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Auto

By Dr. Jay Baron and Debbie Maranger Menk

ONE OF THE MOST SIGNIFICANT INDUSTRIES IN NORTH AMERICA

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INTRODUCTION

The headlines read "GM to spend $2 billion in hiring" (The New York Times), "Toyota to hire workers" (Inside Indiana Business), "Chrysler plans to hire"(The Associated Press)…. Yet, after the long and debilitating recession in 2008, 2009, and 2010, many auto communities and those communities that formerly hosted automotive facilities are tempted to build their futures on the next great thing: 'Green' jobs, knowledge-based jobs, and high tech industries are often cited as the great hope for local economies. However, it would be a mistake for these communities to entirely move away from the auto industry as it is one of the most significant industries in the Midwest and in the United States, because it involves assembly plants, supplier facilities, and dealerships in every state

This article outlines the significance of the auto industry by discussing the industry in a variety of contexts. Initially, the article describes the long-standing economic influence of the auto industry within the Great Lakes regional economy. The second section describes the period of transition that the industry has undergone in recent decades. Following, the article emphasizes the potential for technology to improve automotive performance and to create demand for further investment and high-skilled jobs. The final section explains the opportunity of international investment in regards to the auto industry. In addition, this article discusses the role that the Center for Automotive Research plays in conducting research and holding forums, which are of significance to the automotive community.

FIGURE 1

The Oldsmobile was the first mass produced gasoline engine vehicle. Its early production in Michigan helped push machine shop bicycle tinkerers into being automotive suppliers and then auto producers themselves. Ransom Olds purchased engines, transmissions, and parts from the Dodge Brothers, Henry Leland, and Benjamin Briscoe, who went on to create Dodge, Cadillac, Lincoln, and Maxwell-Briscoe (later acquired by Chrysler).

TRADITION

The heart of the auto industry is in the American Midwest. At the beginning of the 1900s, when the automotive industry was just beginning to form in the United States, the Great Lakes region's main commerce came from industries which were producing gasoline engines, bicycles, and carriages. These industries built a trained workforce and supply chain that the first automakers tapped to begin producing motor vehicles. The Midwest was home to many inventors working out of their garages and early automotive entrepreneurs with capital to invest. (See figure 1.)

Once the earliest automobile companies began production, regional supplier companies began to specialize in automotive parts, which drew other automakers to the Midwest. This in turn stimulated further creation, expansion, and emigration of suppliers. It is this process of agglomeration that was largely responsible for creating such a concentrated industry in the Great Lakes region.

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The auto industry is of both historical and contemporary significance. The industry extensively employs workers from many fields such as manufacturing, engineering, legal services, and advertising. As the automotive industry has evolved, the industry has demonstrated a growing interconnectedness between technological and automotive innovation. In particular, improving vehicle communication systems and designing cars with lightweight materials will enhance automotive performance, fuel economy, and passenger safety. These technological advances require thorough R&D, generating a robust source of investment and demand for highly-educated technical employees. In general, this article seeks to increase public awareness regarding the immense potential for the auto industry to drive future economic growth.

By 1904, all major U.S. auto facilities and producers were located in the state of Michigan, which produced more than 40 percent of all cars in the U.S. Through subsequent years of investment, the Great Lakes region leveraged a few initial advantages to build an entire industry. Based on this successful history, the Midwest offers manufacturing companies many competitive benefits such as proximity to suppliers, a pool of skilled labor and management, and world-class road, rail, air, and shipping infrastructure. While the historical context is important in understanding the development of the auto industry, recent changes within the auto industry are creating significant implications for the industry's economic profitability and demand for employment.

TRANSITION

The auto industry of today offers communities and their residents opportunities for long-term prosperity. If there is any doubt about this notion, consider the response of communities and states to even just a rumor that an automaker or major supplier is searching for a site for a new plant. And when plant sites are chosen, often the economic incentives provided to the new employer set new records in the realm of economic development and private sector investment.

The industry is currently well positioned to be profitable at much lower levels of production. In the 1990s and early 2000s, auto industry production capacity stood at record levels, and even with the high levels of vehicle sales in those years, the industry was seriously overbuilt. During the recent recession, automakers and suppliers rationalized capacity, bringing both capacity and production levels more in line with market demand. And as the economy has begun its slow recovery, industry employment has grown as well – with around 20,000 jobs in motor vehicle and parts manufacturing being created between December 2009 and May 2011, although employment levels remain below the high levels seen before the recession.

