

BMW's Impact in South Carolina:

Two Decades of Economic Development



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Executive Summary

In 2014, BMW's Spartanburg County plant celebrated its twenty-year anniversary. Two decades earlier, when the first BMW assembled in North America rolled off the production line, the future of state economic development seemed promising. Yet it was uncertain what the lasting effects would be two decades ahead.

It is now clear that BMW has had a potent, enduring effect on the state's economy. This study evaluates BMW's contributions to South Carolina's development at the 20-year milestone. The Spartanburg county campus engenders economic impacts that can be measured in terms of economic output, employment, income, and value added.

- BMW's annual economic output amounts to \$16.6 billion. This figure reflects the dollar value representing all output produced in South Carolina that can be attributed (either directly or indirectly) to BMW.
- The production of BMW automobiles supports 30,777 jobs in South Carolina.
- The BMW plant and associated businesses generate \$1.8 billion in labor income that would not exist otherwise in South Carolina.
- The total impact of BMW on South Carolina's value-added (similar to state gross domestic product) amounts to \$2.8 billion.

Regional economic impacts can be divided into direct, indirect, and induced effects. The direct impacts reported in this study reflect all South Carolina purchases made by BMW. The indirect impacts express the additional economic activities that result from inter-industry purchases by BMW and local firms in South Carolina. Finally, the study presents BMW's induced impact, which calculates the economic activity that stems from increases in spending income by local households.

A summary of BMW's impacts (direct, indirect, induced and total) is given below for statewide output, income, and employment:

	Employment	Labor Income	Value Added	Economic Output
Direct Impact	7,654	\$677,399,093	\$1,018,047,851	\$12,537,202,953
Indirect Impact	13,444	\$732,815,429	\$1,111,684,452	\$2,938,875,640
Induced Impact	9,679	\$362,442,766	\$677,761,174	\$1,158,262,928
Total Impact	30,777	\$1,772,657,287	\$2,807,493,477	\$16,634,341,520



Economic multiplier analysis determines the total impact (direct, indirect, and induced). The study finds that BMW generates a large multiplier effect, spreading the benefits across the state's regions and industries.

- This total economic impact is associated with a statewide employment multiplier of 4.0. Thus, for every direct job created at the BMW plant, an additional three jobs are created elsewhere in South Carolina through the economic multiplier effect.
- BMW's employment multiplier is one of the highest in the state and is twice as high as the average multiplier effect of all industries. The combination of BMW's high total volume of activity and its high employment multiplier effect make it a uniquely strong contributor to the state's economy.

BMW has demonstrated a long-term commitment to the state through its environmental leadership, community involvement programs, and dedication to South Carolina's economic competitiveness.

- BMW is committed to workforce development. Initiatives include an on-the-job apprenticeship system in Upstate South Carolina, partnerships with local technical schools, and active support of vocational and K-12 education.
- BMW has also become a statewide leader in environmental stewardship by operating as a sustainable enterprise and serving as an example for others to follow. For example, BMW has become a leading innovator in a variety of areas including green management, extensive recycling and reuse programs, and clean energy sourcing. These programs raise statewide awareness of the importance of environmental sustainability.
- BMW contributes to local economic development through advanced research and development activities at the Clemson University International Center for Automotive Research (CU-ICAR) in Greenville, South Carolina. These collaborative efforts help increase the rate of technological innovation in the automotive and motor sports industry as well as to help promote a more highly educated, technically proficient workforce.

This study was financially supported by BMW Manufacturing Corp. The research team at the Darla Moore School of Business independently designed the methodology and assumes full responsibility for the integrity of the results. The study is based on an objective research design and widely accepted economic modeling techniques, using conservative assumptions that are biased toward understating BMW's role in economic development.



Table of Contents

Introduction1

Background2
 Figure 1: South Carolina Automotive Cluster 5

The Economic Impact5
 Table 1: The Economic Impact of BMW on South Carolina 7

Qualitative Impacts on State Competitiveness8
 Supplier and Cluster Development9
 Figure 2: BMW Suppliers..... 10
 Workforce Development.....11
 Environmental Sustainability12
 Research and Development12

Conclusion.....13



Introduction

When Germany won the FIFA World Cup in 2014, it was not a chance event. The road to victory started two decades earlier with a long-run strategy centered on innovation, talent development, and steady improvement. A similar approach to producing BMWs—creativity, high-skill labor, precision engineering, and continual improvement—has helped elevate the German company to the top of the global market for luxury automobiles.

