MOC Final Project:

Challenges and Strategies for the Competitiveness of the Baden-Württemberg Automobile Cluster

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**Introduction**

The country of Germany has a world-renowned reputation for the premium quality of its engineered products. This reputation is especially strong in the automotive industry and related cluster with brands such as BMW, Porsche, Audi, and Bosch. Not only does it have a strong reputation, but also this cluster has a strategic and economic importance for the country, including 20% of their exports (International Cluster Competitiveness Project, 2010).

A critically important area for the German Automotive cluster is Baden-Württemberg (BW) in south western Germany. It is the area where Porsche and Mercedes have their headquarters and where 1.2 MM cars per year\(^1\) are produced yearly. This report is designed to provide analysis and recommendations for the area. It will start by analyzing the relevant supporting conditions of the country of Germany. Then, it will take a macro-view of the German automotive cluster. Finally, it will look at the automotive cluster conditions in BW providing some concluding recommendations.

**Germany’s Economic Performance and Prosperity: A Powerhouse**

Germany is the fifth largest economy in the world with a population of 81MM people (CIA World Factbook, 2015). The macroeconomic environment in Germany has remained stable and strong with the top ranking in the world in inflation, and in the ratio of government surplus to deficit (Delgado, 2012). Looking at their performance in terms of GDP per capita, they have remained strong as shown in Figure 1. The strength has remained, even among dampened growth due to the 2012 Euro crisis. Comparing Germany to a peer group of other developed nations with a competitive automotive cluster, they rank second in GDP per capita ($PPP).

\(^1\) Estimated based on a ratio of the revenue in BW from car sales to Germany overall multiplied by German cars manufactured.
Two main reasons for the increased prosperity (GDP per capita) in the past are increased labor force participation and regional investment. According to World Bank data, infrastructure investment has remained high over the past two decades. Moreover, labor force participation has increased from 67% in 1990 to 77% in 2012 (World Bank, 2015). Figure 2 shows that the country has overtaken its peers between 1990 and 2012 and now leads in terms of labor force participation.
While the story of a growing GDP per capita is positive, there is a concerning underlying trend. A majority of the growth has come from increased labor force participation and less from increased productivity, when measured in terms of real GDP per hour worked. Figure 3 shows that Germany’s productivity (real GDP per hour worked) has increased at only average annual growth of 1%, which is almost at the bottom of its peer group and only 0.1% higher than that of European competitor France.

One of the reason suggested for the weaker productivity in Germany is insufficient expansion of the capital stock which leads to excessive restraints in terms of investment activity. This suggests that there is a widespread cause, and one that is not limited to Germany, but nevertheless has a huge impact on German productivity trend. “In Germany, which will allow for only very limited growth in the volume of labor assuming it does not actually contract, investment activity will have to be stepped up considerably if Germany wishes to remain on a satisfactory economic growth trajectory” (Schneider, 2013).
R&D and Innovation in Germany

Germany spends about 3% of its GDP in R&D investments (World Bank, 2015), which is higher than the U.S, France, and the U.K, but lower than Korea and Japan (Figure 4). In terms of patent applications of their residents, Germany scores 3X lower than Korea and approximately 5.5X lower (World Bank, 2015) than the U.S. and Japan (Figure 5). This data suggests that it is possible that Germany is investing in more sustaining innovation and likely more development work, causing it to produce less patents.