The U.S. market is one of the largest and most profitable motor vehicle markets in the world. The three U.S.-based companies have refocused product design and improved quality and productivity. Ford has achieved profitability, and the bankruptcies at GM and Chrysler helped these companies slash costs and cut debt. They, along with international automakers, are situated to fully participate in the fiercely competitive but profitable U.S. market. It is expected that the industry will be stable and able to support growth in coming years.

The complexity of vehicles made in the U.S. contributes to the large job-creating impact of the U.S. auto industry. The industry directly employs over 1 million people who are engaged in designing, engineering, and manufacturing new motor vehicles. Another 700,000 people are employed by dealerships located in nearly every community in the country. The automotive industry is a huge consumer of goods and services from many other sectors, including raw materials, construction, machinery, legal services, computers and semi-conductors, financial services, advertising, and healthcare, helping create many more jobs throughout the economy.

Along with changes in employment, the industry is investing in plants, opening new plants, and retooling others. In 2010 to 2011, the auto industry announced investments of over $18.1 billion throughout the U.S. More than half of these investments are being made in the Midwest. As the industry changes to keep up with new products, changing consumer tastes, and greater demands for skilled labor, new facilities are opened and older facilities are either retooled with new investment or closed.

Source: GM Media

In addition to automaker investments in the Midwest, General Motors and other companies have announced investments throughout the country. In January 2012, GM detailed plans to build a stamping facility in Arlington, TX.

While new investments present new opportunities for their communities, closed facilities represent tremendous challenges to their communities. The inventory of closed commercial and industrial building space is ready to be put into new uses and serve new industrial needs. For communities with these buildings that offer opportunity for repurposing, the Center for Automotive Research (CAR) has performed extensive research examining those traditionally automotive manufacturing facilities that have been successfully repurposed. With this research and experience, CAR works with communities to help them understand the conditions and strategies that can bring new uses, new employment, and new industry into unused facilities. Despite the challenges suffered within automotive and manufacturing communities during the recent economic recession, the auto industry's potential for technological innovation offers hope for a more promising future.

TECHNOLOGY

The auto industry of the past was an industry that used cutting-edge innovation and demanded constant creativity and invention. Likewise, today's industry demands high technology inputs and offers challenging knowledge-based and 'green' jobs.

The automotive industry is vibrant and high tech. With respect to the technology used in vehicles, the industry is undergoing radical changes. Adoption of new vehicle technologies relating to emissions, vehicle electronics, connectivity, fuel economy, safety, and powertrain represents opportunities for communities to attract companies and entrepreneurs to take advantage of skill sets, the trained workforce, educational institutions, and other assets throughout the Midwest.

The vehicle electronics market is growing rapidly. An average vehicle might contain around 60 microprocessors to run its electrical content, as compared to around only 15 microprocessors in a vehicle just 10 years ago. It is estimated that currently, vehicle electronics make up as much as 40-50 percent of the total cost of the vehicle. This is up from 20 percent less than a decade ago. As companies increasingly rely on vehicle electronics to comply with environmental and safety requirements, the automotive electronics market is expected to expand even more rapidly.

Today, electronics, in the form of sensors, actuators, micro-processors, instrumentation panels, controllers, and displays, appear in nearly all major vehicle systems, including:

- Engine controllers and sensors
- Safety systems
- Chassis control
- Measurement and diagnostics
- Entertainment
- Navigation systems
- Communications
- Emissions monitoring

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Electronics have introduced new functionality not possible in a purely mechanical framework. Modern vehicles contain electronic components in nearly all vehicle systems, including those pertaining to powertrain, passenger safety, and more. While all of these systems are important, several merit closer inspection, because they represent growth areas or because they are so critical to current and future vehicles. One of these systems is the powertrain, which is absolutely essential for the vehicle to operate. In addition, due to stricter fuel economy and emissions standards and the evolving mix of powertrain types (e.g., hybrids, electric, etc.), the powertrain characterizes a likely growth area for electronics.

Source: GM Media

Alternative powertrain vehicles will continue to be a source for future growth and development within the industry due to stricter fuel economy and emissions standards.

