International Industry Analysis: Global Automotive Industry

Team Report, Section 1

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Introduction

The automotive industry comprises all those companies and activities involved in the manufacture of motor vehicles, including most components, such as engines and bodies (Britannica Insights, November 2020). The industry's main products are passenger vehicles, light trucks, including pickups, vans and sport utility cars and commercial vehicles (i.e., delivery trucks and large transport trucks).

The automobile was first invented in Germany and France in the late 1800s, although Americans quickly came to dominate the automotive industry. Actually, mass production of automobiles started in the 1900s, when Ford introduced assembly line car production to manufacture its Model T. This technique became standard and led to the emergence of General Motors and Chrysler, with along with Ford, formed the "Big Three" auto companies in the 1920s.

During World War II, manufacturers concentrated their resources to the military, and subsequently automobile production ascended in Europe and Japan to meet the raising demand. Correspondingly vital to the expansion of the American urban cities, the industry had developed a shared global enterprise with the upsurge of Japan as the leading automaker by 1980. Even though, the automotive industry was to have its highest social and economic effects in the United States, it was originally refined by the Germans and Frenches by the end of the nineteenth century. It was headed by names such as Gottlieb Daimler, Karl Benz, Nicolaus Otto or Emile Levassor (History.com Insights, April 2010). Nowadays, the major motor vehicles manufacturer are Toyota and Volkswagen; in terms of the global automotive supplier, this field is dominated by European and Japanese players such as Bosch, Continental and Denso.

Global sales of automobiles are forecast to be just under 62 million units in 2020, down from a maximum of almost 80 million in 2017 (Statista, Automotive Industry Worldwide, November 2020). This was mainly due to the impact of Covid-19 pandemic, which forced the closing of many factories and no new vehicles were rolling off the assembly lines. Work stoppages from outbreaks are still affecting the industry on a global scale, even though factories have reopened in many markets.

Among the largest automobile markets, China led the path in 2019 with the largest automobile market based on sales with around 21 million units and, also on production with more than 21.3 million cars produced in 2019, accounting this way for almost one third of the world's passenger vehicle production (Statista, Automotive Industry Worldwide, November 2020).

Environmental concerns are becoming a priority in the industry, prompted by initiatives such as the Paris Agreement. Automakers are starting to expand their business into the electric mobility sector, since around the globe countries are passing emissions controls on new vehicle models. By 2025, every third new car sold is expected to be propelled or assisted by an electric battery. Moreover, mobility services and autonomous driving are anticipated, over the next decade, to stir up another revolution in the auto sector. The front of this movement is expected to be guided by China which is projecting autonomous vehicles sales of 14.5 million units by 2040 (Statista, Automotive Industry Worldwide, November 2020).