Endowments: An Aging Population

Analyzing Germany’s endowments, by far their largest challenge comes from the demographics of the citizens. Specifically, Germany’s ~81MM population is aging, with a median age second to only Monaco at 46.1 (World by Map, 2014), and declining at a rate equal to -.18% per year (CIA Factbook, 2015). According to the CIA Factbook, the country’s fertility rate is at 1.4. Figure 6 shows that by 2060 working age population will decline significantly. Analyzing Figure 6, it is predicted that by the year 2060, the 70 to 80 year old group will represent the largest segment of the population of the country (Dvorsky, 2014). This translates into having a smaller working population to support the rest of the country.
Social Infrastructure and Political Institution

Germany is a federal republic that has a reputation for giving the individual states a lot of autonomy to manage their clusters and develop their economic policy. The federal government invests heavily in infrastructure and closely supports cluster development through federal grants, research funds and expertise. Overall, the data from Doingbusiness.org, ranks the German political system positively:

- 9th out of 71 in Social and Political Institutions
- 8th out of 71 in Effectiveness of Law Bodies
- 9th out of 71 in Low Favoritism in Decisions of Government officials
- 7th out of 71 in Basic Health and Education

In Germany, social protections are a central part of the country’s organization and politics, specifically with wages coordinated across the industry. There is a high degree of cooperation between union representatives and management, where councils are involved in management decisions. In addition to that, Doingbusiness.org has rated Germany poorly in terms of starting a business shown in Figure 7 (World Bank Group, 2015). The country ranks poorly
compared to its peers in areas that are critical for new business ventures such as registering property and paying taxes. All these factors mean that not only is it hard to start business, but also that this could hurt Germany’s competitiveness in the long run.

**Figure 7: Comparison of Ease of Doing Business**

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<td>Resolving Insolvency</td>
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**Cluster Analysis: Export Orientated Economy**

Germany possesses a strong export oriented manufacturing base. Figure 8 (y-axis is world share, x-axis is change in world share, and bubble size represents overall exports) shows that this manufacturing base is diversified and that it dominates its competition. Automotive and production technology clusters are some of the biggest in the nation and employee the largest number of people among export oriented clusters.
Germany possesses great factor conditions with strong research capacity and support for sustaining (as opposed to disruptive) technologies, which creates an environment conducive to a manufacturing based economy. However, as discussed earlier, there are holes when it comes to the number of procedures required to start a business, protection of minority shareholder interests, and time required to start a business. There have been only 130,000 annual graduates in STEM subjects – science, technology, engineering and mathematics – in Europe, which is not enough to meet the demand. There is a risk of losing out in developing technology and innovation, because there is a supply side constraint (Roland Berger, 2013).

Germany has multiple related and supporting industries in the country that strengthen the manufacturing base and create numerous clusters. This allows for cross over in suppliers,
research, and training. Figure 9 (International Cluster Competitiveness Project, 2010) shows the full portfolio of clusters in Germany.

![Germany's Share of World Exports by Cluster, 2010](image)

**Figure 9: Germany’s Share of World Exports**

The **demand conditions** are favorable in Germany with a local buyer that has a high prosperity (GDP per capita) which enables the manufacturing base to focus on premium products.

Additionally, prosperity of the local buyers (high GDP per capita) enables demand conditions for the manufacturing base to orient itself towards premium products. Additionally, the area has stringent environmental regulations, which makes it a candidate to focus on innovation in products that reduce the environmental impact on the planet.

Finally, the **context for firm strategy and rivalry**, makes it less probable for the growth of unproven technology. Particularly, there are weaknesses in technology transfer, the existence of trade barriers, a low prevalence of foreign ownership, and a weakness in investor protections.
Figure 9 summarizes the relevant diamond conditions for Germany through the lens of this cluster (Delgado, 2012).

![Figure 10: German Diamond Conditions](image)

**German Automotive Cluster Analysis: A History of Events**

The car industry has a long tradition in Germany and has been deeply rooted in the German economy and culture for several decades. Despite several challenges, the industry has been able to consolidate and reinvent itself several times and maintained a leading position on a global level for more than 100 years. Pioneer Carl Benz invented the first car at the end of the 19th century, which was the birth of local car manufacturing. In the beginning of the 20th century, the inflow of FDI from the U.S. further developed the industry. With the advent of WWII, most of production shifted to military production. In the 1950-1960s, companies from East Germany relocated to South-West Germany and the industry consolidated and updated its competitiveness. In the 1970s-1980s, companies faced increasing competition from Asia, an increased trend to automation started shaping the industry and minor disputes around labor participation occurred (Boelcke, 1987). In the 1990s, German reunification opened new domestic
market and production opportunities. Furthermore, China became an important expansion destination.