FIGURE 2: RENDERING OF CONNECTED VEHICLE SYSTEMS

Source: USDOT (2011).

Another path for future development is through vehicle communication systems. As shown in Figure 2, these technologies enable information sharing within and among vehicles, as well as between vehicles and mobile devices or roadside infrastructure. These communication systems contribute to greater capabilities in the areas of mobility, infotainment, and safety, where "mobility" refers to the ease and efficiency of travel and can include navigational assistance and traffic coordination. Infotainment systems include features such as navigation and entertainment.

Many of these features are brought into the vehicle through handheld devices such as 3G and 4G smart phones; the explosive growth in wireless communications presents enormous opportunities for vehicle technology that are difficult to predict at this time. Safety systems also go beyond communications and include a wide variety of features, from those that are now standard in vehicles, such as air bags, to those that are currently found only in high-end automobiles like lane departure warning systems.

Vehicle electronics also contribute significantly to improved environmental performance of motor vehicles, and thus electronics are an important enabler of "green" vehicle technology. These contributions come through several different mechanisms.

At the most basic level, electronics offer improved control to a variety of vehicle sytems, allowing for more efficient operation of engines and other powertrains, heating and cooling systems, etc. This results in less fuel (or other power) consumed and thus lower harmful emissions. Indeed, today's complex hybrid powertrains could not be operated and managed without an array of

electronics, including sensors, controllers, and actuators. Furthermore, electronics components tend to be lighter than the mechanical components that they replace, again leading to less demand for fuel and power options.

In the next ten years, electronics, in the form of vehicle communications and connectivity, will contribute in other ways, too. For example, as electronics bring traffic and mobility information into the vehicle and allow for even more efficient powertrain operations based on situational awareness and more efficient vehicle routing to avoid congestion, crashes, construction zones, etc., again improving fuel economy and lowering emissions.

In May 2009, the Obama Administration announced plans to raise the long-standing Corporate Average Fuel Economy (CAFE) standard from 27.5 miles per gallon (MPG) to 35.5 by 2016. After much review and discussion, the federal government, as well as a large block of automakers, recently came to an agreement that will require automakers' fleets to average 54.5 MPG by 2025. Such ambitious requirements will challenge American companies to provide the technologies required – and to add the capacity necessary to manufacture these technologies at the high production volumes necessary to satisfy a market as large as that of the United States.

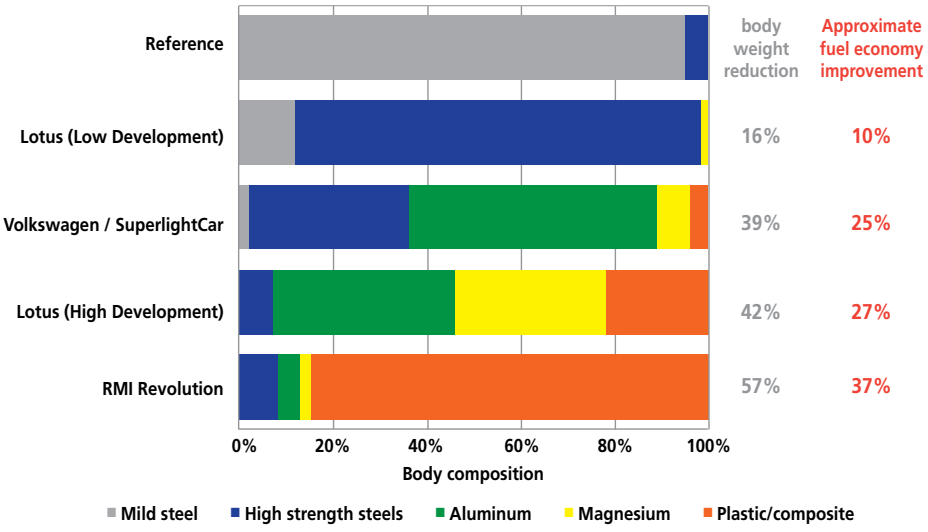
The U.S. is currently outpacing China in vehicle sales growth, as the annual number of light vehicles sold in the U.S. increased by 10.3 percent in 2011. Given the size and profitability of the U.S. market, international firms with appropriate technologies will increasingly look to locate here. A significant opportunity therefore exists for economic developers to attract to their communities international firms whose products improve vehicle emissions, fuel economy, safety, and connectivity. Because of the cutting edge technology involved, it is likely that communities which are the most effective in marketing their region's technical prowess, educated workforce, and connections to educational institutions will have the most success.

