
OHIO ENERGY & ADVANCED MANUFACTURING CENTER

A White Paper

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MANUFACTURING CENTER



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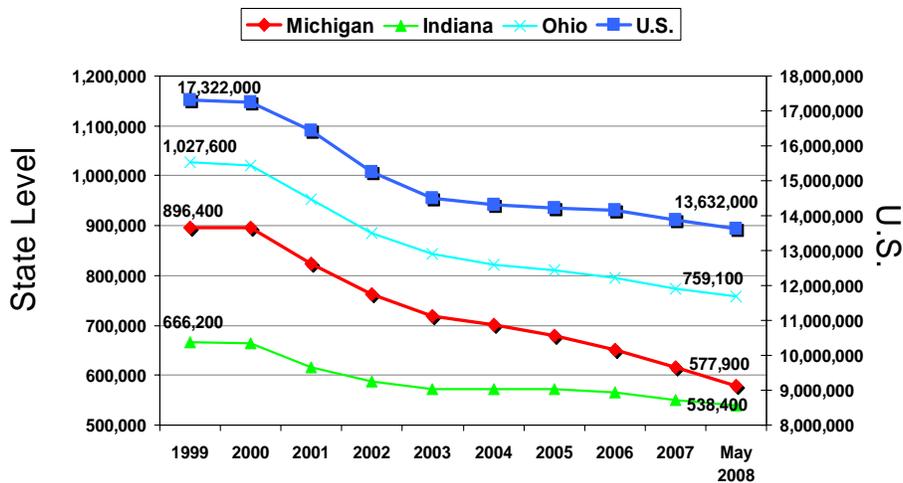
Contents

Problem Statement	1
Case for the OEAMC	3
The Sustainable Agile Manufacturing Model	3
Economic Development through R & D	7
Conclusion	8
Authors' Biographies	9

Problem Statement

For the United States, our extended period of world dominance in manufacturing has ended. Other countries have become global leaders in many industries and the United States now finds itself flooded with manufactured imports. Our country is trying desperately to recover from the devastating loss of 3,690,000 manufacturing jobs from 1999 to 2008.

Manufacturing Employment 1999 – May 2008

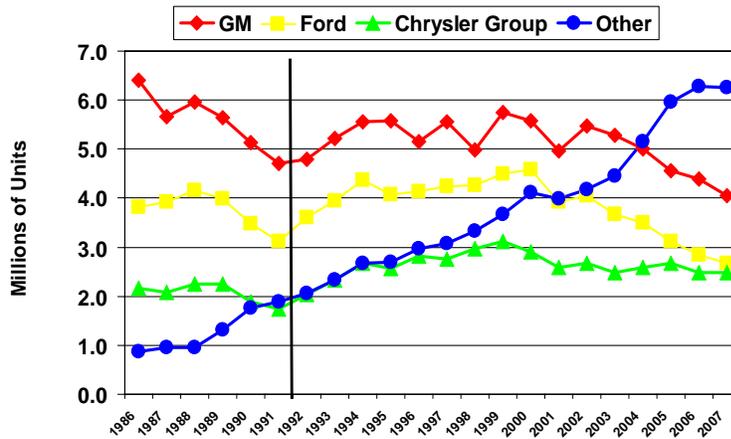


Source: BLS July 2008

In the automotive industry, current production models are outdated and new models are slow to be introduced. The Center for Automotive Research (CAR) in Ann Arbor, Michigan, recently reported to its members that Ford and GM are now below recession levels in automobile production in the United States. And, as goes the job loss in the auto industry, so goes the rest of the U.S. manufacturing industry. Closer to home, Ohio went from 1,027,600 to 759,100 manufacturing jobs from 1999 to 2008.



North American LV Production Ford and GM NA production below recession levels



Source: Automotive News

Ohio's industries have been hit hard by a global economy that is rapidly shifting to regions with cheaper labor sources, absence of environmental laws, favorable monetary policies, and government investment in industry infrastructure. Manufacturing in China, India and other developing nations is increasing exponentially, and, as time goes on, these producers will move up the value chain, just as Japan once did.

