South Carolina Automotive Sector

Analysis of an Emergent Cluster

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Disclosures: Kendall Fitch is a resident of South Carolina. She, John Soleanicov, and Daniel Newman are U.S. citizens. No special or nonpublic information was used. The team did not travel to South Carolina during the project.

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1. Introduction

The automotive sector in South Carolina employs 25,000 workers, who in 2009 earned over $41,000, 23% more than the average wage in the state (Institute for Strategy and Competitiveness, 2012[1]). Between 1998 and 2009, employment in South Carolina's automotive sector increased, while the primary automotive hubs within the United States – Michigan, Ohio, and Indiana – shed labor. Automotive activity in South Carolina began with tire production in the early 1970s, expanded into injection system manufacture and then passenger car assembly over the next two decades, and broke through into research and design with the establishment of a dedicated department at Clemson University in 2003.

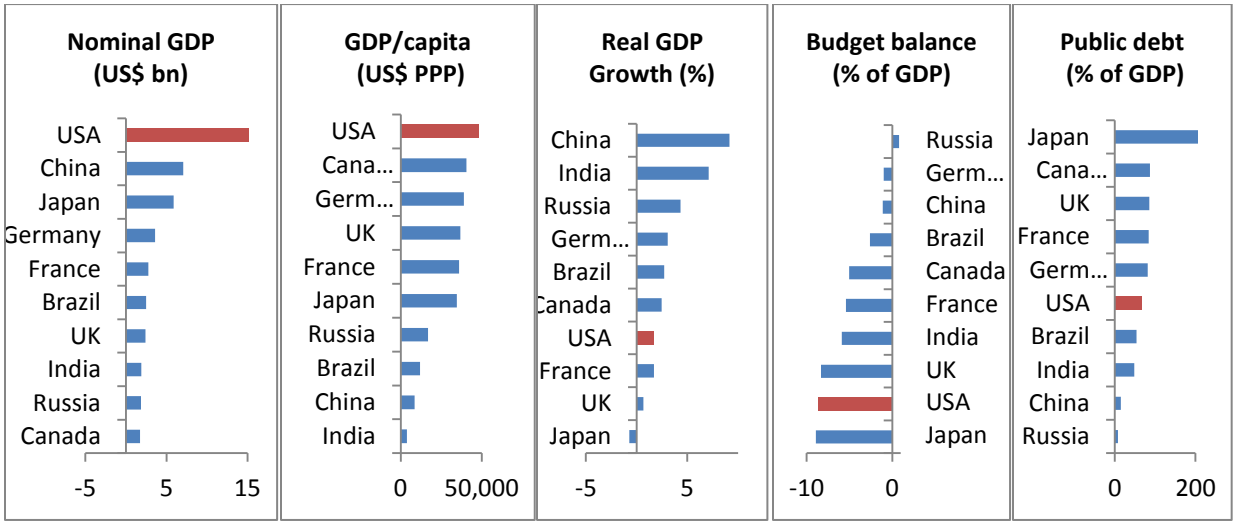
However, the sector does not yet manifest the characteristics of a fully developed cluster. BMW, the sole assembler of passenger cars in South Carolina, locates the most sophisticated aspects of production (design, engine manufacture, etc.) outside the state, and exports 70% of its production. Car assemblers targeting the U.S. market prefer to locate within "auto alley" in order to minimize shipping costs of finished vehicles to consumers across the country (Klier and Rubenstein, 2010). Intense competition only characterizes one sub-sector (heavy-duty/armored vehicles) within the state, while single firms occupy niches of all-terrain vehicles, electric buses, and commercial vans. Despite the existence of an automotive engineering department, generation of auto patents remains very low in South Carolina at 1.3 per thousand automotive employees, 74% and 87% below the comparable figures in Michigan and California, respectively (ISC, 2012). The state's technical training programs have generated savings for employers by bearing some of the burden of training costs, but basic education remains a critical problem.

[1] Data available online at <http://clustermapping.us/index.html>; hereinafter denoted "ISC"

2. The national context for automotive production

a. Macroeconomic outlook

With a population of over 300 million, the third largest land area in the world and a stable, democratic political system, the U.S. remains the largest economy in the world after the recent economic crisis, with GDP of $14.6 trillion (World Bank, 2012[2]). Despite bitter partisan disputes over budgets and unconventional monetary easing by the Federal Reserve, the U.S. maintains an expansionary fiscal and monetary stance while continuing to enjoy the low interest rates of the world's reserve currency issuer. Macroeconomic data for selected large national economies appears in the charts below (Economist Intelligence Unit, 2012).



Unusually high unemployment of 8.2% (Bureau of Labor Statistics, 2012[3]) limits the rebound of aggregate demand as households deleverage following the crisis. On the other hand, rates on auto loans have fallen to a five-year low of 5.1% (Federal Reserve Board, 2012[4]).

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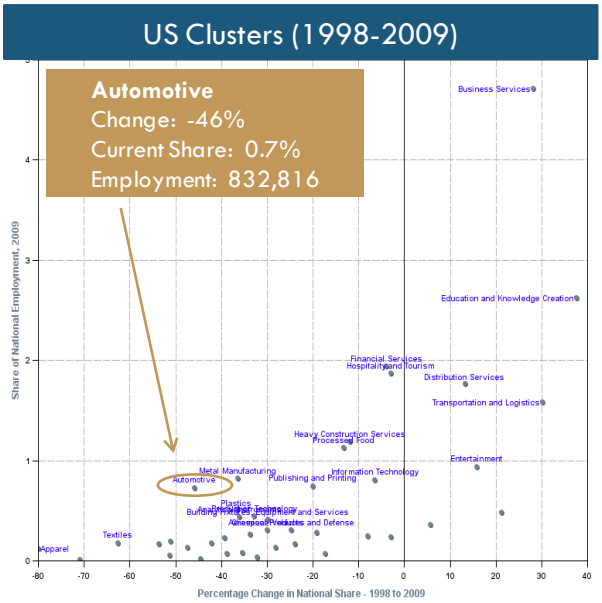
[2] Data available online at <http://data.worldbank.org/>; hereinafter, "WB"
[3] As of April 6, 2012; data available online at <http://www.bls.gov/news.release/empsit.nr0.htm>; hereinafter "BLS"
[4] 48-month new car loan; data available online at <http://www.federalreserve.gov/releases/g19/Current/>

The U.S. economy is highly diversified, with services accounting for a large and growing employment share. Automotive employment, as shown in the chart at right (ISC, 2012), has declined dramatically since 1998. U.S. auto exports exceeded $100 billion in 2010 (second only to hospitality and tourism), claiming a world export share of 8.5%. This, however, represented a loss of 3.1 percentage points since 2000 (ISC, 2012[5]).



b. Business environment

Despite recent slippage is some areas, the U.S. remains a highly competitive place to do business. Its Ease of Doing Business ranking has held steady at 4th, with particular strengths in getting credit, enforcing contracts and investor protection (WB, 2011[6]). Productivity growth has been strong since the crisis, with manufacturing output per hour increasing by over 5% annually between 2008 and 2010 (BLS, 2012). Unique strengths in innovation, entrepreneurship and capital markets drive U.S. competitiveness, but serious weaknesses include regulatory complexity, low investment in infrastructure, and a relative weakness in K-12 education.