To succeed, BMW operates a complex network of facilities at 29 sites in 14 countries around the world (2014). The largest single production site is located in Greer, South Carolina. More than factory alone, the campus in Spartanburg County, in the heart of the state's Upstate region has grown steadily since its 1994 inaugural. Today, Plant Spartanburg assembles all BMW X series models. From South Carolina's ports, BMW Manufacturing Co. exports to more than 140 countries.

This study assesses the influence of BMW on South Carolina's economy. It will be seen that BMW's manufacturing operations in Greer have become a major economic engine in the state. As a high-volume producer, BMW not only employs a large workforce, but also supports an extensive supplier network throughout South Carolina. This supply chain generates vast economic ripple effects across many industries. These spillover effects support indirect job creation and higher incomes for South Carolinians.

The study provides both a quantitative and qualitative analysis of BMW's economic effects on South Carolina. The quantitative economic impact of BMW will be assessed primarily through the value of output, employment, labor income, and overall economic activity (value added). In addition to these quantifiable effects, BMW's South Carolina investment will be put into context of qualitative improvements to the economy in terms of cluster development and sustainability.

BMW's economic effects extend across the state. The plant has one of the highest employment multiplier effects in South Carolina. In addition, BMW also facilitates improvements to South Carolina's labor force, as the employment opportunities it creates give rise to an increase in demand for workforce training and higher education. BMW is also directly involved in advancing automotive research and development in South Carolina through partnerships with universities and other research organizations. The company is a leader in sustainable manufacturing processes. Through each of these impacts, BMW has become a mainstay in South Carolina and one of the state's leading sustainable businesses.

In the following sections, the narrative first provides a short history of BMW assembly operations in South Carolina. Then the study turns to a full description of the economic impact model and the results. The next section offers an overview of BMW's major qualitative impacts on South Carolina's economic development and competitiveness in four areas: supplier development and



clustering, workforce development, environmental sustainability, and research and development.

Background

In the early 1990s Munich-based Bayerische Motoren Werke AG decided to invest in the United States and establish its first full manufacturing operation outside of Germany. A manufacturing factory presence in North America would give the company flexibility in its global operations and a more diversified production platform.

The United States was BMW's largest passenger car market in the early 1990s, so the investment made sense. One of the core principles of the company's philosophy is that "production follows the market." After a site location search, the company decided to locate in Spartanburg County, South Carolina. Governor Carroll Campbell spearheaded an effort to bring BMW to South Carolina, with the full cooperation of the South Carolina Ports Authority and the South Carolina Department of Commerce (formerly the State Development Board).

South Carolina offers a highly advantageous location for automotive production. Among the state's pluses for manufacturing include the availability of skilled labor. Workforce development has been central to upgrading the state's competitiveness, led by the state's customized training programs through the Technical College system (now ReadySC). The flexibility of the labor force is another key asset. South Carolina also boasts good transport and logistics infrastructure, notably the port of Charleston, rail links, and an extensive interstate highway system. The plant is situated adjacent to the Greenville-Spartanburg International Airport, which has a 1,001-foot runway (305 meters) with the ability to receive cargo shipments from Europe.

When construction broke ground in April 1993, the Spartanburg County campus was favorably situated on 1,039 acres adjacent to Interstate 85 between Atlanta and Charlotte. The building of the campus turned out to be one of the quickest automotive plant startups in history. Plant Spartanburg was operational by 1994. Early that year, BMW associates started to move into the facility. By July the first vehicle (a 318i) was assembled.

Since then, the Spartanburg plant has been expanded substantially. In turn, the region has undergone a fundamental transformation. Traditionally a textile producing region, the transition into automotive production began in the early 1970s. Since 1994, BMW has been the hub of this this growing industrial cluster.