1. PESTEL Analysis

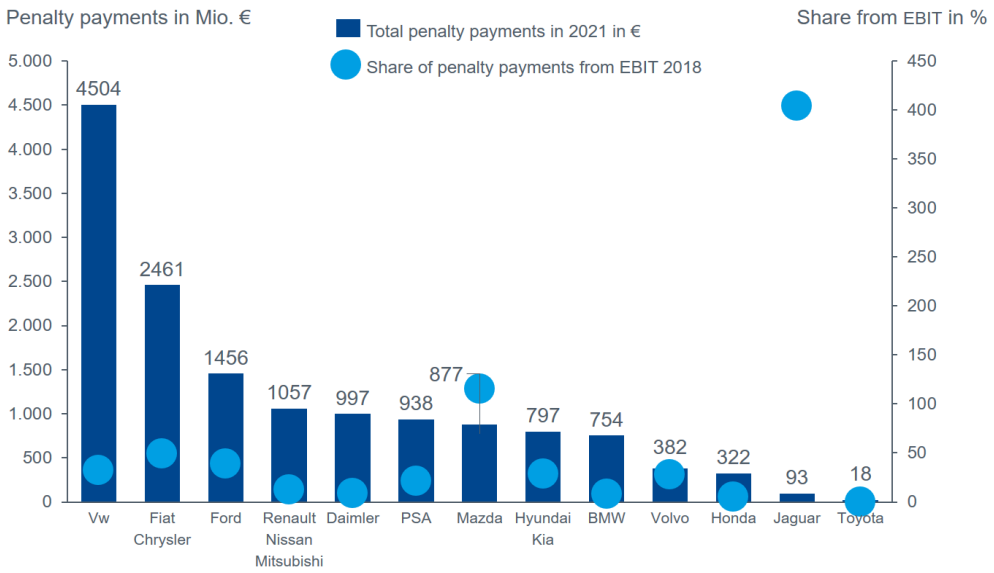
1.1. Political factors

Country	Incentive	Amount	Scope
China	Exemption from vehicle tax until 2022	Complete vehicle tax	Newly bought PEVs, PHEVs, Fuel-Cell
France	Grant	Up to 10,000 €	Switch from Diesel to PEVs
	Grant	6,300 €	Purchase of new PHEVs
Germany	Subsidy	3,000 €	Purchase of PHEVs
	Subsidy	4,000 €	Purchase of PEVs
	Exemption from annual circulation tax	Based on CO2 emissions	For ten years
Japan	Exemption from car acquisition and tonnage tax	Complete acquisition and tonnage tax	For new EV owners
	Subsidy	USD 7,700	For new EV purchases
Russia	Tax free imports	Import Tax -25% ; VAT -20%	PEVs only
U.S.	Federal Government tax credits	Up to 7,500 USD	Purchase of PEVs
	Subsidies	1,500 – 6,000 USD (varies by state)	Purchase of PEVs
UK	Subsidies	Up to 3,500 BP	Purchase of EVs
Netherlands	Exemption from purchase and motor vehicle taxes until 2025	Total purchase and motor vehicle taxes	
	Subsidy	4,000 €	Purchase of new BEVs
EU	Heavy investments into infrastructure, R&D and industry. Eg. Subsidy for Tesla in Brandburg and Varta battery development (together with German government)		

Overview of countries and their respective subsidies on EV purchases

1.1.1. Government subsidies

The greatest forces on the Automotive industry by politics are the measures taken by governments all around the world promoting the shift to more ecological mobility and therefore electric mobility. By using instruments such as tax-breaks, grant and subsidies, the prices of fully electric, hybrid or fuel cell vehicles are reduced and consequently more attractive to end consumers. In addition, the R&D in the field of electric vehicles, fuel cell and battery is heavily backed with government support and the industry is using the subsidy money to come up with new technology at a very fast pace.



Overview of the expected penalty fees for OEMs in 2021 due to new EU regulation (source: self-made, expert interview)

1.1.2. Environmental penalty fees

On the other side, to further pace the shift to electric mobility, the EU has introduced strict CO2 pollution goals to automotive OEMs connected to penalty fees for missing the targets. Even though the EU is only one major market, the penalty fees affect car dealers from all around the world. The average emissions target is defined as 95g/km CO2 from 2021 onwards. For every 1g/km of CO2 that a manufacturer exceeds its average emissions target by, it will be fined €95 multiplied by its volume of new-car registrations in the preceding year.

It is very clear already that most car manufacturers will fail to meet the target in 2021 as well as in 2022. In 2019 the CO2 emissions increased once again, giving a bad outlook for the OEMs to meet the 2021, 2025 and 2030 targets, which were agreed on in December 2018.

1.1.3. Public transport

Governments all over the world launch initiatives to promote the use of public transport. One target is to provide incentives for “green” transportation, and another is to balance out the overwhelmed city infrastructure in major cities. Countries invest in new public transportation infrastructure and aim to cut the prices of tickets to increase demand. As

public transport is an alternative to urban car mobility, this affects the car industry in a negative way.

1.1.4. Global relationships

Trump's trade policy and Brexit have caused the auto industry to slump. Worldwide, 35 million fewer cars were sold. The damage amounts to 700 billion euros, mainly due to the trade policy of the United States, the global automotive market has collapsed since 2017. At that time, more than 84.4 million passenger cars were sold. It was assumed that the car industry downturn would bottom in 2019, with around 77.3 million in vehicle sales (at that point, nobody saw COVID coming yet). Since Biden replaced Trump as US president just recently, the automotive industry is looking into the future with more hope, as they expect the trade war with China to decline, giving the industry better access to the world's most important growth market.