Of particular relevance to the automotive cluster are U.S. demand conditions. The U.S. is a nation of drivers, with 809 vehicles[7] per thousand people, only behind Monaco and far above other vehicle producers like Germany. Since the recession, vehicle sales have rebounded over

[5] Data available online at <http://data.isc.hbs.edu/iccp/>
[6] Data available online at < http://www.doingbusiness.org/data/exploreeconomies/united-states/>
[7] Motor vehicles include cars, buses, and freight vehicles but do not include two-wheelers. World Bank World Development Indicators.

10% (First Research[8]). Moreover, sophisticated demand for the vehicle types produced in South Carolina (e.g., luxury cars, armored vehicles, electric buses) is significant. Luxury cars account for 15% of the $91 billion U.S. auto market (IBISWorld, 2012). With over $700 billion of federal funding, the U.S. defense market is the largest and most sophisticated in the world (Stockholm International Peace Research Institute, 2012[9]). In 2009, the U.S. raised vehicle emissions standards. A full list of factors influencing competitiveness is provided below.

US National Diamond

Context for Firm Strategy and Rivalry

- Strengths
  - Intense national competition (30+ Auto OEMs nationwide)
  - Ease of doing business (4th/183)
- Weaknesses
  - Distortive effect of taxes and subsidies on competition (107)
  - Impact of taxation on incentives to work and invest (62th)
  - Increase in political gridlock, regulatory uncertainty and complexity
  - Precedent of nationalization of struggling car manufacturers

Factor (Input) Conditions

- Strengths
  - Leading universities and cutting edge R&D
  - Availability of risk capital, highly developed capital markets (listed market cap at120% of GDP)
  - Abundant natural resources
- Weaknesses
  - Slipping GCI rankings in logistical (22th) and communication infrastructure (17th)
  - Weakness in K-12 education (52nd in math/science)
  - Decline in regulatory competitiveness (30th)
  - Erosion of skills among long-term unemployed and discouraged workers

Demand Conditions

- Strengths
  - High buyer sophistication (13th) with high purchasing power
  - High government procurement of advanced technologies (6th), particularly in military
  - Early demand for products and services
  - Nation of drivers: 0.8 vehicles/capita (2nd), high and growing (22%) demand for luxury vehicles
- Weaknesses
  - Stringency of regulatory standards and environmental regulations (21&24)
  - Government success at ICT promotion (29)

Related and Supporting Industries

- Strengths
  - High quantity (ranked 13th) and quality (15th) of suppliers
  - High development of clusters (8th), with leading historic clusters in automotive
- Weaknesses
  - Relative slippage in quality and quantity of suppliers
  - Slippage in availability of latest technologies (18th)

Source: Rankings taken from World Bank Ease of Doing Businesss Index 2012 and Country Competitiveness Model (CCM), Institute for Strategy and Competitiveness, Harvard University (2010). Ranked out of 132 unless otherwise specified. Other data from World Bank, industry reports.

[8] Data available at <http://mergent.firstresearch-learn.com/industry.aspx?chapter=0&pid=21>
[9] Data available online at <http://www.sipri.org/research/armaments/milex/resultoutput/milex_15>

3. The local context for automotive production: South Carolina

a. Economic snapshot

South Carolina has 4.7 million residents, representing 1.5% of the U.S. population. With per capita income of $31,304 (24% below the national average), the state ranked 48th out of 50 in 2010. Worse still, the state saw a decline of 3.7% in this measure in the decade prior, compared to growth of 6.5% for the country as a whole (Bureau of Economic Analysis, 2012[10]). As of March 2012, unemployment had decreased substantially from its peak during the crisis of 12.0%, but at 8.9% remained higher than the national average of 8.2% (BLS, 2012). Only 61.9% of students completed high school in 2008, ranking South Carolina 49th in the country on this metric of educational attainment (University of South Carolina, 2011[11]).

b. Historical development

As one of the original thirteen colonies, South Carolina has a long history as an agricultural center. In 1690, the port town on Charleston was one the fifth largest city in North America and it remained in the top ten cities by population until 1840 (U.S. Census, 2010[12]). Charleston's growth was originally driven by its importance as a trading hub for rice and indigo, later by tobacco and cotton, which supplied northern textile mills during the industrial revolution of the early 1800s. The legacy of this economic structure can still be seen today: 40% of the population still lives in rural environments. This ranks the state 39th in the country for urbanization (University of South Carolina, 2011).

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[10] Chained 2005 dollars; data available online at <http://www.bea.gov/itable/>
[11] Most recent data is from 2007-8; available online at <http://www.ipspr.sc.edu/scip/education/defaulted.asp>
[12] Data available online at <http://www.census.gov/main/www/access.html>

South Carolina has a troubled history of race relations. Despite a 1954 Supreme Court decision that integrated schools, by 1970 only 12 of South Carolina's 93 school districts had actually integrated. Pressure from the Department of Justice in 1970 finally achieved full integration. Currently, 66% of state residents are Caucasian, 28% are African-American, and 5% are Hispanic (U.S. Census, 2010). The legacy of racial discrimination persists: African-American workers earn wages that are 20% lower than Caucasian counterparts with similar educational attainment (Southern Education Foundation, 2002).

c. Politics and policy

South Carolina has a deeply conservative history. It is the state where Strom Thurmond, who infamously led a filibuster in opposition to the Civil Rights Act of 1957, served as senator for 49 years (1954 – 2003). South Carolinians have voted for the Republican candidate in nine of the last ten presidential elections. The state has witnessed a succession of libertarian governors with four of the last five coming from the Republican Party (South Carolina Votes, 2012).

South Carolina is a right-to-work state, meaning that unions are very limited. This policy reveals a belief that low wages contribute to comparative advantage, though this begs the question: is the ultimate goal of policy to attract companies, or to make people better off? The state also relies heavily on tax incentives to attract both foreign and domestic manufacturing companies. The corporate income tax rate of 5% is 1.6 percentage points lower than the national average, and firms considering South Carolina are granted zero tax rates on property, personal income, inventory, sales, manufacturing equipment, power and materials for finished products, wholesale purchases, and worldwide profits (Porter and Ramirez-Vallejo, 2012).

d. Endowments

South Carolina has limited endowments, but those it does have favor the automotive sector. Industrial energy is priced 20-30% lower than the national average[13]. Along with neighboring North Carolina, South Carolina generates 11.5% of total nuclear energy produced in the U.S. (Porter and Ramirez-Vallejo, 2012). The Port of Charleston positions firms in South Carolina to serve export markets, but faces increasing competition from larger ports on the east coast (Porter and Ramirez-Vallejo, 2012).

e. Competitiveness organizations

The New Carolina Initiative (formerly, the South Carolina Council on Competitiveness) was established in 2004 on the advice of Harvard Professor Michael Porter. He and co-author Jorge Ramirez-Vallejo described the objective: "to attain and sustain a high and rising standard of living for the citizens of South Carolina by increasing the productivity of its economy" (Porter and Ramirez-Vallejo, 2012). The New Carolina Initiative hoped to achieve this ambitious goal by organizing relevant stakeholders to build a shared vision and to solve problems through collaboration. For instance, in work related to the Transportation, Distribution and Logistics cluster in 2008, New Carolina hosted a summit with over 50 people from the sector. According to Porter and Ramirez-Vallejo, the summit was the first time all stakeholders related to transportation investment in the state came together to create a joint strategy. Despite limited support from state political leaders, the New Carolina Initiative continues to act as the organizing force for economic development in the state.