The company has greatly exceeded its initial pledge of approximately 2,000 jobs and \$600 million in capital investment. The Upstate South Carolina campus has expanded continually since 1994 as new product lines have been introduced.



The South Carolina campus now comprises more than five million square feet. A majority (80 percent) of the vehicles are customized for individual buyers. Linked to BMW's global production and distribution network, the South Carolina campus serves as a model of rapid response to the continually changing demand for premium automobiles.

To meet burgeoning North American demand, BMW persisted with its "production follows the market" rule. While roadsters had been in production since 1995, in 1998 BMW decided to produce the X series models in South Carolina (these are known as Sports Activity Vehicles, including the X3, X5, and X6).

Over time, the decision to make Plant Spartanburg the sole production site for the X series would require massive investment. In 2000, the company announced a \$200 million expansion, followed by a \$400 million investment in 2002. By 2006, BMW Manufacturing assembled its one millionth car was named "top plant" by *Plant Engineering* magazine (which would be repeated the next year). With growing U.S. and worldwide demand, the company committed to invest another \$750 million investment in 2008, adding 1.5 million square feet to the factory.

The global recession that commenced in 2008 had a deleterious effect on automotive sales. Yet demand for BMWs remained steady. The steady production in South Carolina helped stabilize the state's economy during the protracted slump. In 2012, it was determined that the South Carolina establishment was the largest automotive exporter in the United States. As the global economy recovered, BMW was poised for expansion once again. A \$900 million expansion was announced in 2012.

In 2014, twenty years after ground-breaking, BMW had produced 2.6 million vehicles in South Carolina. With global demand for the X series continually growing, BMW corporate leaders made one of their most significant announcements: The company committed to invest another one billion dollars over two years in Plant Spartanburg. At buildOut, the plant will have an annual capacity to produce 450,000 passenger vehicles.

To meet this constantly changing demand, the South Carolina campus now encompasses the expanding manufacturing plant and several important support centers. These centers are:

- Analysis. Personnel in the 160,000-square-foot lab inspect and test all welding and components produced at the BMW plant.
- Process Development. This center is a 13,800-square-foot center serves as the coordination hub for the North American supplier network. BMW personnel forecast, schedule, and manage the movement of thousands of individual parts from all the North American suppliers.



- Testing. On a 2.4-mile track, BMW personnel evaluate vehicle performance over a wide range of simulated driving conditions.

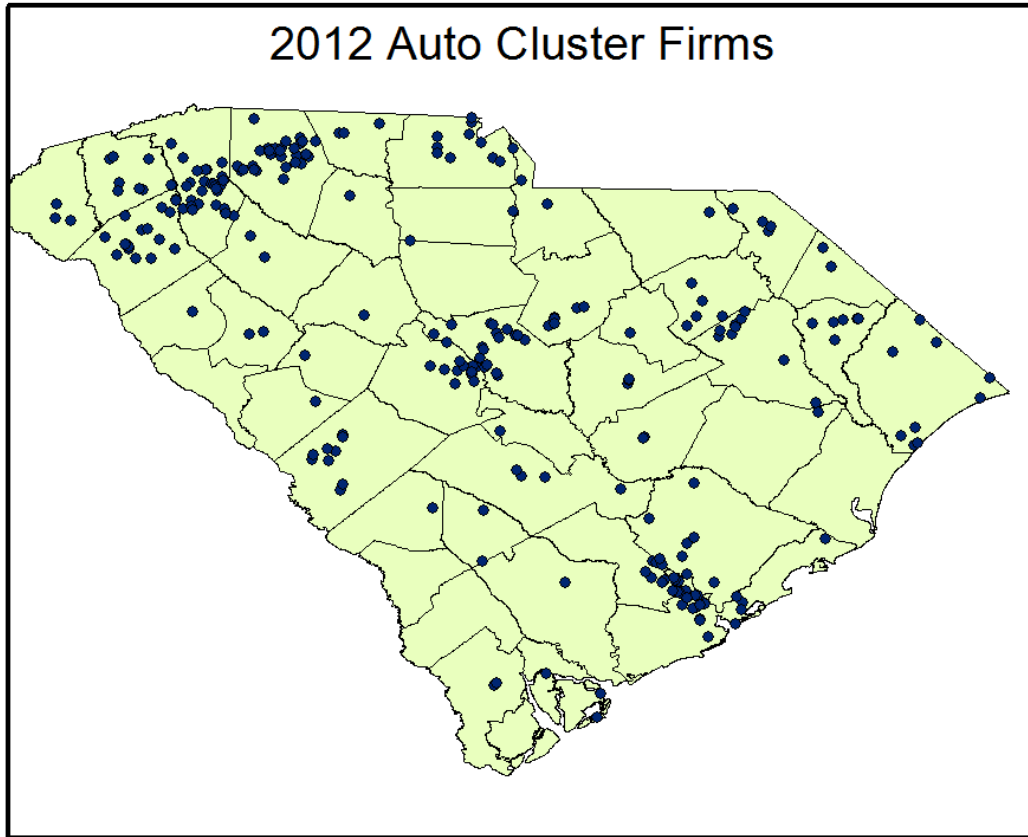
To support the enormous private expansion of BMW, the state of South Carolina has invested in infrastructure. In particular, two significant projects help bolster BMW's exports from South Carolina.