In response, manufacturers in Ohio and throughout the United States are looking for methods to adapt their processes and products. Manufacturers who adopt innovative methods and implement effective strategies to shift their paradigm will improve their competitiveness and profitability. We must now commit to strategically investing in emerging technologies to regain market share in all manufacturing industries.

Governments can play a role in re-energizing our country's manufacturing base. State and federal governments can assist by amending their tax policies, committing to improve public infrastructure and expanding their workforce development programs; but the most significant "game changing" innovations must come from the private sector.

Incremental changes in manufacturing functions have not been effective in stopping the hemorrhaging of jobs from Ohio and the United States to countries with a low cost labor advantage. We must alter the landscape of manufacturing in order to maintain profit margins and high quality labor rates. Without significant modifications to the way we produce goods in this country, Ohio and the United States will fall even farther behind in manufacturing excellence and competitiveness. Leading manufacturing companies that are squeezed by rising energy prices, demands for low mark ups and foreign competition are exploring opportunities to collaborate with material suppliers and strategic manufacturing partners in the development of future technologies.



Case for the OEAMC

Several years ago, manufacturers and others in West Central Ohio recognized the need to effect changes in energy production and manufacturing technologies through focused research and development (R&D). They have taken aggressive steps to bring about significant investments in the energy and manufacturing businesses of our region.

Our Vision...

The vision of the OEAMC is to stimulate economic development in Ohio and the United States through Sustainable Agile Manufacturing focused on mass customization.

The activities underway have a very real and immediate need for a strong organization to coordinate the interaction of the various R&D projects and their collaborators. In the summer of 2008, the Ohio Energy & Advanced Manufacturing Center (OEAMC) was incorporated to serve as this leadership organization.

The vision of the OEAMC is to stimulate economic development in Ohio and the United States through Sustainable Agile Manufacturing focused on mass customization.

The mission of the OEAMC is to provide an environment in which collaborating partners can share and develop intellectual property in an open and protected working environment. The OEAMC will serve as a central organization for creating consortia that will identify common manufacturing problems, contribute intellectual property, and commit financial capital to address the challenges associated with Sustainable Agile Manufacturing technologies. The OEAMC has adopted a position of neutrality with regard to the intellectual property that is developed by our consortium members.

Our Mission...

The mission of the OEAMC is to provide an environment in which collaborating partners can share and develop intellectual property in an open and protected working environment.

The Sustainable Agile Manufacturing (SAM) Model

SAM will . . .

- *Provide financial reward for invested capital.*
- *Respect the environment.*
- *Utilize renewable energy sources.*
- *Respect non-suppressive employment practices.*
- *Respect intellectual property rights.*
- *Deliver point of sale manufacturing.*
- *Create wealth through innovation.*

The Sustainable Agile Manufacturing (SAM) vision will be achieved by scaling up new and emerging technologies to change pre-production systems to become more timely and cost effective. Today's systems limit new product innovations because of slow and costly design, fabrication and prototyping associated with traditional mass production systems. In a mass production world, the ultimate deciding factor is cost and, in such a world, U.S. manufacturers are not able to compete. In a mass production world, there will always be someone willing to do it for less or a foreign government willing to provide subsidies to artificially drive down cost.



If Ohio's economy is to stabilize and grow once again, dramatic productivity improvements must be derived from the technology and the creativity of Ohio industries. New technologies and materials now allow for a *shift in manufacturing from a concept of mass production to mass customization*.

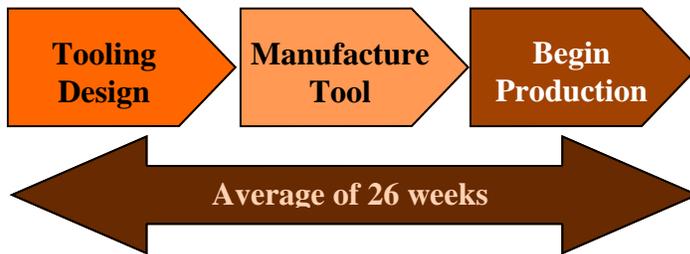
We must change the rules of the game.