**Automotive Cluster Size**

The automotive cluster is one of the largest and most important sectors in Germany contributing to around 20% of total German industry revenue in 2013. The sector accounts for over 30% of all passenger cars in the world. The cluster produces 3.5 million more units than the next closest European competitor. The German car industry has been leading the segment globally for many years with 3 German companies amongst the top 10 global automotive manufacturers. German automotive industry is not limited to car manufacturing, 21 one of the world’s top 100 suppliers are also German companies. In 2014, the revenue for German suppliers rose to an all-time high of 70 million euros with employment of 290,000 (GTAI, 2015). As shown in Figure 11, the largest market for exports from Germany is Europe with over 50% of exports followed by the United Kingdom and the United States at 17 and 15%, respectively (Di Bitonto, 2009).

![Figure 11: Export Areas for German Passenger Vehicles (%)](image-url)
Specifically, the German automotive cluster has a focus on premium cars. The development of this focus starts with the local demand, considering that of the cars registered in Germany in 2012, 23.2% (9.95 million) were luxury vehicles (Bekker, 2012). The premium cluster is anchored by brands, such as, Audi, BMW, Mercedes-Benz, Porsche, and Volkswagen.

**Automotive Cluster Investment**

In addition to the branding efforts, the premium nature of the automotive cluster has to do with investments. The automotive cluster is the largest recipient of Foreign Direct Investment (FDI) in the country amounting to over 44% of the total investments. The industry spent a substantial amount of EUR, 17.6 billion, on R&D in 2014, which is equivalent to one third of Germany’s total R&D expenditure (Di Bitonto, 2009).

OEMs and suppliers are an integral part of the technological market transformation globally. The industry is focused to improve the combustion engine energy efficiency, alternative drive technologies such as electric, hybrid, fuel cells cars and lightweight materials and electronics. The headcount in R&D is growing with 95,000 employees (+3%) of 756,000 (+1.9%) employees in the industry as a whole (GTAI, 2015).

**Baden-Württemberg Cluster Analysis**

An integral part of the German automotive cluster is Baden-Württemberg (BW). The area has a population of ~10.6MM, a 2015 unemployment rate of 4% (compared to 6.8% in Germany), and an export volume of EUR, 181.4 billion in 2014 (Statistik Baden-Wuerttemberg, 2015). The region (shown in Figure 12), like all of Germany, is responsible for their individual economic development, regional development, and education services and policies. BW is one of
the most economically successful regions of all of Germany, only being eclipsed by the city-states in terms of GDP per capita as Figure 13 indicates (Statista, 2015).

Due to the federalist system in Germany, state government has wide-reaching influence on economic development. Baden-Württemberg has been faced with a low endowment of natural resources forcing the government to focus on to investing in the human resources creating a long history of high-quality education and state-funded research. For example, BW was the first State to introduce compulsory education in 1649 and opened the first German Technical University in 1825. Today, a wide landscape of leading state-owned technical universities and state research institutes exists.

Several industries relocated to Baden-Württemberg from former East Germany at the onset of Cold War. Furthermore, precision mechanics, machinery and to some extent cars were the industries in which no other German region had established itself up until the 1960s with heavy industry in North-Rhine Westphalia and airplanes and shipbuilding in Northern Germany.
Baden-Württemberg Innovation

The State of Baden Württemberg has traditionally spent more money on R&D than the German average (3.5% vs. 3%) and several other countries such as Japan and the United States (Werner, 2007). In addition to that, Baden-Württemberg’s universities regularly rank among the best in the nation. Building on this foundation, studies come to the conclusion that Baden-Württemberg is one of the most innovative regions in Europe and the world (Einwiller, 2012).