[13]Data available at < http://www.scpowerteam.com/advantages.aspx>

f. Clusters in South Carolina

With the decline of the state's traditional mainstay, the textile cluster, automotive and other emergent clusters seek to fill the void. Several of these others are briefly considered below before a detailed examination of the automotive cluster is presented.

Textiles – The production of textiles began in South Carolina in early 20th century as producers from the northern United States sought cheaper production costs in the south. The total number of jobs in the sector peaked at 230,000 in 1973 and has been declining ever since (Moore School of Business, 2002). A certain degree of innovation continues to take place, however, especially at Milliken Research, which has produced 664 U.S. patents in the last 10 years and has started to cross over into the automotive cluster (New Carolina website, 2012[14]).

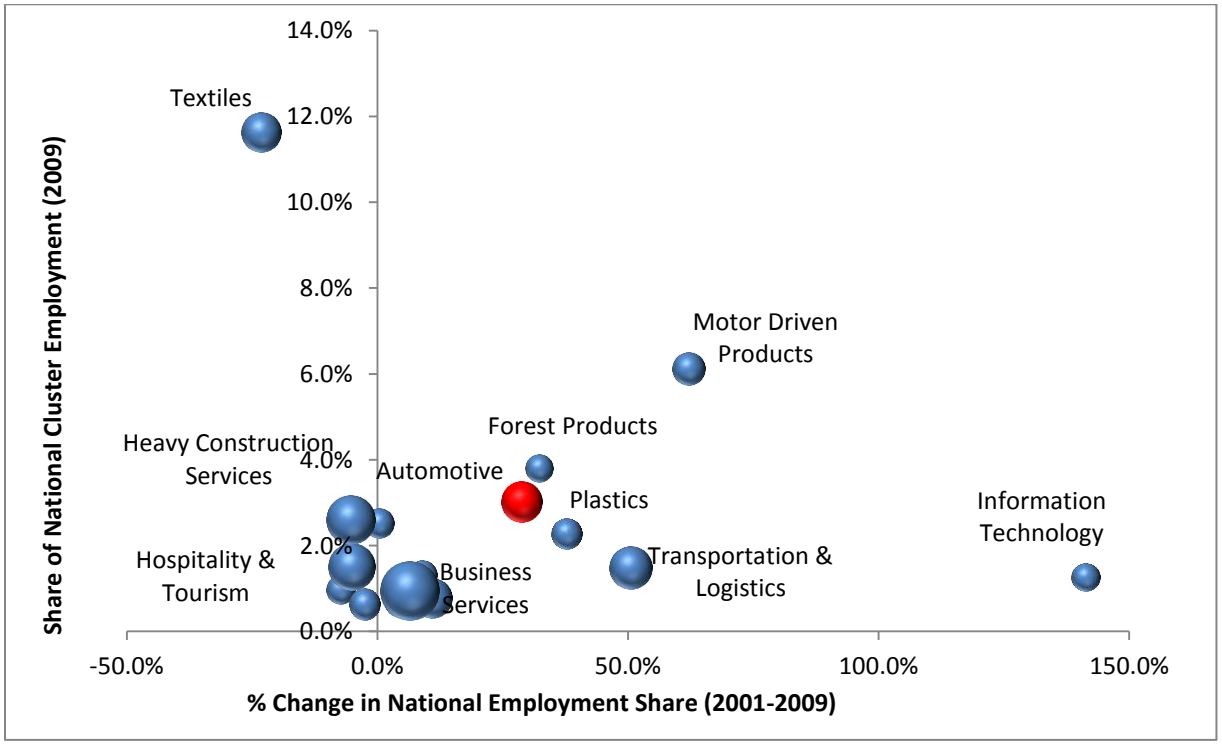
Hospitality & Tourism – The hospitality and tourism cluster in South Carolina revolves around several key destinations: Myrtle Beach, Hilton Head Island and Charleston (Porter and Ramirez-Vallejo, 2012). In 2005, a commissioned study recommended the creation of eight Tourism Development Areas, the establishment of the South Carolina Tourism Alliance, an umbrella organization meant to coordinate the multiple actors in the industry and many other key recommendations (New Carolina website).

Transportation, Distribution and Logistics (TDL) – The TDL cluster in South Carolina revolves around the state's deep-water port in Charleston, but also includes two additional ports, nine airports, five major interstate highways and 2,600 miles of rail (Porter and Ramirez-Vallejo, 2012). The widening of the Panama Canal, scheduled for completion in 2014, should provide

[14] Data available online at <http://www.newcarolina.org/clusters/textiles.aspx>

the ailing cluster with an opportunity for new business. South Carolina's Departments of Commerce and Transportation, the South Carolina Ports Authority, New Carolina and several private sector industry leaders have come together to create the TDL Council, intending to identify and eliminate obstacles to the cluster's growth. Secretary of Commerce Robert "Bobby" Hitt credited the council with recent success in attracting almost $200 million of investment to the cluster in the last year, creating more than 3,000 jobs (TDL Council website, 2012[15]).

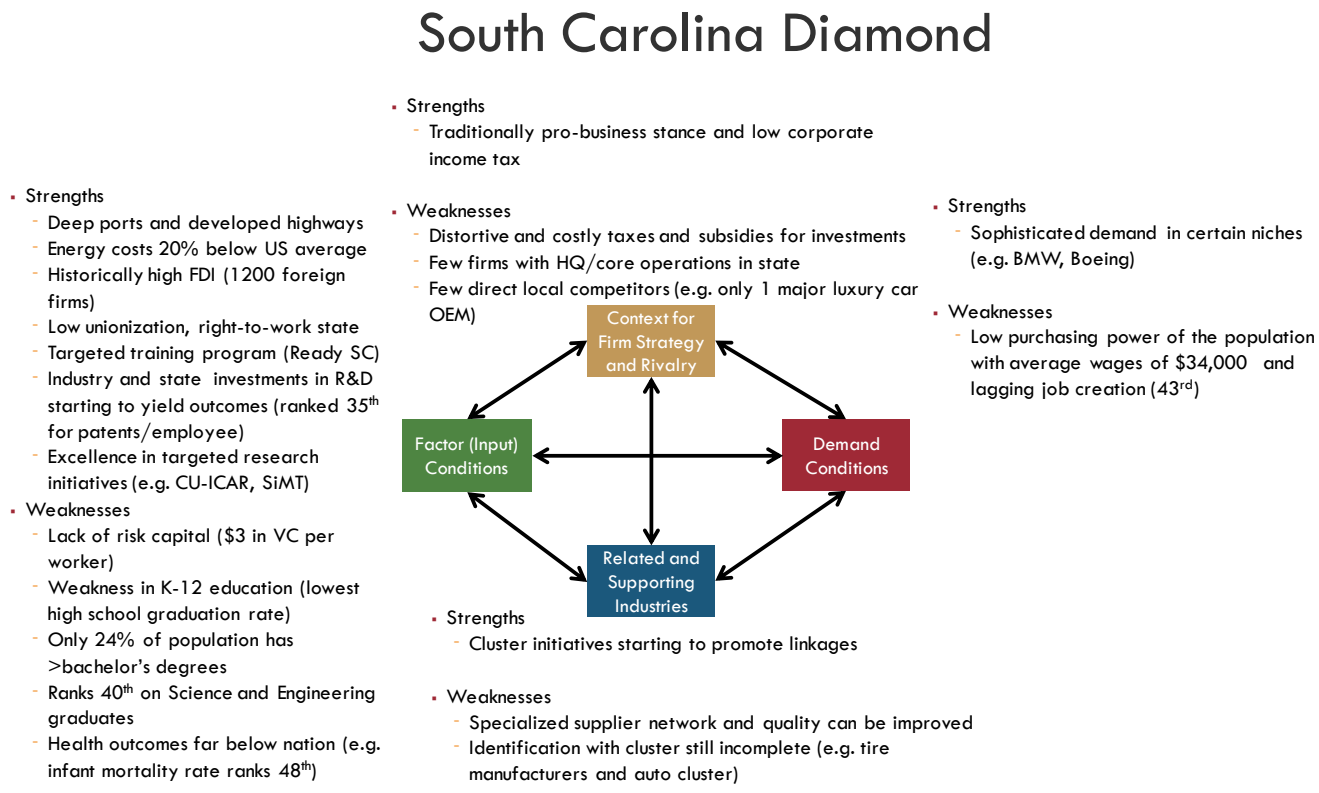
Other Clusters – Other important clusters in South Carolina include business services and heavy construction services. Information technology, motor driven products, plastics and forest products have gained share in national employment. The chart below (ISC, 2012) shows data for traded clusters with at least 10,000 employees, with bubble size reflecting in-state employment.