1.1.5. Luxury Tax

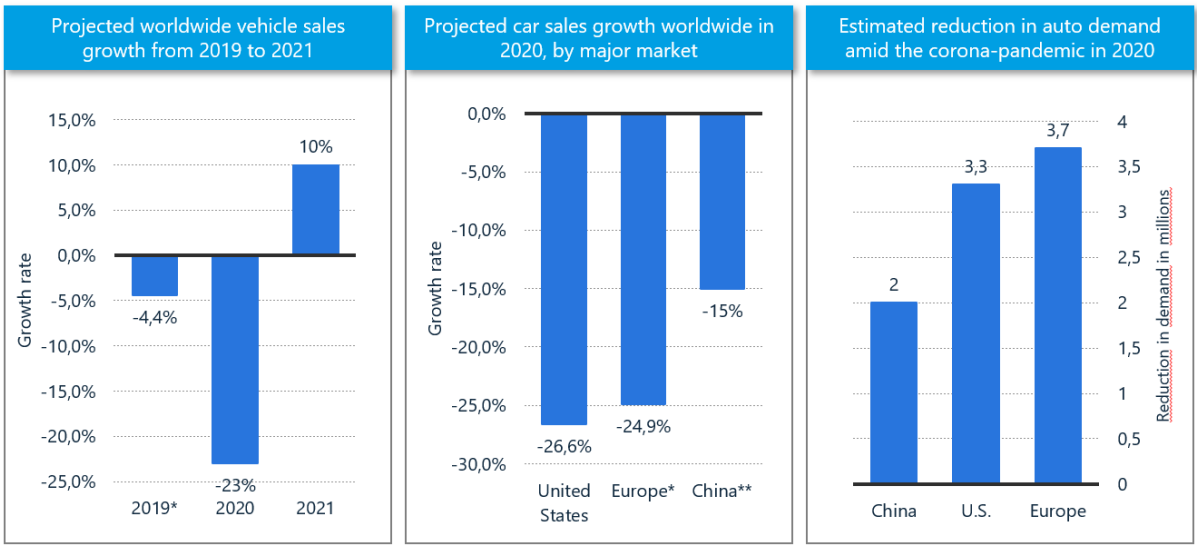
Similar to other luxury goods also high-end cars are affected by additional taxes imposed on them: E.g., India (15%), Australia (33%), China (10%), Canada (up to 20%). These taxes have less effect on the automotive industry than other factors mentioned before, since the luxury segment is rather small and the demand is not as elastic (the rich people will afford to buy the premium cars, even with the substantial amount of taxes).

1.1.6. Automotive lobby and industry influence

It was the German car companies that covered up their unlawfully high exhaust emissions for years by using manipulated software and probably also colluded without permission. However, this scandal was only possible because politicians have had the manufacturers' backs for many years. The German government prevented stricter limits and tighter controls in Brussels and even when it comes to dealing with the diesel scandal, German authorities are nowhere near as tough as in America, for example. This may also be because the German politics and the companies are often closely interwoven in terms of personnel. Top politicians and government officials move to positions in the auto lobby and some even make the leap back into government office after a few well-paid years in the industry. Generally, the high value of the automotive industry for countries (employment, taxes, exports) allows the automotive OEMs to put a lot of pressure on governments. An example that shows the dependence on the car makers is the 2009

bailout of GM by the US government and the high amount of money that was pumped into the industry during the COVID pandemic by governments from all major OEM countries.

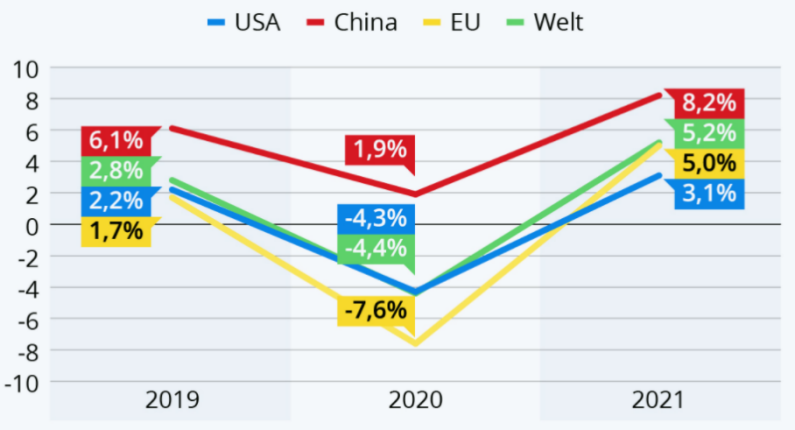
1.2 Economic Factors



Overview of the impact of COVID-19 on the sales of the automotive industry. (Source: statista)