BW: A Strong Car Cluster

As BW developed as a strong research and manufacturing center, a strong car cluster was built in the region anchored by major automobile manufacturers and suppliers. These companies include Mercedes, Porsche, and Continental. The map in Figure 14 shows on the left automobile clusters in Germany, while on the right shows the areas where German suppliers, production, and education institutes are located (Gupta, 2009).

Figure 14: Map of the BW Car Cluster (Gupta, 2009)
BW Automotive Diamond Conditions

On the factor conditions, the absence of natural resources and more recently high labor costs forced productivity improvement and lead to a focus on premium products in the automotive sector. The comparably good education system and highly trained work force add to the high value creation. Strong related industries such as machinery allow for local sourcing and knowledge spillovers which tremendously increases the competitive position of the region. and good education further favors premium manufacturing. Companies are in strong competition with each not only about customers but also skilled personnel. Additionally, cars are widely considered a status symbol in Germany and especially Baden-Wuerttemberg itself has one of the highest demands for premium automotives. Due to high security standards and a strong regimes of environmental regulation, firms are constantly being forced to innovate in key areas such as driver safety and emission. The high gas prices in Germany furthermore make German cars considerably more fuel efficient than for instance their American counterparts. The firm context is coined by competition but also joint industry efforts in areas such as labor force training and strong personal ties between company executives. At the same time, it is a problem for manufacturers that the German car market is getting more and more mature with aging population slowing down growth in the market.
Four of the world’s top 15 suppliers in the car industry are German headquartered in Germany and maintain a strong presence in Baden-Wuerttemberg. Around 40 vehicle and motor manufacturers as well as 237 companies, which count as direct suppliers to the vehicle industry, are based in Baden-Württemberg. On the OEM side, Daimler AG and Porsche AG, two of the most innovative car manufacturers have their head offices in Baden-Württemberg. In total almost 740 companies are represented in Baden-Württemberg, which corresponds to around one third of all German businesses in the automotive industry. As Figure 16 indicates, the cluster landscape is well developed auto assemblers as well as world class Tier 1 and Tier 2 suppliers at the heart of the cluster. Basic inputs such as steel and aluminum can partly be sourced from the region.

There is a strong network of supporting agencies such as the chambers of commerce as well as the institutes for collaboration such as Automotive BW and E-Mobility BW that are offering several activities and services to companies in the region. Among those activities are

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**Figure 15: BW Automotive Diamond conditions**

<table>
<thead>
<tr>
<th>Factor Conditions</th>
<th>Context for Firm and Strategy:</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Highly skilled labor force; 6 of the 10 highest ranked universities in Germany are in BW</td>
<td>+ Vigorous and public competition between several companies in small geographic proximity</td>
</tr>
<tr>
<td>+ Absence of natural resources and high labor costs</td>
<td>+ Joint (government, trade chambers &amp; private companies) investment into labor training</td>
</tr>
<tr>
<td>+ Strong personal links between company executives leading to better coordination and common strategy</td>
<td>+ Mature market demand slowing growth</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Related and Supporting Industries:</th>
<th>Demand Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>+ Degree of local sourcing is 70%</td>
<td>+ Sophisticated and demanding home market for premium cars (automotives widely considered as a status symbol), BW has the highest GDP per capita in Germany</td>
</tr>
<tr>
<td>+ Availability of competitive suppliers</td>
<td></td>
</tr>
<tr>
<td>+ World class process machinery manufacturers available locally</td>
<td></td>
</tr>
<tr>
<td>+ Absence of strong battery and software clusters</td>
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</tbody>
</table>
branding, fairs and networking channels as well as assistance for small and medium sized companies to enter world markets. Due to EU regulation, there are strict limits to the degree of how new companies can be incentivized through monetary means to settle in the state. Another problem that has frequently been brought up by the experts we interviewed is that universities might be limited in the degree to which they work on possible breakthrough research because industry funding directs them to prioritize research on sustaining established industries. The main missing part on the cluster map is battery manufacturing and software engineering (highlighted in red below), which is especially noteworthy in regards to the future industry trends that were flagged by various experts.