[15] Data available online at <http://www.tdlcouncilsc.com/about.aspx>

g. South Carolina diamond analysis

Investment in technical education and the efforts of the New Carolina Initiative notwithstanding, South Carolina struggles to compete with other states as an attractive location for doing business. Weak education and low incomes correspond to an under-skilled labor force and unsophisticated demand, while the state pursues a recruitment strategy predicated on low wages and tax incentives that reinforces a context for strategy and rivalry defined by very limited competition. The state's strengths and weaknesses are summarized in the diamond below.



Source: South Carolina Competitiveness: State and Cluster Economic Performance, Professor Michael E. Porter, February 25, 2011; South Carolina Indicators Project at the University of South Carolina. US Census National Science Foundation (for 2009 Graduate Students and Postdoctorates in S&E)

4. Automotive production

a. Value chain

Auto production occurs in seven stages: design, raw material supply, tier 2 supply, tier 1 supply, original equipment manufacture, marketing, and customer distribution (S&P, 2011).

Design – Completed in-house, design time has been reduced from five years to one year today. A prototype "concept car" is first produced and market-tested before beginning full production.

Raw Material Suppliers – Comprised mainly of steel, glass, plastic and rubber, raw materials are procured mainly on the basis of cost, which can fluctuate depending on market conditions.

Tier 2 Suppliers – These are the suppliers of the Tier 1 suppliers, who generally produce simple parts. These suppliers rarely interact directly with assemblers.

Tier 1 Suppliers – These companies supply automakers directly and are often highly integrated into the production process. Assemblers will often bring their own Tier 1 when opening a new plant and availability of local Tier 1 suppliers is a key decision factor when choosing a production location.

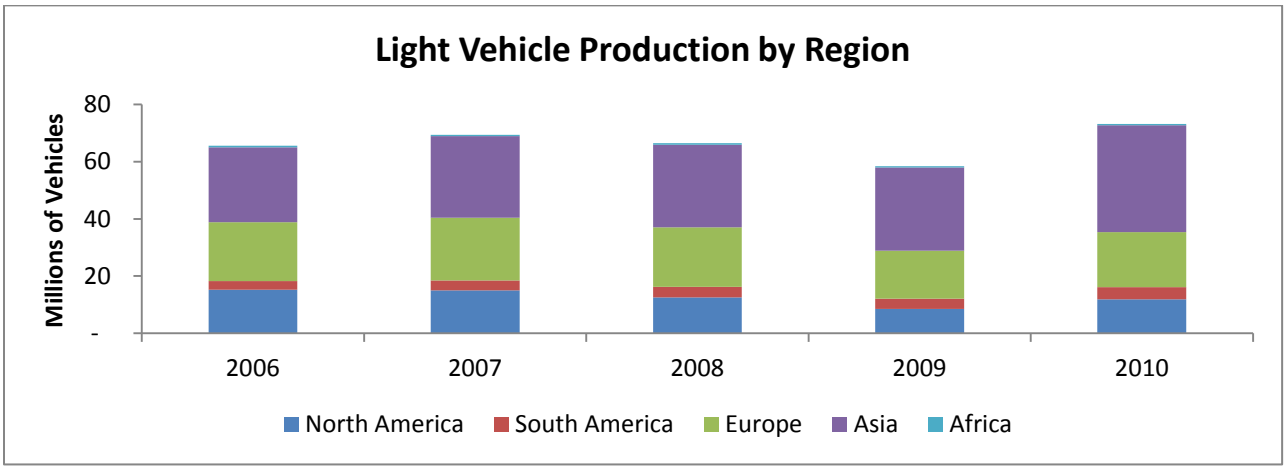
Assembly / OEMs – The main automakers generally choose to assemble cars close to consumers to minimize time to delivery.

Marketing – Highly localized, this process can involve multiple makes and models, depending on sophistication and size of demand.

Distribution / Dealers – End consumers usually purchase new automobiles from independent dealers, most of whom are free to negotiate the mark-up and final price directly.

b. Global dynamics and U.S. market

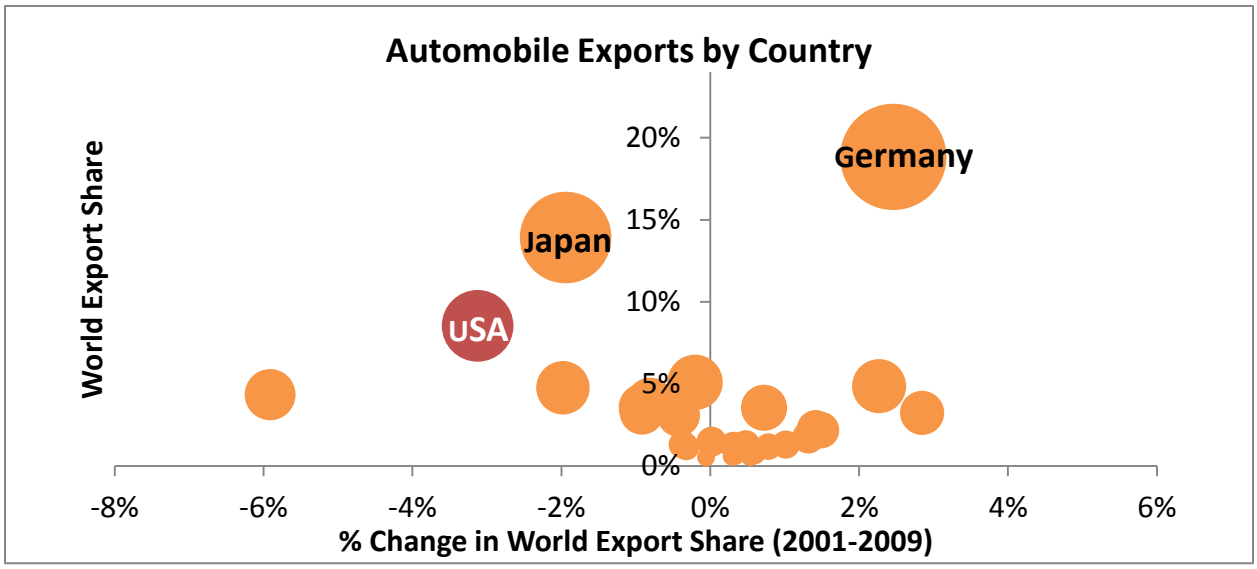
The dynamics of the automobile industry reflect those of the global economy more broadly. Both production of and demand for automobiles have diffused from North America and Europe into emerging markets, especially Asia and South America. In 2009, China surpassed the U.S. as the largest market for new vehicles, as demand in the U.S. fell precipitously from 25% of total demand in 2006 to 15% today, as shown below (S&P, 2011).