The OEAMC will enable Ohio manufacturers to change the rules of global commerce by emphasizing Ohio's strength in technology and innovation. In this way, the new battle front for manufacturing will not be fought on the old metrics of cost, but will be won through applied innovation. The OEAMC will assist Ohio manufacturers to be properly prepared to be global innovators and leaders in technology.

The paradigm shift is a technology systems approach to manufacturing that the OEAMC team has identified as Sustainable Agile Manufacturing (SAM). A key to SAM is the development of a new pre-production (tooling) system that enables mass customization. The ultimate goal of mass customization is to permit product segmentation for very

small customer groups, even individuals, and to enable rapid product cycles.

Traditional Tooling Model

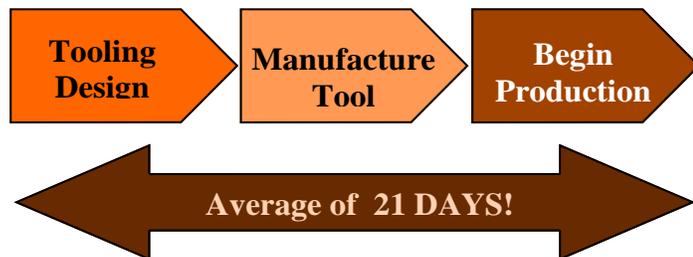


The foundational principal is the "10% model" which seeks to develop pre-production systems in 10% of the time, at 10% of the cost, but for only 10% of the previous model's production cycle. Thus, the ultimate outcome is the same amortized

piece price, but produced 10 times quicker which is an outcome that will support the economics and logistics required for SAM.

If mass customization is the answer, why haven't the U.S. manufacturers already adopted this model? Much of the answer lies with manufacturers' dependence upon a costly and burdensome system of design and tooling, necessitating long lead times, long periods of production, and long schedules to amortize the costs of these pre-production steps and tools.

Agile Tooling Model



This approach discourages customization and creativity, and necessitates large production runs and capital commitments. Further, it opens up opportunities for off-shore manufacturers to step into U.S. markets with cheap "knock-off" products.



The objectives of the OEAMC are to focus its efforts on the creation and coordination of consortia that achieve advances on the set of technology clusters described below. Through the development of individual innovations in each of the focused technology clusters and their integration and coordination into full-scale systems, SAM's promise can be fully realized.

The OEAMC supports the concept of Sustainable Agile Manufacturing (SAM) by addressing a number of focused technology clusters including but not limited to:

- *Design and Development*
- *Sustainable Energy*
- *Advanced Materials*
- *Agile Tooling*
- *Additive Manufacturing Technologies*
- *Advanced Forming and Joining Technologies*
- *Coatings/Decorative Technologies*
- *Simulation Software*

In the **Design and Development** cluster, the principal approach is to encourage manufacturing industries to constantly pursue product changes. New product designs will drive their own current products into obsolescence and thus allow the manufacturer to stay ahead of the competition. In addition, product innovation will remain a key component of the design and development process.

For many manufacturers, the cost of doing business is becoming increasingly driven by the cost of energy. As such, the **Sustainable Energy** cluster must fully optimize energy consumption as part of the manufacturing process. In some cases, this will mean utilizing the byproducts of the manufacturing process as a source of energy (e.g., waste heat for thermoelectric power generation) and, in other cases, producing electricity in unison with the manufacturing of advanced materials (e.g., power production using Integrated Gasification Combined Cycle while, at the same time, producing carbon nanofibers).

The use of **Advanced Materials** is critically important to the Sustainable Agile Manufacturing concept. Currently, raw materials that are used in manufacturing processes are becoming increasingly scarce as well as costly due to the growing demands of emerging economies in the Far East. Instead, manufacturers will need to embrace the use of advanced materials such as environmentally-friendly composites, non-petroleum-based polymers and plastics, and materials and components built with nanotechnology in order to sustain a cost-competitive manufacturing environment.

The field of Advanced Materials also plays an important role in the area of **Agile Tooling**. Traditional tooling for manufacturing currently consists of single-purpose, metallic tools that are both time-consuming and costly to produce. Instead, Agile Tooling takes advantage of the use of "soft" tooling that can be easily machined and deployed for mass customization applications. The utilization of Agile Tooling may require advances in high-tech manufacturing processes such as the use of high-velocity metal forming for stamping applications. The return on the investment in Agile Tooling will be significant via shortened amortization periods and the mass customization of products.