**Figure 16: BW Auto cluster map**

**BW Cluster: Comparison to Global Competitors**

Experts familiar with the industry identified Seoul, Tokyo and Detroit as the most important competing global clusters for Baden-Wuerttemberg (compared in Figure 17). It is
noteworthy that all of the strong clusters are located outside of Europe. Tokyo is an especially relevant competitor because of its advanced technology and strong supporting industries in areas in which Baden-Wuerttemberg is relatively weaker, such as electronics and battery technology, as well as its position as an important exporter. South Korea in a similar way benefits from its connection to the electronics industry, high patenting rate, and moderate labor costs. The Detroit cluster, at the same time, serves one of the largest domestic markets in the world and is positioned in a very dynamic market environment.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>Vehicles Produced (MM)</th>
<th>Quick Description</th>
<th>Well Known Brands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo, Japan</td>
<td>8.2</td>
<td>High quality, advanced technology, large exporter</td>
<td>Toyota, Nissan, Mitsubishi</td>
</tr>
<tr>
<td>Seoul, South Korea</td>
<td>4.1</td>
<td>Moderate labor cost and large regional export market</td>
<td>Hyundai, Kia, Samsung Motors</td>
</tr>
<tr>
<td>Detroit, U.S.</td>
<td>2.45</td>
<td>High labor cost and serves mostly domestic demand</td>
<td>GM, Ford, Chrysler</td>
</tr>
<tr>
<td>BW, Germany</td>
<td>1.7</td>
<td>Serves large regional market, high quality brand, and strong engineering expertise</td>
<td>Audi, Mercedes, Porsche</td>
</tr>
</tbody>
</table>

Figure 17: BW Comparison Chart

**Manufacturer’s Perspective**

Industry specialists have predicted next couple of years to be marked by increasing volatility and uncertainty for the automobile industry. European market is expected to remain stable, Japanese market to decline, NAFTA will grow moderately, and China remains the only major growth driver with projected growth of 5.3% by 2025 (Mohr, 2013). Germany’s share as a percentage of total global production has declined in the last couple of years. New capacity has been added in other locations because of various reasons such as import tariffs (China),
transportation costs (U.S.), and costs of materials (e.g. energy). Though vast majority of Research & Development (R&D) is still being done in Germany as 70% - 80% of R&D employees are located in the country. (IBIS Report). High value-add jobs in R&D have been added increasing the employee count in Germany while only manufacturing jobs have mainly been added outside the country.

German manufacturing looks to be competitive for the upcoming future. However, new capacity will be added in other locations due to lower import tariffs (China), transportation costs (U.S.), and cost of materials (Europe). Looking at the industry cost analysis, Figure 18 shows that labor are only 6% of revenue, while other costs including transportation make up 12% of revenue. Specifically, individual markets have their own specific design conditions, so they will need to develop location specific models with development work happening locally.

Therefore, local German production will likely to remain at the same level, while new capacity will be added in other locations. Europe will retain its lead as a R&D location. Germany will maintain its supremacy in the premium vehicle segment, China, with its traditional strength in the volume segment (Mohr, 2013).

![Figure 18: Industry Cost Structure](image)
Supplier’s Perspective

For the last couple of years, the automotive industry has been undergoing structural changes given the increase in number of models, shorter product cycles, deployment of new technologies, focus on electromobility, vehicle connectivity and automatic vehicles. The industry has its peculiar pressures but these factors have fundamentally altered the relationship between the OEMs and suppliers and their respective contribution towards value creation. This requires a review of their own value-creation strategy and capacities to deliberate and adopt a future-oriented competitive position. These are some of the findings of the recent study by Oliver Wyman and the German Automotive Industry Association (VDA) conducted in 2013 (Oliver Wyman, 2013).