- The inland port of Spartanburg County opened in 2013. From this location near the Spartanburg plant, factory output and inputs can travel to and from the Charleston port along a Norfolk Southern rail line within a few hours. BMW and other firms have been able to reduce truck traffic to the port by more than 25,000 annually.
- The South Carolina Ports Authority is enhancing the Charleston port through a two billion dollar harbor dredging and deepening and other improvements.

Thus in 2014, South Carolina is firmly established as one of the leading automotive production regions in the United States. BMW is the foundation of a wider agglomeration of automotive firms in the state (shown in Figure 1) that has now replaced textiles as the leading manufacturing sector. As the map in Figure 1 displays, the cluster is concentrated in the Upstate, the Midlands, and the Charleston (Low Country) regions, but extends across the whole state as well.



Figure 1: South Carolina Automotive Cluster



Source: Compiled by the Division of Research, Darla Moore School of Business, University of South Carolina from National Employment Time Series (NETS) data.

The Economic Impact

The main purpose of this study is to assess BMW's economic effects on South Carolina's output, employment income, and value added. The basic data used for the analysis are BMW's South Carolina payroll and local (in-state) purchases. With these data, it is possible to calculate the economic effects more broadly. In simple terms, quantifying the economic impact entails capturing the extent to which BMW's direct activities at the Spartanburg county plant stimulate further economic effects throughout the state, spreading employment and income. Based on an economic model tailored to explain the BMW manufacturing system, the analysis provides a basis for evaluating the cluster of business activities that develop as a result of demand for automobiles produced in South Carolina.

Regional economic effects can be divided into direct, indirect, and induced impacts. The direct impact reflects all in-state purchases made by BMW and the income of its employees. These purchases include employee wages and benefits, equipment, building construction and remodeling, technology services, service vendors, and overhead or administrative costs. This spending activity boosts local demand, leading to new jobs and more income for employees and suppliers.

Economists refer to inter-industry purchases as *indirect* effects. For example, when BMW sources components from in-state firms, these businesses experience an increase in demand. To satisfy this demand, they must purchase additional inputs and equipment from their suppliers. These suppliers must then purchase additional supplies as well. In the BMW case, these indirect effects flow through the local economy and affect sectors outside of the automotive industry.

Another economic effect of BMW on South Carolina is stimulated by the income generated through payrolls that would otherwise not exist in the state. The *induced* impact results from the economic activity associated with the spending of household income generated both directly and indirectly by BMW. The campus itself has a large payroll. Workers at the Spartanburg plant largely spend their paychecks locally (out-of-state household spending is not included in the analysis). There is additional spending by employees of supplier businesses, which expand their payroll following BMW purchases. Again, a large part of this additional income will then be spent locally on local food, entertainment, housing, and so forth. These industries will then also see an increase in demand for their goods and services, which will lead to higher incomes for some of their employees, part of which will also be spent locally.