1.2.1. COVID-19 impact

In the major markets only (China, US, Europe) the Corona pandemic led to a reduction in car demand of 9 million vehicles. This reduction results in a sales loss of up to one quarter of total sales and forced the whole industry into major financial distress. Positively, the market is projected to start recovery in 2021. Over the summer and fall of 2020 the automotive industry has proven to be resilient. From the massive economic drop in spring 2020, the industry has been able to demonstrate growth in vehicle sales over the past months across China, Europe, and the US. The billions of dollars pumped into the economies, as well as the news regarding a possible vaccine have led to increased optimism. Nevertheless, uncertainty remains and the sales in Europe and the US are not expected to regain pre-COVID levels before 2023. In comparison, China is doing a lot better in the pandemic recovery and is expected to approach 30 million new vehicles sold by 2025.



GDP growth rates from 2019 – 2021 for the major automotive markets and worldwide.

1.2.2Economic Development

The economic growth is expected to recover quickly from the 2020 pandemic. The positive development of GDP in major markets, as well as the growth of the middle class in developing countries will enhance the customer base of potential automotive buyers. Global GDP per capita is growing with a CAGR of 4.4% between 2014 and 2023. The growing economic performance also triggers global average consumer expenditure per capita to grow with an average of 4.1% in the same period.

1.2.3. New Market Entrants

The hype in electric mobility, and the huge growth potential in this segment attracting investors, has led many new automotive start-ups to emerge and challenge the industry leader Tesla. The Silicon Valley starts to produce cars; many new automotive OEMs founded in the past few years focusing on the electric vehicle market, for example:

- Tesla (funding: $16 B)
- Rivian (funding: $5.6 B)
- Lucid Motors (funding: $1.1 B)

Due to the culture, the Chinese market will adopt electric mobility quicker than the US and Europe giving plenty of business opportunities for new EV start-ups, such as:

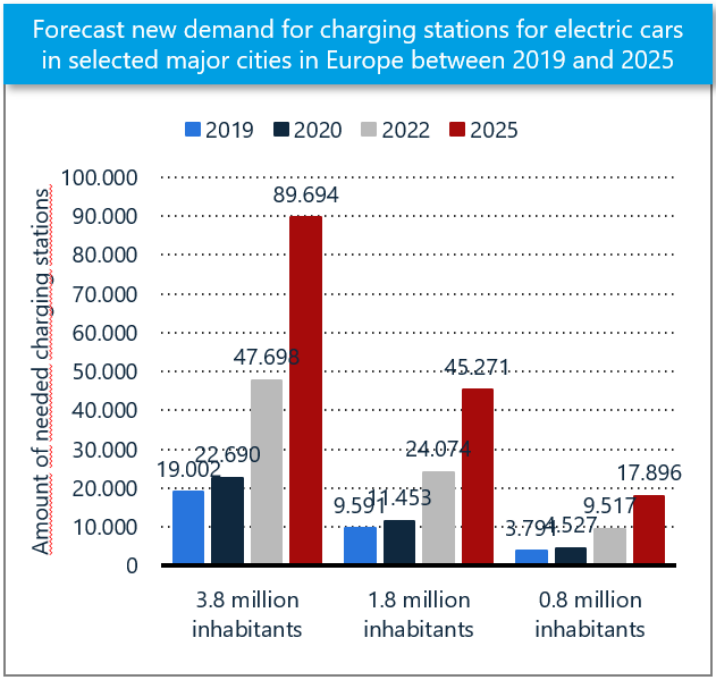
- Nio (funding: $3.5 B)
- WM Motor (funding: $2.7 B)
- Faraday Future (funding: $2.0 B)

Additionally, more traditional car manufacturers (still producing large quantities of combustion engine type cars) grow dramatically and benefit from governmental incentives. The huge growth in China combined with the protectionist measures from the government founded the base for national OEMs to grow, for example:

- BYD
- BAIC
- Great Wall
- Geely
- SAIC

Big industrial conglomerates and smaller automotive OEMs rise in India and benefit from the growth of the local market. E.g.:

- Mahindra
- Tata Motors
- Ashok Leyland
- Bajaj Auto

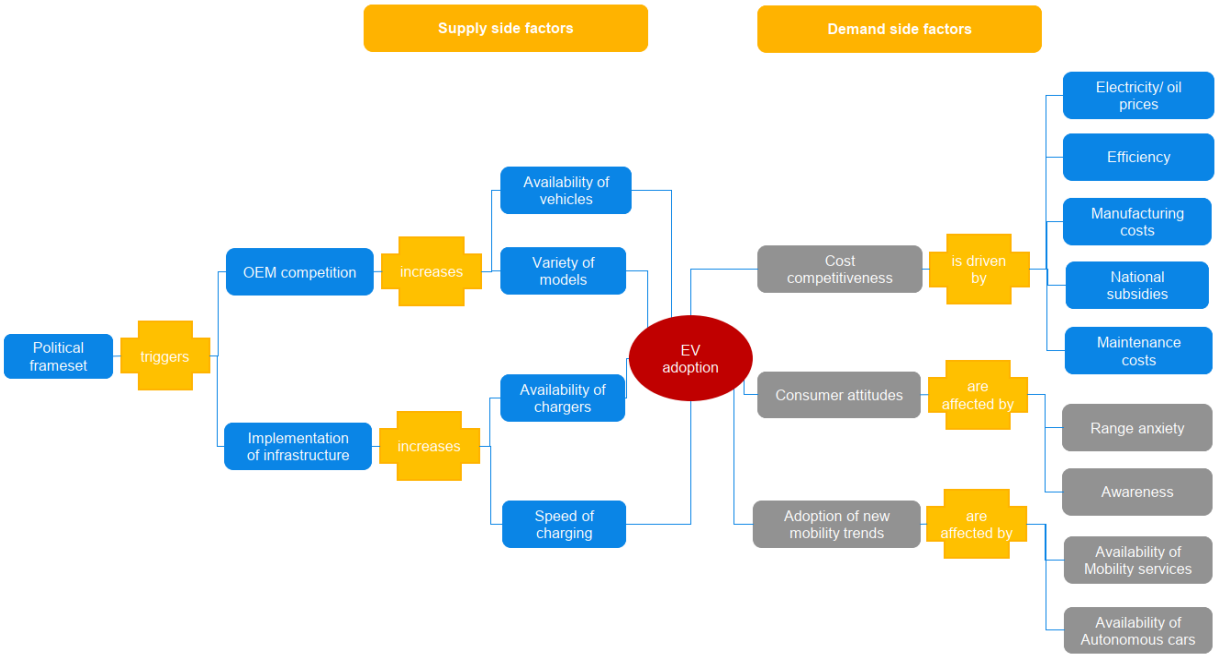


Forecasted demand for charging stations in average European cities by size. (source: statista)

1.2.4 Electric mobility infrastructure

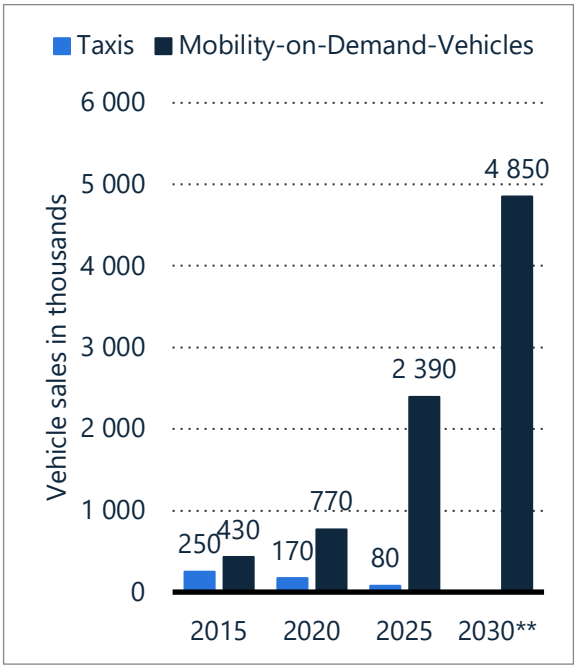
The shift to electrification puts high pressure and need for invest on the infrastructure. The increasing levels of urbanization (+0.8% CAGR between 2014 and 2023) intensify the problems related to infrastructure as the amount of people rises, but the available area doesn't.

1.3 Social factors



The social acceptability of EVs plays a major role in the growth opportunities of the industry. Tesla has played a pivotal role in bringing about this change in mass public perception of the electric car ("The Tesla Effect"). All its cars, from the Roadster to the soon to be launched Model 3, have scored high on both performance and aesthetics while

ticking to their zero-emissions policy. Together with major investments in infrastructure and lowering EV prices the social acceptance keeps growing.