Currently, Germany has the largest portion of high value added development centers for suppliers with 21 of the world’s top 100 automotive suppliers being German (Mohr, 2013). In Germany, they also have a strong small or medium sized supplier segment that have been growth drivers for their future. In the short-term, slower growth is expected for the automotive supplier industry, however in the long term the magnitude with which these challenges will have an impact on automotive suppliers is expected to increase significantly. There will be continued shift of end customer demand to Asia and ongoing relocation of engineering to China (CEE) and production (new markets beyond BRIC). This can be seen in the figure 19, where R&D is remaining strong in Germany, while new manufacturing employees is growing in China. For suppliers, market access and technology driven mergers and acquisitions will unlock access to emerging markets. This environment yields an ever higher number of both opportunities and
risks for automotive suppliers and those who will focus on the winning product, customer and regional mix will hugely benefit (Roland Berger, 2014).

Figure 19: Continental Case Study

Risk 1: E-Mobility

E-Mobility gets high attention in a world of limited fossil fuel and with increasing attention for global warming and environmental issues in general. It sums up all alternative fuels to run cars such as electricity and hybrid fuels. A number of large and medium sized companies are already offering solutions in the area of E-Mobility (E-Mobil BW, 2015). Companies such as Tesla have been gaining market share, investing in large-scale plants, and likely to gain scale advantage. Faced with this situation, the main challenge for Baden-Württemberg will be the availability of battery technology and repowering-stations in the German home market. An expected increase in regulation on carbon emission alongside with initiatives by the federal government to increase the size of its own e-mobility fleet as a means to make the technology more visible on the streets can be seen as main driver in the future. Tightened regulation is not only on the way in Europe but in other important markets such as China and Japan. To reach the overall fleet targets as set by the government, E-Mobility solutions will be needed (Mohr, 2013).
E-Mobility solutions will most likely be supplemented by other new technologies such as mobility networks. Furthermore, several studies indicate that there will be a shift in research intensity from OEM to suppliers, so that suppliers will add increasingly greater value and drive the differentiation of the industry in regards to the new trends (Oliver Wyman, 2013).

**Risk 2: Autonomous Vehicles**

Autonomous vehicles or self-driving cars have been a popular topic of discussion over the last few years – sparked by the segment on Google’s foray into the industry. According to one report, autonomous vehicles are coming to market late in 2015 in the U.S. A study of consumers suggested that 55% would be willing to purchase a partially autonomous car, while 44% would consider a fully autonomous car. Of this group, consumers suggested that 20% of them would be willing to pay more for the technology with the promise of lowering insurance and fuel costs, while increasing the overall safety of vehicles (1.26MM accidents happen in Europe yearly (Annual Statistical Report, 2008)). According to a McKinsey report, vehicle connectivity is growing fast with a 50% penetration rate (for new vehicles) by 2016 and close to 100 percent in 15 to 20 years in the areas of Japan, North America, and Western Europe (Mohr, 2013).

The rise of autonomous vehicles will require a cluster to develop expertise in software, sensors, and policy. The BW cluster (and Germany overall) has existing collaborators on sensor technology (e.g. companies like Siemens), however they lack the expertise in building software that focuses on user experience and ease of use that will likely dominate in car interfaces. The other obstacles for the widespread adoption of autonomous vehicles are to determine how to
actually regulate them. The major question becomes whose fault will it be in an accident (the manufacturer or the owner) and who will need to buy insurance on the cars.

Risk 3: European Overcapacity

Analyzing the chart by McKinsey and Co. in Figure 20, Europe has an overcapacity problem likely a result of a weak economy in all of Europe driving the sale of less cars (Mohr, 2013). Thus far, the German car manufacturers have not seen a lot of negative repercussions, due to their commitment to the premium segment of the market and to their ability to diversify globally.