In each round of indirect and induced spending by South Carolina businesses, some of the money leaves the state's economy or is saved. For example, firms in the local automotive industry will purchase some of their supplies from vendors located outside of South Carolina. In addition, employees will save part of their income or spend part of it with firms located outside of the state.

Economic multipliers are measures that determine the total economic impact that will result from a direct impact. BMW's Spartanburg County automotive production touches off the economic multiplier that leads to the total impact (a sum of the direct, indirect, and induced impacts). Not all multipliers are equal. Multipliers are different in industry. They are largely determined by the size of the local supplier network as well the particular region being examined.

Given direct information available from BMW Manufacturing Co., the researchers used IMPLAN, an input-output model calibrated to the South Carolina economy to assess the multiplier and effect and the total impact. The customized IMPLAN model for South Carolina economy contains specific information on economic linkages between approximately 500 different industries statewide.



Typically, analysts calculate multipliers for four main measures of economic performance: output, employment, income, and value added. First consider the employment impact. Raising employment in South Carolina is a principal goal for policy makers and an ongoing concern of all citizens. Direct employment in the plant has reached more than 7,654 full-time equivalents (see Table 1, based on 2013-14 figures). In terms of the total impact, the production of BMW automobiles supports 30,777 jobs in South Carolina.

As Table 1 reveals, BMW’s business indirectly supports more than 13,444 jobs. These jobs represent the employment needed by suppliers to fulfill BMW contracts. After receiving orders, supplier firms generate more indirect employment and earnings as their own purchases spread into the wider economy. In addition, Table 1 shows the induced effect on employment through payroll spending amounts to 9,679.

Table 1: The Economic Impact of BMW on South Carolina

	Employment	Labor Income	Value Added	Economic Output
Direct Impact	7,654	\$677,399,093	\$1,018,047,851	\$12,537,202,953
Indirect Impact	13,444	\$732,815,429	\$1,111,684,452	\$2,938,875,640
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Total Impact	30,777	\$1,772,657,287	\$2,807,493,477	\$16,634,341,520

The second column of Table 1 shows that the BMW manufacturing operations generate \$1.77 billion in total labor income for the state. The plant itself directly accounts for \$677 million in wages and salaries, with indirect and induced effects responsible for the rest.

In the third column of Table 1, it can be seen that total impact of BMW on South Carolina’s value-added is \$2.8 billion. Since value added is conceptually similar to the state’s gross domestic product, it is often considered the best measure of the net contribution to the statewide economy.

Finally, the impact associated with BMW’s annual economic activities yields a total economic output of \$16.63 billion. Economic output is a broader measure than value added or labor income, measuring the overall value of production. The Upstate plant itself accounts for \$12.54 billion in annual economic output. The remainder is determined through its linkages with the economy at large.

Next consider the multiplier effect of BMW. The multipliers (for employment, labor income, value added and output) are defined as the ratio of total to direct impacts. The employment multiplier is the most commonly cited. As discussed earlier, BMW’s South Carolina investment supports 30,777 total jobs in South Carolina. Given that 7,654 workers are directly employed at the plant, this total job impact yields a multiplier of 4.0. That means that for every direct job in South Carolina, three additional jobs are created elsewhere in the economy. A typical employment multiplier for South Carolina industries and services is closer to two. While most of



the direct and indirect jobs are in the manufacturing sector, the multiplier effects support jobs in virtually every sector of the state's economy.

The estimates of BMW's economic impact presented in this study do not include the large effect on the Port of Charleston and the inland port. Moreover, BMW contributes to the state's tourism industry. The company runs a vehicle delivery center at the Greer site. In 2014, the BMW Performance Driving School hosted more than 10,000 visitors, who came to the center to pick up their new vehicle or as driving school attendees. Beyond the typical South Carolina tourist attractions, the delivery center helps promote the state's quality of life to consumers and tourists. The company also contributes to the community through the annual BMW Charity Pro-Am, raising more than \$10.8 million for more than 150 charities since 2001.