Beyond electronics, research and development (R&D) is ongoing for other key vehicle systems. To provide better fuel economy, automakers and suppliers strive to reduce the weight of cars while maintaining vehicle safety and cost effectiveness in production. Many estimate that a 10 percent reduction in vehicle mass will result in a 6 percent to 7 percent increase in fuel economy. Weight reduction is appealing to automakers because it tends to increase other performance factors valued by consumers. Ride and handling; noise, vibration, and harshness; braking; and acceleration all benefit from reductions in vehicle mass. Combined with the benefit to fuel economy, mass reduction is poised to be a major technology strategy deployed by automakers in the next 15 years. Up to a 250 to 750 pound reduction in average vehicle mass is expected by the year 2025, according to some forecasts.

There are several technologies that may be leveraged to reduce vehicle mass from today's standard vehicle. At the design level, new software technology is paving the way for a more systematic approach to vehicle design. Using simulation tools, engineers are able to model new vehicle designs that provide comparable levels of safety and performance yet require less material through more intelligent design schemes. Simulation software providers that are focused on a systems approach to vehicle mass reduction will benefit from the aggressive weight reduction required over the next 15 years. New optimization models that look at organic structures to determine the strongest and lightest vehicle designs are a recent development in design for lightweighting.

At the materials level, high strength steel, aluminum, magnesium, and composites are being constantly improved to provide the lightest material possible for a given application. Figure 3 depicts five different vehicle compositions, and reflects the significant body weight and fuel economy benefits that are associated with light-

FIGURE 3: LIGHTWEIGHTING VEHICLES



Material composition of lightweight vehicle body

John German, ICCT
EIA Energy Conference
April 26, 2011

R&D continues to contribute to the implementation of cutting-edge materials in vehicle composition. The vehicle pictured here is composed of sheet steel (gray), ultra-high strength steel (yellow), high-strength steel (red), hot-formed steel (green), and hardened sheet steel (blue).

Source: VW Media

weight materials. Organizations with manufacturing specialties in these advanced materials for automotive components are in the best position to benefit from automotive lightweighting.

The greatest challenge with new materials will be in forming and joining. At the integration level, new assembly and joining techniques are being developed to form and join these new materials in a robust and durable way. Forming technology is expected to be more of the evolutionary type as the materials may require some upgrades in tooling and modifications to forming processes. Joining technologies may require a more transformational approach as new materials are no longer able to be joined using traditional joining methods. Automotive lightweighting has an impact in all areas of vehicle design, development, and manufacturing.

These new developments in the automotive industry represent opportunities for communities to leverage their existing strengths in workforce capabilities, industry infrastructure, and plant capacity as well as providing opportunities for new investment. Automotive research and development spending and needs are expanding rapidly to keep pace with the demands for ever more sophisticated and effective new technologies. Communities with the right educational and workforce assets can position themselves to attract new research and testing facilities.

Investment in local schools and development of integrated vehicle technology programs such as the Indiana Advanced Electric Vehicle Training and Education Consortium (I-AEVtec) can be used to prepare the local workforce by providing the skills that will be required by automakers in the near future. Programs that bring together communities, educational institutions, and companies can also be used to establish a community as a automotive research center, facilitate relationships with companies, and generate new local businesses through technology transfer.

Traditionally the center for automotive manufacturing, Michigan still maintains dominance in automotive R&D spending and employment in the U.S., as shown in