The "Big 3" American firms of General Motors, Ford, and Chrysler once dominated U.S. production. Today, ten foreign carmakers operate factories in the U.S. and all ten companies are headquartered in one of three countries: Germany, Japan, and Korea. Since Japanese players first began U.S. production activities in the early 1980s, U.S. and foreign firms have concentrated assembly plants within a 100-mile wide north-south corridor running from Great Lakes to the Gulf of Mexico, bounded on the west and east by highways I-65 and I-75, respectively. This corridor, known as "auto alley," derives its value from the need to locate production in the middle of the country to reach consumers on both coasts, and contains all but two of the assembly plants built in the U.S. since 1980. One is a Toyota plant in San Antonio that serves the Texas pickup truck market; the other is BMW in South Carolina (Klier and Rubenstein 2010).

c. South Carolina positioning

South Carolina's positioning outside of auto alley and near the Port of Charleston highlight its export-oriented purpose. To achieve economies of scale, each model is exclusively produced at one location. As such, BMW Spartanburg currently produces seven models within three families: the X3 and X5 (crossover luxury SUVs) and the X6 (a crossover luxury midsize). These vehicles are exported to more than 130 countries. As shown below, Germany has both the largest and the fastest growing share of the global export market (ISC, 2012).



Beyond BMW, the positioning of the South Carolina automobile cluster is geared towards larger vehicles. Products produced by other OEMs in the cluster include commercial vans, all-terrain vehicles, electric buses, fire engines, and armored vehicles. The higher assembly component of these products make them well-suited for manufacturing in South Carolina, given the price of labor in comparison to other potential U.S. locations.

5. The South Carolina automotive cluster

a. Cluster profile

CU-ICAR distinguishes the cluster. A unique automotive-focused R&D facility at Clemson University, it is jointly funded by public and private sources. Founded in 2003, it boasted the country's first automotive engineering department. In addition to training graduate students – of whom 40% remain in-state after graduation, according to Dr. Imiatz Haque, chair of the Department of Automotive Engineering – CU-ICAR offers flexible formats to cluster participants; these range from large-scale industry projects to R&D support for small suppliers. It has already raised the profile of the cluster and served as an anchor for new investments. Another anchor presence and key strength of the cluster is BMW, which provides a highly visible testament to the cluster's capabilities with its export-focused, sophisticated production.

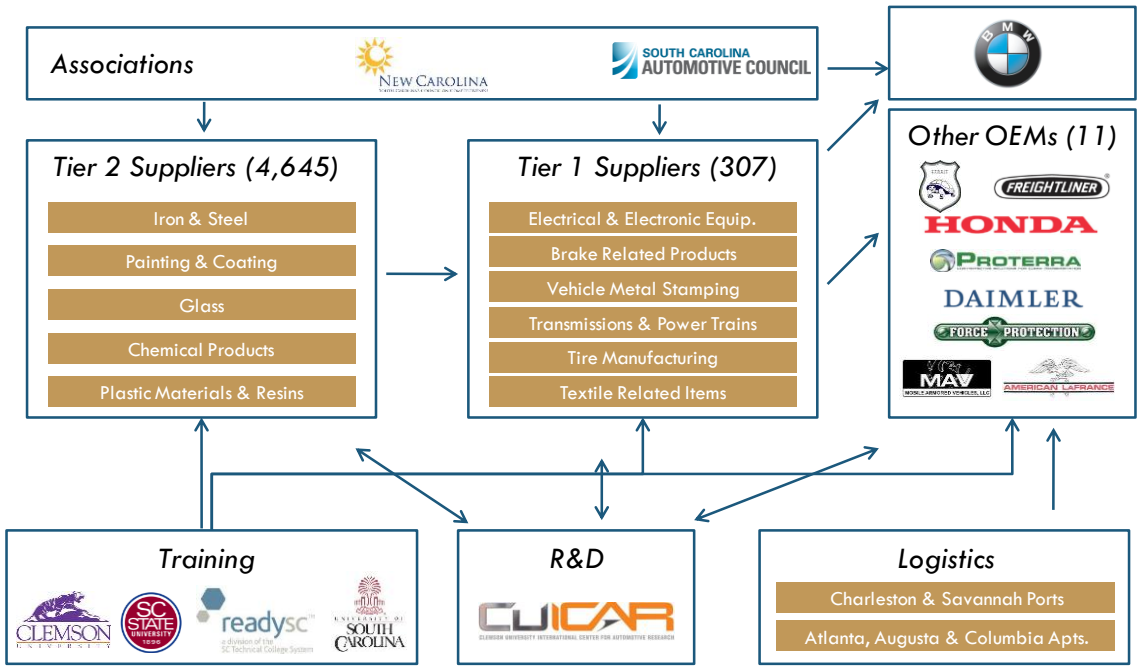
A key weakness of the cluster is that inter-OEM competition is limited, since BMW remains the only passenger car OEM in the state. Moreover, high value-add, sophisticated functions like R&D and headquarter operations continue to be located outside South Carolina. The only OEMs to have established their U.S. HQs in South Carolina are the ones focused on armored and rescue vehicles, through the electric bus manufacturer Proterra has just chosen to establish its HQ in the state as well. In addition, despite the establishment in 2010 of the Auto Council, it appears that cluster linkages and identification with the cluster (e.g. by the significant tire subcluster, much of which produces for out-of-state customers) are incomplete.[16]

[16] Views of the team based on interviews with cluster participants.

b. Cluster map

While the anchor of the automobile cluster in South Carolina is BMW, many other companies and organizations play crucial roles in the cluster. Besides BMW, there are eleven other OEMs active in the state. Together, these OEMs support 307 Tier 1 suppliers and 4,645 Tier 2 suppliers (Moore School of Business, 2002). Training of the workforce and R&D are provided through CU-ICAR and ReadySC, as well as the major universities in the state. Logistics around the Charleston and Savannah ports and the major airports in Atlanta, Augusta and Columbia also play a key role. Lastly, IFCs such as New Carolina and the South Carolina Automotive Council are instrumental in bringing together cluster participants and working to deepen firm linkages.