Qualitative Impacts on State Competitiveness

Leading global businesses like BMW spread competitive practices, along with technical and managerial competencies, to local economies. In turn, they serve as conduits for upgrading productivity and quality standards throughout the local economy. The core competencies brought into South Carolina by BMW Manufacturing Corp. center around the concept of adaptable, or agile production. To remain competitive, BMW quickly adapts and continually improves its production process.

From the outset in 1994, BMW endeavored to create an adaptable plant with minimum barriers and maximum interaction across functions. The offices for the three principal manufacturing operations—assembly, body, and paint shops—are centrally located, and office associates have a direct view of the factory floor. On the shop floor, the only walls are around the paint shop, necessary to keep it uncontaminated from the rest of the building.

With the expanding South Carolina plant in 2014-15, BMW is in the forefront of agile manufacturing. Linked to BMW's worldwide production and distribution network, the Spartanburg County facility is a model of adaptability and rapid response to the continually changing demand for custom-built automobiles. BMW produces 80 percent of its cars to order. Specifications for each of these individual cars are handled by a sophisticated in-house enterprise-wide computing system. Although the system is centralized in Munich, the production line controlling systems are managed at BMW's manufacturing sites.

BMW has brought notable production advantages to South Carolina manufacturing. BMW's South Carolina facility employs cutting-edge production techniques to assemble its vehicles. One of the first innovative production technologies in the plant was the V-Star measurement system. The V-Star system uses strategically placed cameras to constantly measure the production line's accuracy. The key benefit of the system is that it has allowed the facility to increase the speed of production while maintaining high quality standards. The increase in speed is gained because the V-



Star system allows production engineers to feed real time set-up information into the line during production. Doing so enables engineers to make small adjustments to the line set up before quality problems appear. Not only is the V-Star production management system making a difference at the BMW facility, it is also being picked up by BMW's suppliers.

In addition to state-of-the-art manufacturing quality control systems, BMW has designed and virtually assembled its products using advanced 3-D modeling programs. This has allowed both engineers in Munich and production experts in Spartanburg County to identify assembly problems before they happen. To facilitate the identification of potential production issues, BMW sends South Carolina employees to Munich to participate in knowledge-sharing sessions. During a non-launch year, South Carolina production associates may travel to Munich several times a year.

BMW has infused its advanced manufacturing processes in South Carolina a commitment to continuous improvement, raising productivity in the Upstate plant. A prime example of this effort is the Value-Added Production System (VPS), which was first introduced in 2006. Through the Value-Added Production System, BMW's goal is to maximize value and minimize waste in production and support area processes. The results have a dramatic effect on productivity.

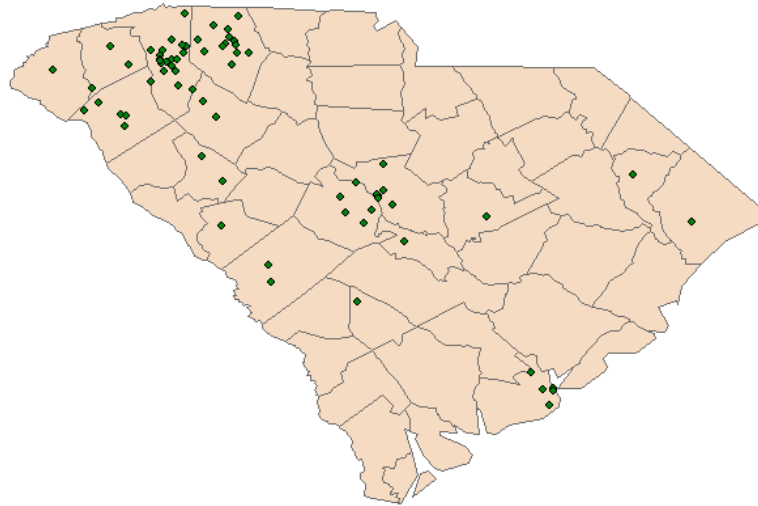
Supplier and Cluster Development

Beyond the plant itself, South Carolina's automotive cluster took off after BMW production began in 1994. An automotive cluster is a spatial concentration of firms in the orbit of leading OEM operations like BMW in South Carolina. The cluster includes first- and second-tier suppliers, a skilled labor pool, joint research and development, and other advantages of local networking. It bolsters local competitiveness through knowledge transfer and shared management and production expertise. The major advantage of a strong cluster is that it raises the regional productivity, which is widely accepted by economist as the central driver of long-run competitiveness.