While German OEM’s have been able to be successful, this could be troublesome for the BW cluster if this trend continues. The manufacturers have built manufacturing facilities in local regions to meet unique demand conditions, especially in China and India. By 2025, China will have further expanded its position as the most important vehicle producing region in the world creating 300 Billion euros in value (Oliver Wyman, 2013). While the German brands could remain strong, the mid-sized suppliers will be the organizations that will not be able to remain strong. These companies, which are mostly family-run companies, have been at the backbone of the German automotive cluster helping it improve efficiency, technology, quality, and international positioning. The shifted production will cause them to become less relevant, eroding away a lot of the core that has given the German automobile cluster it prevalence.
Two different, but related trends are shifting how cars are being used across the globe. The first is car sharing, pioneered by ZipCar, which allows residents of cities to reserve a car on demand for a specific amount of time. The growth of these car sharing programs is represented in Figure 21, which has gone up 10X worldwide since 2006 with the largest share going to Europe. As detailed in Figure 22, for every car that is used for car sharing it replaces between 4 and 10 purchased cars and could reduce carbon dioxide emissions by between 39-54%. The second trend is what is called transport network companies, such as Uber or Lyft. These companies allow users to at a lower cost easily ‘hail a car,’ while on the surface it seems that this would help out car companies. These organization have a vision of replacing the need for car ownership in cities, by using their data and algorithm to increase carpooling on the routes and decrease the cost for a ride across town (LeVine, 2014).

The main challenge these two types of technology present for the BW auto-cluster is it likely will further weaken the demand for cars, which in turn will increase the overcapacity in
the European market. This will also put pressure on policy, as well as require superior security systems.

![Figure 21: Adoption of Carsharing](image1)

![Figure 22: Impact of Carsharing](image2)

**Recommendations**

The automotive cluster in Germany and BW is important to the economic future of the country and the area. It has been one of the top of the world and will continue to be, as long as they view their challenges as opportunities to further increase their competitiveness.

At the country level, Germany needs to focus on how they will handle an aging and declining population, how they can encourage the formation of innovative new businesses, how they can fund technological shifts, and how they can meet the demand for STEM graduates. Substituting for the aging and declining population will be a positive change for the BW automotive cluster. This will ensure that they will have enough able people for their workforce, as well as keep local demand strong. Similarly, all parts of the value chain in the car cluster will require qualified STEM graduates, so encouraging more people to study those subjects will be a major step. Improving the entrepreneurial culture will help the BW automotive cluster address the pending technology risks as discussed above. Finally, by improving the access to capital for
unproven ideas, this will help improve the productivity of the workers as well as further increase the entrepreneurial capacity in Germany. The specific recommendations can be found in the following Figure 23 as follows:

<table>
<thead>
<tr>
<th>Diamond Conditions</th>
<th>Current State</th>
<th>Recommendation</th>
<th>Action Owner</th>
</tr>
</thead>
</table>
| Context for Strategy and Rivalry | Financing is difficult for unproven, but disruptive technology | -Provide downside protections for banks to loan to companies based on new technologies  
-Change regulation to be more friendly to PE/VC firms | Private and Public Banks, State and Federal Governments, IFCs |
| Factor Conditions                | Aging and Declining Population                      | -Simplify and expand immigration laws (pro-immigration)  
-Increase language training and integration facilities  
-Tax incentives for having children | State and Federal Governments |
| Context for Strategy and Rivalry | Entrepreneurial spirit hurt by difficulty to start a business | -Simplify new business incorporation process  
-Create a federal agency that handles & processes all things required to start a business  
-Liberalize labor laws  
-Reduce penalties for bankruptcy | IFCs, Corporate Leaders and Federal Government |
Increased Quantity of STEM graduates
- Provide additional funding for university scholarships
- Partner with local primary and secondary education to work with and market to the students