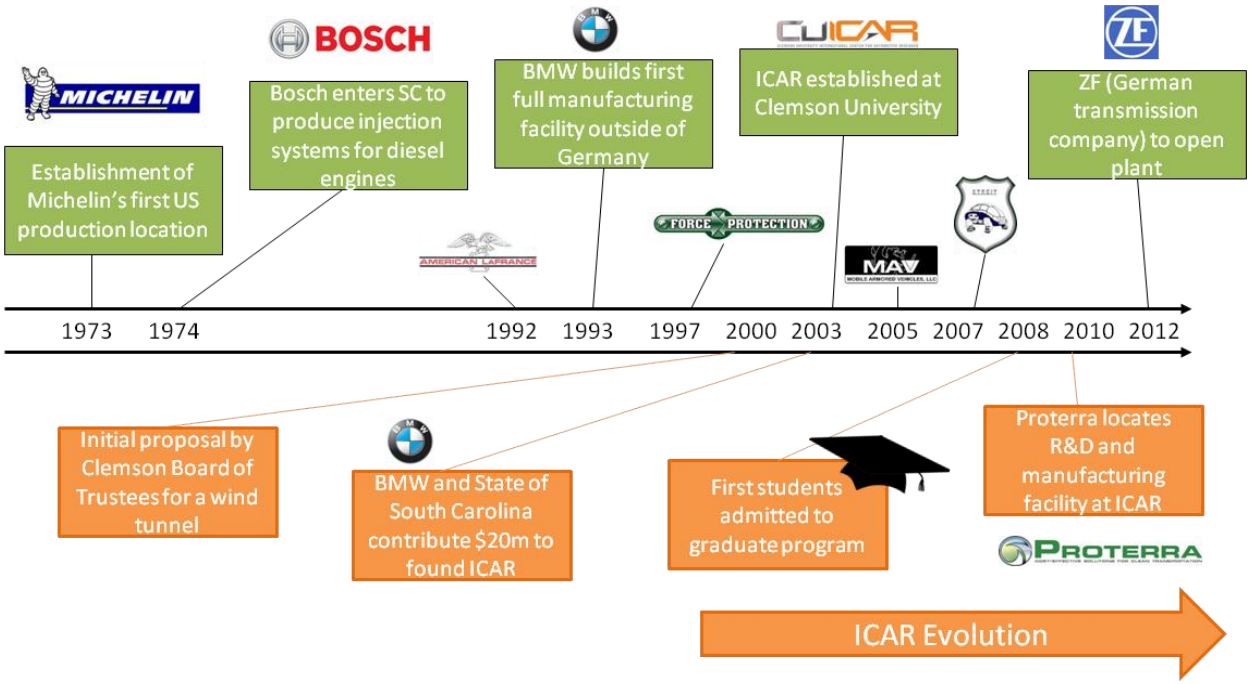
South Carolina Automobile Cluster Map



Source: South Carolina Department of Commerce, South Carolina Automotive Council.

c. Historical timeline

The automotive cluster in South Carolina began with the establishment of Michelin and Bosch manufacturing facilities in the early 1970s. Since then, the cluster's evolution has largely mirrored that of CU-ICAR. After BMW's arrival in 1993, various other OEMs began to gradually locate in the state. CU-ICAR was formally established ten years later, and admitted its first graduate students five years after that. CU-ICAR helped bring other OEMs to the state, some of which chose to locate actual operations on the CU-ICAR campus.



Because BMW's decision to come to South Carolina was instrumental in the development of the cluster, we discuss this decision in detail below.[17] The initial contact between South Carolina and BMW occurred in the late 1980s when then governor Carrol Campell cold-called the company. With declining market share in the United States (U.S. sales declined from

[17] Information about this decision compiled from "When South Carolina Met BMW" by Betty Nash "Incentives and Economic Development: The Case of BMW in South Carolina" by Donald Schunk and Douglas Woodward.

100,000 in 1986 to 53,000 in 1991) and with the falling dollar increasing consumer prices for its products, BMW finally decided to seek out a U.S. location in the early 1990s. After reviewing over 250 sites worldwide, BMW decided on South Carolina for the following reasons:

1. Personal attention from Gov. Campbell
2. Eastern Standard Time zone allowing for easier conversations with Germany
3. The South Carolina Technical College System
4. Transportation links (international airport, interstate 85, direct rail, deep-water port)
5. Clean slate (lack of an existing automotive culture)
6. Right-to-work labor law
7. Existing auto-parts cluster (Michelin and Bosch)
8. Proximity to product and supplier markets

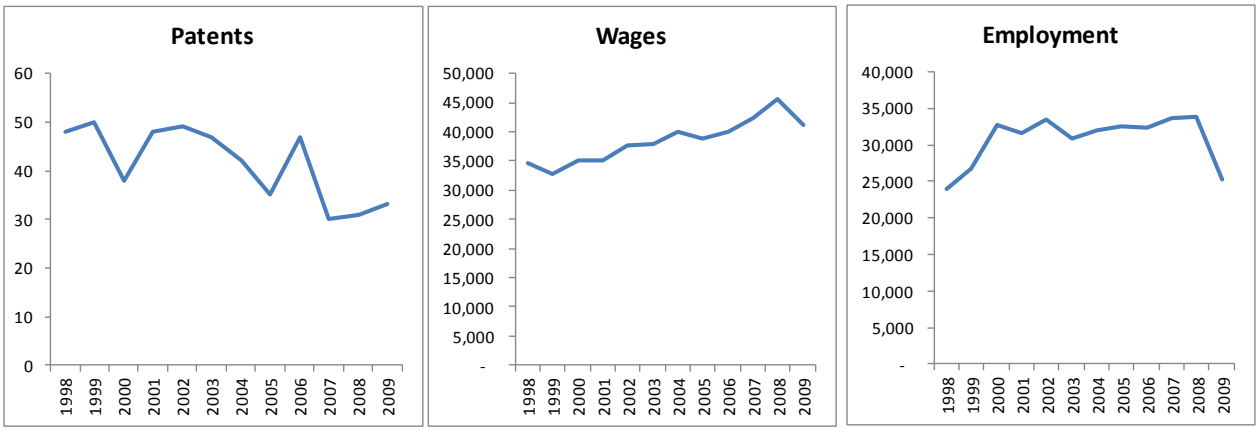
But most of all, South Carolina offered BMW the right incentive package: it was worth approximately $130 million (in 1992 dollars). The package included the following components:

1. 900 acres of farmland worth $25 million (near interstate 85 and airport)
2. Infrastructure and utilities
3. Negotiated fees instead of property taxes
4. Airport land and improvements
5. Worker training

This amounted to approximately $81,000 per job (in 2001 dollars), which is on the low range of a sample of comparable incentive packages offered to foreign manufacturers in the south.

d. Cluster performance

The South Carolina automotive cluster saw gradual increases in employment and wages, although both trends reversed during the recent recession. Patents per 1,000 employees, on the other hand, have trended downwards over the past decade, as shown below (ISC, 2012).



Note: Patents per 1,000 employees.

Qualitative measures of cluster performance, however, suggest that the cluster may be poised for a revival. The recent establishment of CU-ICAR, as well as the new OEMs it has helped attract, will spur employment and innovation. BMW's operations continue, and its investment in CU-ICAR has paid dividends: process engineers at BMW were predominantly German in the mid-1990s, but were almost entirely American by the end of the decade. Today, BMW is the largest U.S. automobile exporter to non-NAFTA countries (Moore School of Business, 2012).