The BMW supplier network is the core of the regional automotive cluster and forms channels for continual improvements in processes and organizational skills. BMW has approximately 40 BMW suppliers in South Carolina. The map in Figure 2 shows that many supplier firms lie within close proximity to the Upstate assembly plant. Most the suppliers are within a two-hour drive from the plant. In general, highly developed supplier linkages create synergies by locating in close proximity.



Figure 2: BMW Suppliers



Source: Compiled by the Division of Research, Darla Moore School of Business, University of South Carolina from data obtained through BMW

BMW's South Carolina facility interfaces with suppliers through procurement and logistics. The procurement division focuses on developing BMW's supply base. Logistics is involved in integrating existing suppliers into BMW's supply chain. Both groups work closely with suppliers to ensure that their competencies are aligned with the needs of the South Carolina plant. In fact, as much, if not more time and effort at the plant is involved in logistics, procurement, and supply-chain management than assembly.

Overall, BMW's North American supplier network encompasses approximately 170 companies. Wherever they are located, suppliers must be ready to fulfill BMW's rigorous requirements, often on short notice. This is even the case when BMW makes minor modifications to its line while in production, which is common for custom manufacturing. Thus, suppliers too must be particularly agile to meet BMW's orders.

BMW plays an active role in improving the supplier capabilities. BMW's development group is dedicated to resolving any problems a supplier faces. Usually, BMW and its suppliers will form cross-functional teams to attack the problem. The engagement begins with identification of the problem, agreement on the objective, and a time line for a resolution of the issue. Some of these issues might include addressing quality, production capacity for a new line, or a change in design requirements.

Two systems set worldwide standards for all BMW manufacturing facilities: production control and production logistics. To keep BMW's just-in-time supply chain running smoothly, the plant integrates these two systems with suppliers through

enterprise resource planning software. To ensure that BMW obtains the highest quality components and parts from its suppliers, BMW has implemented a quality management module. This module creates a direct electronic connection between BMW and its suppliers, providing a feedback loop from assembly to the supply chain. As most of BMW's part deliveries are sequences, this information sharing with its suppliers is critical to keeping the production line moving.

An ongoing evaluation of supplier partnerships is part of the BMW culture. In Europe, BMW has long concentrated on improving its suppliers' capabilities. Historically there has been a close relationship between German car manufacturers and their German suppliers. Often there are agreements to support the development of new parts for specific new car models by the suppliers. Since these developments are usually costly, manufacturers often help suppliers financially or contractually agree to purchase a certain quantity. To be sure, this is not the case for every supplier, but only for those that are deemed strategically important to the car manufacturer. However, suppliers often do a huge part of the development of new components for car manufacturers and work closely with them.

Today at the Spartanburg County facility, the manufacturer-supplier partnership has been strengthened through procurement and logistics development groups. The responsibility of these groups is to develop lasting supplier capabilities. Suppliers must possess project management talent and a commitment to automated supply chain management systems. To help, BMW has a dedicated supplier development group. BMW Manufacturing Co. also connects with small businesses through its annual Supplier Diversity Matchmaker Conference, which facilitates networking among women and minority business owners and first-tier BMW suppliers

Again, these supply linkages underscore the advantages of BMW's investment in South Carolina. Not only is supplier improvement beneficial for BMW, but it also helps local suppliers attract contracts from other automotive manufacturers.

Workforce Development

The transfer of expertise and skills through the global BMW network—needed for agile and adaptable production—benefits the local labor force. The open and agile environment allows for tacit knowledge sharing through interaction among associates. Production line workers are organized in self-directed teams. These teams perform specific tasks but many associates are able to replace somebody else, if necessary. This allows for quick changes when necessary.