IFC’s, State and Federal Government, and Company Leadership

Table: Country Level Recommendations

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<tr>
<th>Factor Conditions</th>
<th>Increased Quantity of STEM graduates</th>
<th>Current State</th>
<th>Recommendation</th>
<th>Action Owner</th>
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| Related and Supporting Industries | Availability of battery technology and repowering-stations for E-mobility is questionable | -Create JVs located in BW with Japanese and US battery companies.
- Build 3 test recharging stations in BW.
- Make it a specific IFC goal to attract battery | OEMs, IFC, Federal Government |

At the BW level, the automotive cluster has been strong as the premium supplier of cars for Europe. The risks that they face come from breakthrough technology, new business models, and a growing overcapacity problem in the area. The threat of companies like Tesla, without the expertise in battery technology and charging stations, could put the BW companies at a disadvantage. They will likely have to partner in joint ventures to gain this expertise to stay ahead. Car sharing, transport networks, and existing overcapacities will promote consolidation in the area and force companies to lower their prices. As a way to compete, BW companies will have to remain a premium segment, focus on becoming more nimble in design delivering what the market wants and when it wants, and look for ways to expand in the Middle East and North Africa. Autonomous cars will bring new expertise to the car industry, especially in software, which BW should commoditize to neutral the effect of this change and play to their strength as an OEM manufacturer. The specific recommendations can be found as follows:
| Related and Supporting Industries | Autonomous vehicles will require clusters to develop software and policy | -Create an institute for open innovation software. Launch an office in silicon valley. Use this to commoditize the software  
-Funds for automotive software professorship | Private Sector, Federal Gov’t, and State Government |
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<td>Related and Supporting Industries</td>
<td>Autonomous vehicles will require clusters to develop software and policy</td>
<td>-Pass new legislation to allow autonomous cars. Work with IFCs to draft this legislation</td>
<td>IFC, Federal Gov’t</td>
</tr>
</tbody>
</table>
| Related and Supporting Industries | Autonomous vehicles will require clusters to develop software, and policy | -Create strategic VCs arms to provide funding for new tech companies.  
-Create an automotive focused accelerator including technical universities. | Private Sector, Universities, Federal Gov’t, and State Government |
| Demand                           | Increasing trend for car sharing and transport networks                 | -Build foundation in the autonomous driving technology to stay ahead of the curve and capture the new market of car sharing | IFC, Private Sector, Federal Gov’t, and State Government |
| Context for Strategy and Rivalry  | Overcapacity in Europe                                                  | -Invest in innovation as suggested above to ensure a premium segment           | IFC, Private Sector, and State Government |
| Context for Strategy and Rivalry  | Overcapacity in Europe                                                  | -Hold trainings on shortening and development cycles and joint development between suppliers and OEM’s to deliver what the market wants. | IFC |
| Context for Strategy and Rivalry  | Overcapacity in Europe                                                  | -Explore trade deals and marketing in North Africa and the Middle East         | Federal Gov’t, |

Figure 24:BW Recommendations
Conclusion

The BW automotive cluster has a strong backbone to build its future success on. If the cluster stays true to its history as a premium car manufacturer but works to address the issues identified above-- it will remain one of the strongest car clusters in the world and retain its edge for many years to come. There is a need for OEMs to redefine their relationship with the suppliers and collaborate to have cutting edge R&D and to decrease turnaround time for innovation. Future technologies and business model innovations will have a huge impact on how the automotive industry operates and the ability to adjust quickly in this dynamic environment will be a major determinant of success. Following this idea, the cluster and the individual actors in it must not be blinded by their own success but instead constantly challenge themselves.

Over the last many decades, the BW automotive cluster has been able to reinvent itself constantly. We are confident that if the right decisions are being made, it will be able to continue this success story in the future. Building on this foundation, the cluster provides a powerful example of how a traditional high wage region can remain a manufacturing and innovation hub also in a globalized market environment and can bring prosperity to the region for years to come.
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