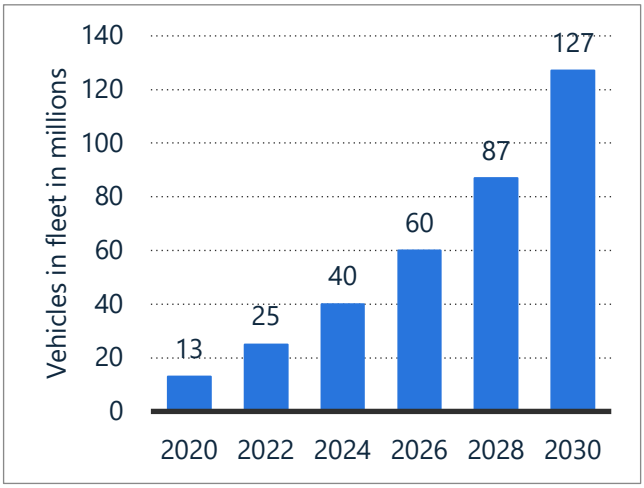
Comparison of vehicle sales for the Taxi and MoD business. (source: Statista)

1.3.1 Shared mobility

The necessary infrastructure, shared mobility services and the social acceptance of EVs will grow and develop hand in hand. The investments in shared mobility by all big car manufacturers is going to trigger and ensure the growth of shared mobility services and infrastructure.

- Daimler: is owner of Share Now, ViaVan
- BMW: is owner of Share Now, Moovit
- VW: is owner of Moia
- GM: is owner of Maven, BOOK, invests in Lyft
- Hyundai-Kia: invests in Grab

1.4 Technological Factors



Projected size of the global electric vehicle fleet between 2020 and 2030. (source: Statista)

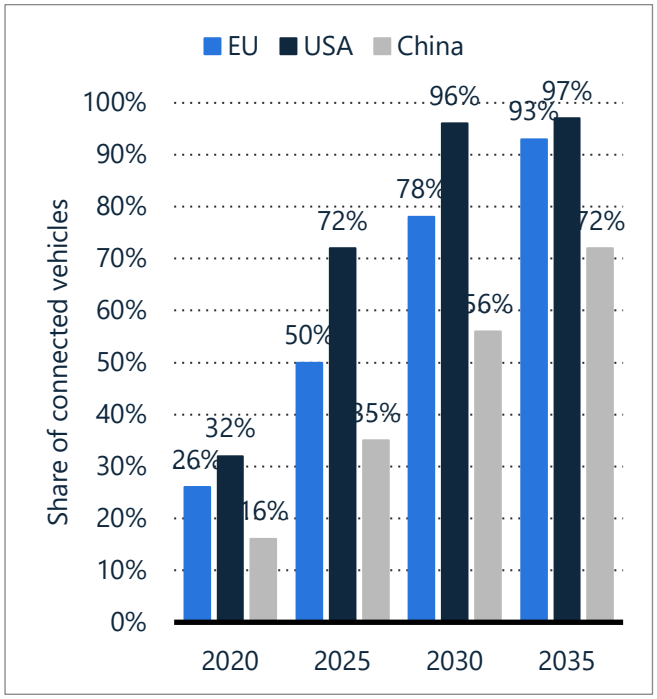
1.4.1. Electric vehicles

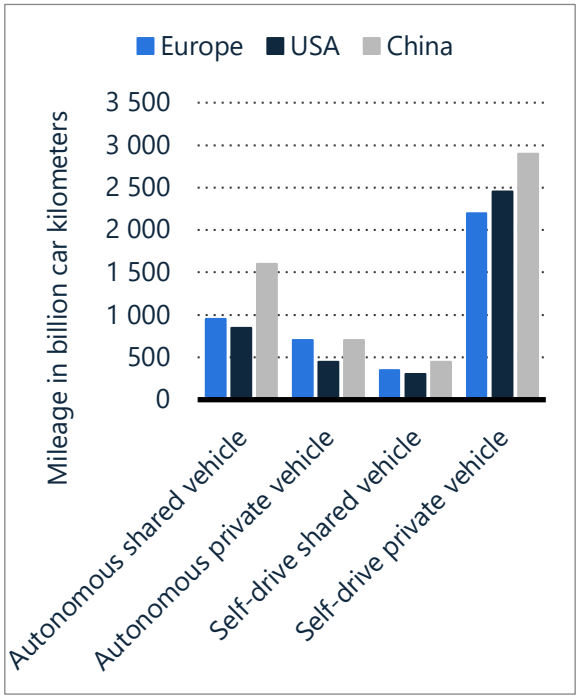
Projected electric vehicle production by 2030 is expected to reach 37.6 thousand in Asia, 16.5 thousand in Europe, 4.4 thousand in North America and only marginal numbers in other geographic markets. The size of the global electric vehicle market will quintuple from 115bn USD in 2019 to 567.2bn