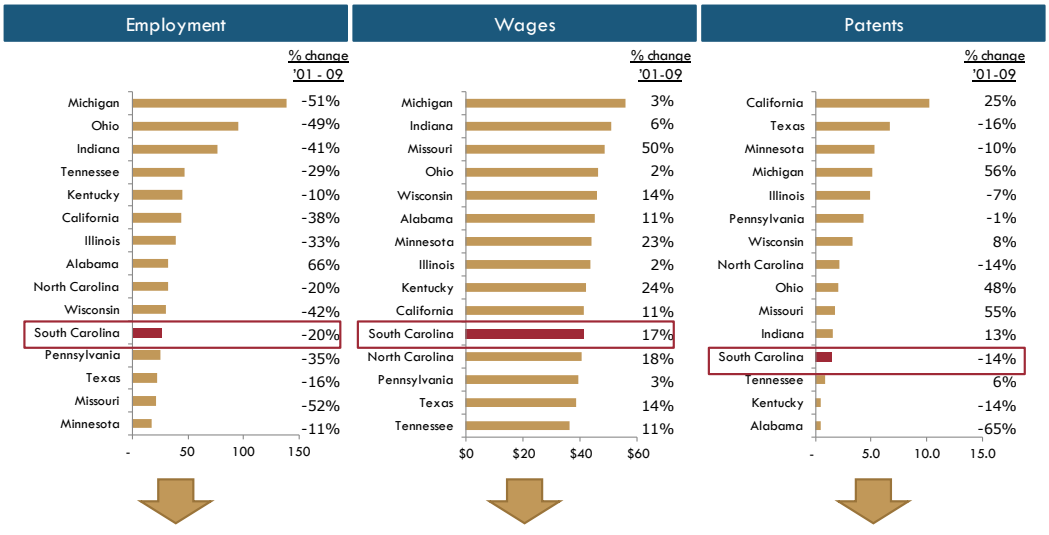
e. IFCs and cluster initiatives

In addition to a significant number of regional alliances (e.g. Upstate South Carolina Alliance) and the ongoing marketing efforts of the South Carolina Chamber of Commerce and the high-profile R&D activity of CU-ICAR, the cluster also benefits from the support of New Carolina and the recently established Automotive Council. As mentioned above, New Carolina has launched a number of successful competitiveness initiatives and has pioneered the cluster approach in the state. However, Professor Douglas Woodward noted that IFCs and the cluster approach have not quite caught on in the state: "There is little cooperation and collaboration between IFCs in the state. Also, in industry you will find that the manufacturers don't talk to

each other, and many don't even consider themselves part of a cluster." But Secretary of Commerce Bobby Hitt responded to this by highlighting positive indications: "The hope is that [the Auto Council] will play the coordinating role. 143-plus companies turned up to the first meeting." Indeed, while it was only founded in 2010, the Auto Council has close linkages with CU-ICAR and industry executives, and represents over 200 facilities in South Carolina.

f. Competing clusters

The South Carolina automobile cluster is ranked 11th in the U.S. on both employment and wages. Over the past decade, employment declined less in South Carolina than in the largest clusters, while wages have increased faster in South Carolina than in ten of the 15 largest clusters. However, the cluster continues to rank low in innovation, as shown below (ISC, 2012).



Note: Employment and wages in '000's. Patents per 1,000 workers.
Source: Institute for Strategy and Competitiveness, Harvard Business School.

g. Diamond analysis

Factor Conditions: A large pool of non-unionized labor that earns wages 21% below than the national average represents a cost advantage for auto employers in South Carolina (ISC, 2012).

Government-backed workforce training, apprenticeship and placement programs (ReadySC, Apprenticeship South Carolina and Quickjobs Carolina) improve the quality of this relatively inexpensive labor. For example ReadySC has trained over 250,000 people in the 50 years since its inception and Apprenticeship South Carolina 3,007 apprentices in 4 years (Porter and Ramirez-Vallejo, 2012). South Carolina offers an established logistics network and access to markets. The Port of Charleston is the 4th largest container port in the country (Port of Charleston website[18]) and a major reason for BMW's decision to locate in South Carolina (Charleston Regional Business Journal, 2012[19]). South Carolina also has 20 foreign trade zone sites, which means that companies that locate here can avoid customs and duty payments on certain imports and exports (Trade Information Center, 2000[20]). From a domestic perspective, the state's strategic east coast location, halfway between New York and Miami, puts it within one day's drive of a two of the country's most important luxury auto markets. Finally, South Carolina has 9 commercial airports, 70 general aviation airports, 9 rail carriers and one of the most comprehensive toll-free highways in the country, making it easy to access all parts of the state (South Carolina Power Team, 2007[21]).

On the negative side, however South Carolina's education system and rate of innovation lag far behind the rest of the country. It places 49th in national high school graduation rates and 42nd in the numbers of science and engineering graduate and postdoctoral students it produces. Despite $200 million invested in ventures such as CU-ICAR, patents per 1,000 people are 2.79 versus the national average of 6.83 (Porter and Ramirez-Vallejo, 2012).

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[18] Data available online at <http://www.port-of-charleston.com/>
[19] Article available online at <http://www.charlestonbusiness.com/news/42950/print>
[20] MacLeod, 2000 and interview with Douglas Woodward
[21] Article available online at <http://www.scpowerteam.com/client_resources/newwhybook07.pdf>

Related and Supporting Industries: The cluster has a sizeable network of suppliers and service providers. This is partly driven by the state's history in textile manufacturing and the 40-year presence of players such as Michelin and Bosch, but it is also partly by design. For example, when BMW located in the state, it brought with it 40 of its preferred suppliers. SC has over 300 first tier suppliers and a presence in all sub-clusters (Woodward, 2011). Also, the state has several IFCs (such as CU-ICAR, the New Carolina Council on Competitiveness, the South Carolina Chamber of Commerce, and the South Carolina Automotive Council), variously focused on increasing the competitiveness of the state and the sector. However, both in relation to sub-clusters and IFCs, our interviewees indicated that actions appear to be dispersed and would benefit from increased coordination and collaboration (see recommendations). In this way, the cluster can begin to generate the spillovers, linkages and positive externalities that are so important to increasing and sustaining competition. As discussed before, there is great hope for the South Carolina Automotive Council, established in 2010, to take the lead in this regard.

Demand Conditions: South Carolina consistently scores low on national demographic and economic indicators, as described above. Against this backdrop, it is not surprising that there is little demand in South Carolina for the luxury vehicles produced by BMW. Fortunately, South Carolina provides ready access to the more lucrative U.S. markets. However, it is important to remember that the ability to export guided BMW's decision to locate in South Carolina.

On the heavy vehicle side, although there are several military bases in the state (including at Fort Jackson and Shaw Air Force Base). Given the current economic situation and the political fallout from its interventions in Iraq and Afghanistan, the demand for military vehicles/SUVs may decline in the near- to medium-term. From the supplier perspective, it is a great advantage to have pockets of sophisticated demand such as from BMW. The demand for high quality

products, from BMW but also other suppliers, creates strong feedback loops that positively reinforce sub-cluster performance.

Context for Firm Strategy and Rivalry: Although there are 11 OEMs in the State, few of them compete directly with each other. The largest player, BMW is the only producer of passenger vehicles. The other players are involved in the manufacture of heavy duty/armored vehicles (America LaFrance, Force Protection, MAV and Streit), all-terrain vehicles (Honda), electric buses (Proterra), commercial vans and chassis production (Daimler). Intense competition drives firms to seek improvements in productivity with greater urgency. This lack of overlap is therefore a major disadvantage for the cluster.

