in the nation and has been recognized for its innovative workforce development practices. As the importance of the existing workforce increases and the costs of turnover remain high, the value placed on an existing responsive training infrastructure will increase for manufacturers.

Recommendation. Build on the technical college system and accelerate efforts by the schools to become a full-service training resource for small manufacturers. The Wisconsin technical colleges can reduce the people development burden for manufacturers by providing training assessment and planning, linking training plans to company strategic plans, establishing consortia of manufacturers around customized training, and bringing new skill development opportunities to the firms.

3. Strengthen the Production Economy Support Structure.

The new production economy depends on the ability of firms to adopt new technology and techniques. Many small manufacturers (over 10,000 in Wisconsin) typically do not have the time, money or expertise to implement the technology or organizational changes necessary to compete.

Wisconsin boasts two manufacturing extension centers – the Wisconsin Manufacturing Extension Partnership and the Northwest Manufacturing Outreach Center, a strong Small Business Development Center network, and many university-based extension services. Currently these organizations are helping Wisconsin manufacturers implement new technologies and techniques such as lean manufacturing and e-business. This network of resources can be a competitive advantage for Wisconsin.

Recommendation. Promote and expand the manufacturing extension network for use by Wisconsin's manufacturers. Use the manufacturing extension centers to help manufacturers adopt practices that strengthen the core competencies of the new economy: people, partnerships, technology, and information technologies.

4. Focus research on production economy challenges with 'The Wisconsin Idea' approach to moving research benefits into Wisconsin firms.

The new production economy depends on the adoption of innovative product and process technologies. The universities of Wisconsin, both public and private, play a critical role in developing the technologies and the expertise to apply those technologies.

The Committee on Visionary Manufacturing provided a set of recommendations for research priorities that set an appropriate framework for universities looking to support a production economy. The following build on the recommendations of the Committee:

Recommendation: Establish inter-disciplinary research and development programs that emphasize multi-investigator consortia both within institutions and across institutional boundaries. The Center for Global Electronic Commerce at the University of Wisconsin is an example of this cross discipline research that targets production economy challenges.

Recommendation: Establish priorities for long-term research with an emphasis on crosscutting technologies that will address the grand challenges. Adaptable and reconfigurable manufacturing systems, information and communications technology, and modeling and simulation are areas worth exploring. The Milwaukee School of Engineering's Rapid Prototyping program is an example of research and application of a crosscutting technology.

Recommendation: Establish basic research on breakthrough technologies such as biotechnology, submicron manufacturing processes, and enterprise modeling and simulation.

Recommendation: Establish interdisciplinary research on the "soft" science of creating an effective production enterprise such as the decision-making process in a value chain, management and use of information for intelligent decision-making, and understanding the effects of new technologies on the manufacturing workforce, work environment and surrounding community.

6. Conclusion

The stakes are high. A 1% increase in Wisconsin manufacturing productivity adds $420 million annually to the state's economy directly, and over $1 billion if intermediate impact is included.

The wealth that is created by a strong production economy supports high-wage jobs (manufacturing *and* service), produces investment in new business and reinvestment in existing business, supports research at our universities, and energizes local communities throughout the state. A diverse production economy provides a buffer in economic downturns and multiple opportunities in a growth economy. Wisconsin has benefited from this type of production economy in the 20th century and can duplicate this success in the next century.

To retain its manufacturing leadership, Wisconsin must recognize and build on its core advantage as a strong producer of goods. The state already has a workforce skilled in production, diverse manufacturing sectors, a "building" culture, and a strong production support infrastructure. By coupling these existing strengths with a commitment to build the best workforce, provide a valuable production support structure, and focus our world-class research on production challenges, Wisconsin can still enjoy the high quality of life that comes to leaders in a production economy.

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