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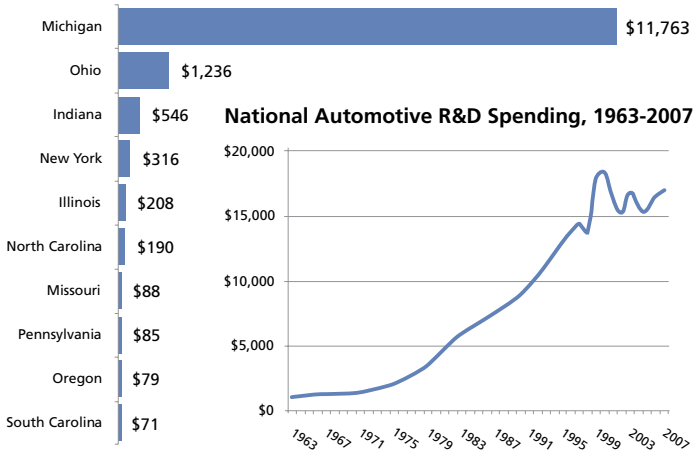
the state-by-state breakdown in Figure 4. In 2007, which is the latest year of data available from the National Science Foundation (NSF), the automotive industry spent $11.8 billion in Michigan while national automotive R&D spending was around $16 billion. The Michigan automotive R&D industry employs an estimated 65,000 professionals. Michigan is home to more than 330 automotive R&D companies with nine of the ten world's largest automakers conducting research at facilities in Michigan. Additionally, 46 of the 50 top global automotive suppliers have research facilities located in Michigan.

Michigan has a vast array of R&D facilities including automaker facilities, automotive supplier facilities, the EPA National Vehicle and Fuel Emissions Laboratory, and the U.S. Army Tank Automotive Research, Development and Engineering Center. The EPA lab, established in the 1970s, was an important establishment for attracting further investment in R&D facilities to the area, because automakers had to prepare vehicles for emissions testing nearby. While the major domestic automakers already had research and development facilities in Michigan, as international automakers entered U.S. markets, they established emissions testing prep facilities in Michigan to be in close proximity to the EPA lab.

This Michigan-centric focus of auto R&D efforts offers all Midwest communities good reason to build strong educational capabilities in advanced manufacturing, science, engineering, and technology fields as prospects for good jobs for graduates are very nearby.

FIGURE 4: AUTOMOTIVE R&D SPENDING, 2007 (in millions)



INTERNATIONAL INVESTMENT

Although the U.S. light vehicle market has been exceeded in terms of annual units sold by that of China, it remains the largest market in the world in terms of the value of the vehicles sold here. For international automakers and suppliers, this fact provides a market for more content per vehicle – while leaving more potential profit per unit – than perhaps any other market in the world.

The U.S. is, in fact, the largest source of profits for many international companies, even though those companies may achieve higher unit sales in other markets. This high profit potential has made the U.S. an attractive destination for automotive manufacturers, suppliers, and other supporting companies from around the world and provides economic developers with a powerful attraction argument.

Source: VW Media

Volkswagen's Chattanooga, TN, plant represents the potential for American communities to reap the benefits from international investment. The German automaker has invested $1 billion in the plant, which directly employs 2,000 workers. The investment has also attracted many supplier parts facilities to the area.

In pursuing investment from companies based overseas, economic developers have a wide range of options to consider, including trade missions, trade show exhibition, self-organized trips, and use of internet-based communication media. A wide array of consulting companies support communities in these functions. The federal government, through the Department of Commerce's Commercial Service, also provides communities with support in seeking international investors. The Commercial Service has operations in many of the world's largest cities and provides a long list of services at very reasonable cost.

CAR's experience in running international trade missions to a wide variety of destinations throughout Europe and Asia has provided several lessons for American economic developers. The most important of these lessons is that to be successful in attracting overseas investors, it is often most productive to actually travel to the target country, as opposed to only using local resources for marketing purposes. While cultural and business practice tradition varies widely from country to country, it is the relationships based on personal contact that seem most valuable in ultimately attracting an international investor to a community.

CONCLUSION

There is a fragile, but emerging economic recovery. The major assets for many Midwest communities include their existing productive and highly skilled workforce, advanced manufacturing infrastructure, inventories of commercial and industrial building space, and educational resources. CAR works with communities to help them develop their economies and infrastructure to support new products, technologies, and the needs of advanced manufacturing companies. Together, CAR and these communities are promoting a sustainable future built on an understanding of competitive business issues, the global reach of advanced manufacturing, and the environmental issues facing both communities and companies.

The Center for Automotive Research is a nonprofit organization based in Ann Arbor, Michigan. Its mission is to conduct research on significant issues related to the future direction of the global automotive industry, as well as organize and conduct industry forums. The Center for Automotive Research's Automotive Communities Partnership (ACP) has been addressing the needs of automotive communities for the past decade. The ACP brings together communities, international partners, automotive companies, educational institutions, and government agencies to advocate for the automotive industry.