Much of today's manufacturing environment is centered on subtractive processes whereby material is removed from a stock material, processes that typically require large amounts of time and energy. Instead, **Additive Manufacturing Technologies** seek to build up a part or component through successive layering of materials and/or by providing coatings or finish layers on existing substrate materials. In many cases, the

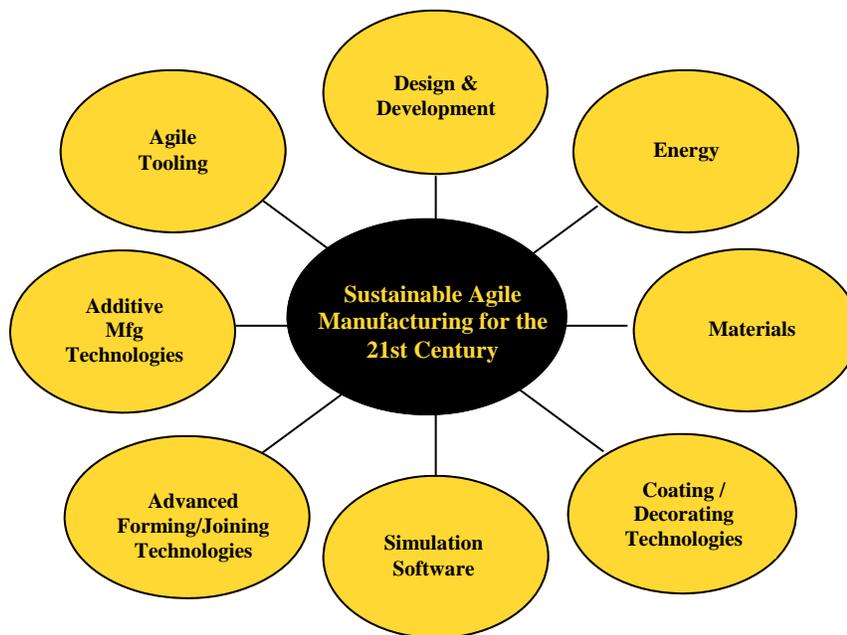


use of Additive Manufacturing Technologies will be significantly cheaper, less time consuming, less wasteful, and more environmentally friendly when compared to subtractive manufacturing processes.

Along with Agile Tooling, **Advanced Forming and Joining Technologies** seeks to develop new ways to stamp and form metallic and non-metallic parts without the use of expensive tooling. In addition, the ability to join dissimilar components will be important as advanced materials are increasingly utilized in manufacturing processes. Finally, the integration of forming and joining technologies with automated assembly processes will enable the manufacturing of fully-functioning sub-systems and systems as they come off of the manufacturing line.

A major driver of the mass customization paradigm is the intent to be able to make each part unique to the customer's specifications. This includes the use of **Coatings/Decorative Technologies** that can be quickly configured and reconfigured to provide the customer with a distinctive cost competitive product. Digital printing technologies as well as the use of smart coatings will enable the mass customization.

As with many engineered systems, detailed design and analysis tasks increasingly rely on the use of **Simulation Software** to provide the designer with a "virtual" environment in which to work. Traditional computer-aided design tools must be improved and upgraded in order to model and analyze the performance of manufacturing processes that enable mass customization. The result will be tremendous turn-around time reductions for product proofing and customization.



Each of these individual technology components by themselves will give manufacturers a competitive edge, however, the coordination and optimization of all of these components through the OEAMC and our consortium members will revolutionize the manufacturing landscape.



Economic Development through R & D

The OEAMC seeks to build on Ohio's rich heritage in manufacturing, being born out of demands from local manufacturers for thought leadership, networking for technical and commercial solutions and capital to fund technology breakthroughs.

We are pursuing Industry-Driven R&D as a deliberate Economic Development Strategy.