One of our main recommendations is to attract more passenger vehicle OEMs to the state. In addition, the state should encourage current players to either move their corporate headquarters to South Carolina or increase their R&D activities in the state. Most of BMW's R&D is for example, occurs in Germany and California. Refocusing more of this work in South Carolina would contribute to an upgrading of the cluster. With Proterra recently investing in new green energy focused state of the art research center and manufacturing facilities, a real opportunity exists for synergies and collaborations on next generation environmentally friendly vehicles (Proterra website[22]).

h. Government role in the cluster

The state government has initiated several different programs that help the cluster. Some of these have already been mentioned above, in particular the workplace training activities of

[22] Data available online at <http://www.proterra.com/index.php/about>

ReadySC, Apprenticeship South Carolina, and Quickjobs Carolina South Carolina State. In addition, the South Carolina Department of Commerce is involved in several different initiatives to bring new business to the state (Porter and Ramirez-Vallejo, 2012). These include pro-active international recruitment of new firms, preparation of shovel ready sites, subsidies, grants and tax rebates (important because SC has one of the most uncompetitive tax structures in the country). Bobby Hitt, the recently appointed Secretary of the SC Department of Commerce, previously spent 17 years working for BMW. It is a positive sign to have someone with such an intimate understanding of the auto industry head the agency.

6. Challenges & recommendations

Below we present challenges and recommendations at three levels: national, state and cluster. Priority recommendations are highlighted in yellow.

a. National recommendations

The United States faces competitiveness challenges as many of its factor input advantages (e.g. K-12 education, skilled workforce and infrastructure) have begun to erode. Taxes increasingly distort competition and related and supporting industries continue to relocate abroad. Demand conditions are increasingly weakened by lax and non-uniform national standards. To regain a competitive foothold the country must address each of these four areas of the national diamond, as well as the overall business environment. Our overall recommendations are shown below[23]:

Issue	Term[24]	Recommendation	Party to resolve
Factor conditions	MT/LT	Ensure that post-crisis uptick in **productivity growth** turns into a sustainable trajectory by encouraging a move toward taking a Shared Value perspective in investing in upgrading of local production and employee skills[25]	Private Sector, Government Agencies
	MT	Particularly focus on **training/skill-upgrading** for long-term unemployed workers after the crisis. Improve efficiency of spending and outcomes in healthcare and **K-12 education**, particularly in math and science.	Department of Education
	LT	Make necessary long-term investments to maintain competitiveness of **logistical infrastructure**.	Department of Transportation

[23] See Porter and Rivkin article: "The looming challenge of US competitiveness," HBR April 2012
[24] ST = Short Term, MT = Medium Term, LT = Long Term
[25] See Porter and Kramer article: "Creating Shared Value", HBR January 2011.

Issue	Term[24]	Recommendation	Party to resolve
Context for firm strategy and rivalry	MT	**Simplify tax structure**, address growing **complexity of regulatory** environment.	Government
	ST	Following the episode of government support for the Big Three automakers, create a different strategy for the auto sector based on upgrading and innovation.	Government, IFCs
Demand conditions	MT	**Increase stringency, predictability, and harmonization of** state/national **standards** related to vehicle emissions and safety. Provide appropriate support for adoption of new vehicle technologies (e.g. electric cars/buses)	Private Sector, Government Agencies
	MT	**Sustain high purchasing power** through emphasis on raising productivity and wages. Sustain high penetration and sophisticated demand for autos through appropriate **investments in the nation's aging highway system**.	Government
Supporting and related industries	MT	Maintain high quality, quantity and innovation capacity of supplier network. Continue to upgrade clusters and promote increased linkages through cluster initiatives.	Private Sector, IFCs
Business environment	MT	Create a viable plan for medium-term **fiscal sustainability** to stabilize macroeconomic outlook. Resolve increasing polarization and tendency toward gridlock in political environment.	Government

b. State recommendations

The state of South Carolina ranks at the bottom of state rankings on many measures of competitiveness. While many of the recent initiatives launched by the private sector (e.g. New Carolina) are promising, they have yet to make a lasting impact. Improved competitiveness will require building on existing initiatives and continuing to strengthen the state diamond.

Issue	Term[26]	Recommendation	Party to resolve
Factor conditions	MT	Focus on interventions (e.g. infrastructure and education) that drive productivity growth and increase operational conditions and living standards for ALL companies across the board rather than picking winners. This is a long-term strategic decision, dependent on political will.	Government
	LT	Improve state **social indicators** (e.g. crime, health, education statistics): focus on quality of **basic education** to address the bottleneck of low high school graduation rates; training programs to **upgrade skills** to create capacity to upgrade the cluster – invest in human capacity and technology to make workers more productive. Take care not to focus exclusively on technical skills and apprenticeships. Government should also invest in advanced professional degrees including engineering but also management, accounting etc	Government, New Carolina
	ST	**Increase access to risk capital** and support for start-ups	Private sector/ New Carolina
Context for firm strategy and rivalry	ST	Strengthen **linkages** between industry and academia; consider state awards and **recognition for companies** (in any cluster) that innovate and drive the state forward (e.g. Porter prize in Japan) to move away from historical focus on headline gross job creation numbers	New Carolina
	MT	Remove the distortive effects of taxes and subsidies to **level the playing field** for all businesses looking to locate in South Carolina. Though we acknowledge that given its almost $700 million budget deficit, it will be difficult to implement any changes that require tax cuts in the short run	Government
Supporting and related industries	LT	Move away from business recruitment strategies focused primarily on tax incentive packages. Shift recruitment strategy to upgrading existing company's support and engagement to drive **future relocation of headquarters and higher value-added services**.	Government, IFCs

[26] ST = Short Term, MT = Medium Term, LT = Long Term

Issue	Term[26]	Recommendation	Party to resolve
	ST	Appoint champions to **take the lead** in cultivating **coordination and collaboration** between IFCs, firms, universities, training centers, labor, institutions for collaboration, and government	New Carolina

c. Cluster recommendations

The automotive cluster in South Carolina has performed well recently. However, its lack of coordination and collaboration within the cluster and the limited competition between OEMs suggest that the cluster is still in a nascent stage. The recommendations outlined below focus on improving the CSR and SRI corners of the cluster diamond, which are most important for upgrading:

Issue	Term[27]	Recommendation	Party to resolve
Factor conditions	ST	Continue to increase **funding for R&D** in the state; assist CU-ICAR with **commercialization of patents** and raising its profile both nationally and internationally	ALL – government, private sector, industry, academia
	ST	Establish collaboration between CU-ICAR and ReadySC to expand specialized training for automobile design and other knowledge-intensive jobs.	CU-ICAR and ReadySC
Context for firm strategy and rivalry	MT	Recruit **additional OEMs** to the state by marketing the state nationally and internationally and showcasing success cases – **focus** on recruiting another **export-oriented** OEM such as BMW. It is clear from conversations that the state has already been involved in many of these efforts but is yet to make headway. With both BMW and Boeing now being located in the state other players may wait to see whether the state has the capacity (HR and	Government, together with the private sector

[27] ST = Short Term, MT = Medium Term, LT = Long Term

Issue	Term[27]	Recommendation	Party to resolve
		otherwise) to accommodate another big player	
	LT	Promote the cluster to attract more **knowledge-intensive jobs** (e.g. the manufacture and design of engines for BMW rather than just assembly). The combination of Boeing, BMW and Clemson's PhDs present a potential niche in technologically advanced products	New Carolina, CU-ICAR
Supporting and related industries	ST	**Promote increasing overlap of OEM suppliers** through upgrading of standards and promotion of communication among industry participants	Automotive Council

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