As the South Carolina plant grows, the workforce needs expand as well. Clearly, there is an ongoing need for BMW trains production workers, engineers, and support personnel. To upgrade its labor force skills, BMW has ongoing training initiatives. These initiatives include an on-the-job apprenticeship system and partnerships with local technical schools. The ongoing partnership with technical colleges demonstrates BMW's commitment to improving the quality of South Carolina's work force. In June 2012 BMW graduated the 30 members of its first class of the BMW Scholars



program and hired 14 of them as full-time employees. The 35-member second class graduated in 2013.

Environmental Sustainability

As the company continues to invest, generate employment opportunities for South Carolinians, and enhance the state's image, it also demonstrates how successful businesses can simultaneously become more environmentally responsible—and address the serious ecological challenges facing all communities in the 21st century. Around the world, the Munich-based company is known as a leading sustainable enterprise. In 2014, BMW was ranked as leader for automotive manufacturing in the Dow Jones Sustainability Index (winning the honor every year since 2005). Accordingly, it serves as a model for the private sector in South Carolina and across the country, showing how the goals of profitability and shareholder value can be compatible with a company-wide dedication to raising environmental standards.

From an environmental perspective, it is important to acknowledge that the Upstate BMW campus sources almost two-thirds of its energy needs from methane gas derived from a nearby landfill. The methane project has substantially reduced greenhouse gas emissions in South Carolina. Moreover, BMW has created the world's first green automotive paint shop—which is powered by recycled methane gas from the landfill. It is the first automotive plant in the United States to use water-based instead of toxic, high solvent paints. Moreover, BMW is the largest user of hydrogen fuel cells, which power forklifts and motorized carts to deliver parts around the factory. The BMW plant manufactures hydrogen on site, with the capacity to deliver more than 400kg of hydrogen daily. The company is working with the South Carolina Research Authority to convert methane gas from landfills into hydrogen.

South Carolina's BMW complex has proven to be both economically successful and environmentally progressive. In 2000, the Environmental Protection Agency accepted BMW as a charter member of the Agency's National Performance Track. This enabled BMW to reconfigure the Spartanburg County facility to meet forecasted demand without constant EPA intervention. Staying ahead of the curve on environmental issues has not only contributed to the preservation of South Carolina's environment but it has also helped BMW meet its customers' demands.

Research and Development

Crucially, the business activities of BMW augment the South Carolina automotive industry's innovative capacity. The most notable example is support for Clemson University International Center for Automotive Research (CU-ICAR), situated in an 84,000 square-foot building on a 250-acre campus in Greenville, South Carolina. To support that effort and help build innovative capacity in South Carolina, BMW has established an Information Technology Research Center (ITRC). Mechanical, electrical, computer engineers and students at ITRC work in an open innovation environment. Major initiatives are designed to advance the interactions among IT infrastructure, IT applications, and manufacturing process innovation.



Conclusion

BMW is a highly sophisticated and competitive enterprise, dedicated to engineering the highest performing premium automobiles available in world. In 1994, the company decided to invest in South Carolina to establish a U.S. manufacturing presence for their growing global businesses. The operations have brought billions of dollars to the region, which circulates through the economic multiplier effect to stimulate business development. Twenty years after the decision, BMW's complex of activities supports more than 30,000 jobs. A competitive automotive cluster is now firmly rooted in the South Carolina economy. For regional competitiveness, a major advantage of BMW's vanguard role in supplier relationships is that it offers spillover benefits for the automotive cluster.

BMW has proven to be a long-term stakeholder in South Carolina. Beyond the economic multiplier effect, BMW Manufacturing Corp. also supports a diverse group of community and educational organizations. The BMW Scholars apprenticeship demonstrates BMW's collaborative effort to improving the quality of South Carolina's work force. At the South Carolina facility, BMW has devised a number of initiatives to increase work force diversity. The program has led to success in hiring and retaining women and minority candidates. The company also forms partnerships with other community groups; funds K-12 education initiatives, social service programs, and cultural activities; and encourages volunteerism. Started in 2001, the annual BMW Charity Pro-Am has raised nearly \$11 million in funds local charities.

BMW's overall community impact reflects a triple bottom line approach, based on economic, environmental, and social goals. This three-pronged strategy not only ensures that BMW Manufacturing Corp. is a responsible corporate citizen, but also enables South Carolina to achieve long-term competitive success.