Beginning in 2005, industry, academia and local government initiated a partnership to foster Sustainable Agile Manufacturing as an economic development strategy in the West Central Ohio region centered in Lima. The partnership began to seek out resources from a wide ranging set of public and private organizations, including state and federal governments, private foundations and corporate interests. These efforts eventually led to the formation of the OEAMC in the summer of 2008 to facilitate and coordinate the collaborative endeavors.

The track record of this partnership is substantial and growing:

- March, 2006: \$1.4 million award from Ohio's Third Frontier Project, establishing the Advanced Materials Commercialization Center.
- December, 2006: \$3.3 million award from Ohio's Job Ready Site program for establishment of Synthetic Gas Research Center.
- March, 2007: \$1 million award from Ohio's Third Frontier Project for Electromagnetic Forming of Fuel Cell Plates.
- March, 2008: \$1 million award from Ohio's Third Frontier Project for Agile Hybrid Joining of Fuel Cell Plates
- June, 2008: \$3 million award from Ohio's Third Frontier Project for the establishment of Material Deposition Center.

**\$9.7
million in
approved
grants to
date**

The projects listed above link the initial partners including American Trim, Rhodes State College and the City of Lima into a series of creative relationships with a wide ranging assembly of private companies, educational institutions, and non-profit intermediaries. These include Whirlpool, DuPont, International Truck, General Motors, Crown Equipment, Global Energy, Applied Sciences, HTC Pure Energy, The Ohio State University, Ohio Northern University, University of Dayton, and EMTEC.

The West Central Ohio region is also home to two large-scale industrial energy projects that are in various stages of development and represent, in total, over \$3 billion in new investments in this region:

- Husky Energy is finalizing plans for upgrading the Lima Refinery to process heavy sour crude. This \$2 billion project will increase production to more than 200,000 barrels per day, creating a pathway for Canadian crude to reach U.S. markets.
- Global Energy has begun site preparation and initial construction on a fully permitted IGCC plant, though final funding is yet being sought for the project. The \$1 billion investment will create the nation's first clean coal plant with active carbon sequestration. The plant will produce electricity and synthetic natural gas.



Conclusion

It is important to note that the manufacturing system of the past took root and developed in a world that was not flat. However, manufacturing and trade are now accomplished on a global basis with the ultimate driver for manufacturing being cost. As it is currently designed, this is a game that Ohio and the U.S. manufacturing community cannot win.

The solution is to change the rules in the manufacturing game by moving from mass production to mass customization through Sustainable Agile Manufacturing. Inspiration for this approach can be found in Thomas L. Friedman's book *The World is Flat: A Brief History of the Twenty-First Century* in which he stated:

“The convergence of new players on a new playing field, developing new processes and habits for horizontal collaboration is the most important force shaping global economics in the twenty-first century.”

The Ohio Energy & Advanced Manufacturing Center has placed itself on this new field of play and seeks to assist the Ohio and U.S. manufacturing community with industry-driven research and development activities that further strengthen our position in the global economy.



Dr. Eric T. Baumgartner is the Dean of the T. J. Smull College of Engineering and Professor of Mechanical Engineering at Ohio Northern University. Prior to joining the faculty at ONU, Dr. Baumgartner was a Senior Engineer at NASA's Jet Propulsion Laboratory and received the 2008 IEEE Automation and Robotics Award along with two of his JPL colleagues for their contribution to Mars exploration through robotic systems.

Mr. David J. Berger is completing his fifth term as the Mayor of the City of Lima. Mayor Berger has previously served on the Governor's Urban Revitalization Task Force and on the All Ohio Save Defense Jobs Task Force, and is a board member of the Ohio Municipal League. He has championed access to Ohio's Third Frontier Program as a strategic economic development resource for local industry.

Mrs. Judith M. Cowan is the President of the Board of Directors for the Ohio Energy & Advanced Manufacturing Center. Judy has over 20 years experience in the field of economic development. Twelve of those years were spent serving Ohio Governor's Voinovich, Taft and Strickland as the Governor's Regional Economic Development Representative for West Central Ohio.

Mr. Steve C. Hatkevich is the Director of Research and Development at American Trim, LLC, in Lima. Steve has been in the manufacturing field for 25 years implementing new technologies to improve the competitive position of his employer.



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