USD in 2026. Due to technological advancement and economies of scale and learning the price for electric vehicle is going to fall naturally (even without subsidies) from a 49% price mark-up in 2017 to a 35% price mark-up in 2015. Hybrid vehicles are expected to have the highest growth rates, followed by BEVs. Lithium-ion battery pack costs are falling drastically (from 721 USD/kwh in 2012 to 135 UDS/kwh in 2020) and the average range of electric vehicles is projected to increase from 300km in 2020 to 440km in 2030. The recent disadvantages of EVs regarding lacking range, infrastructure and high prices will continuously diminish and make the product more attractive.

1.4.2. Battery technology

New battery technologies will additionally help EV adoption (referring back to the model in the "social" chapter). Currently Lithium-Ion batteries are the most commonly used battery type. Solid state batteries for example have double the energy density of Li-Ion batteries, are cheaper, are more durable (lifespan of 10 years) and cause less concerns regarding flammable materials.





1. Predicted share of connected cars in the US, CN and EU from 2020 to 2035. (source: statista)

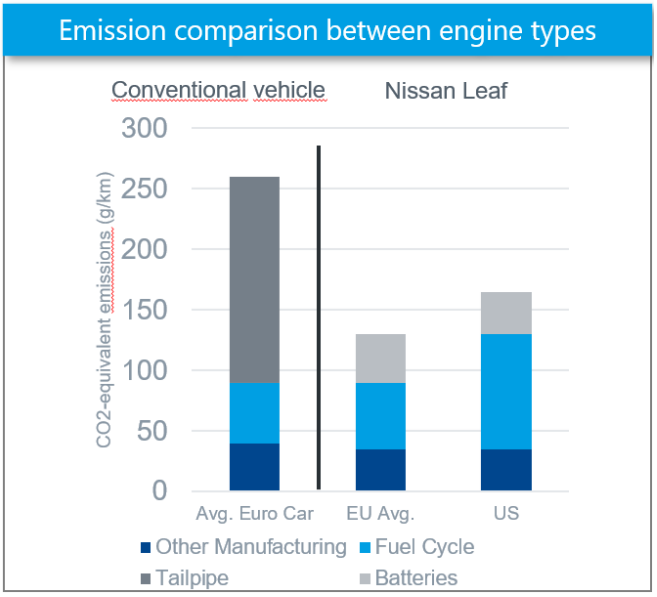
2. Mileage of passenger cars in EU, USA and CN by type of vehicle in 2030. (source: statista)

1.4.3. Connected and self-driving vehicles

The new technology side of mobility caused a shift in the competitive environment of the traditional OEMs. Instead of industrial and engineering companies being the closest competition, it is now tech firms. The traditional automotive players are lacking behind in capabilities and therefore invest in the new tech startups, for example:

- WAYMO: Google and their Waymo spinoff is by far the most recognized leader in the area.
- GM Cruise: With billions of dollars in investments from SoftBank, Honda, GM, and T.Rowe Price Associates, GM Cruise is in good condition.
- Argo AI is an independent company that started in 2017, with a $1 billion investment from Ford Motor Company. Volkswagen only recently joined the partnership, investing another $2.6 billion.

1.5 Ecological factors



Comparison of CO2-equivalent emissions of an average ICE car and a Nissan Leaf. (source: statista)

The Kyoto and Paris climate targets bound countries to introduce environmental protection measures. Part of these measures are the incentives to a shift towards electric mobility mentioned in the "political" part, as EVs produce considerably less CO2 emissions in comparison to combustion engine vehicles (see graph on the left). Even though the initial environmental footprint for current EV production is higher than that of ICE's, during the whole lifecycle of a car the electric cars are a lot cleaner.

Claims are made that the various processes involved in the manufacturing of EV's are much more detrimental for the environment than the production of an IC vehicle. The "Lithium Triangle" in South America and the Cobalt mining in the DR Congo stand under high criticism by environmentalists.

1.6 Legal factors

Recently there are many legal issues regarding data security with connected cars. It is not fully clear yet how the collected data will be allowed to be processed without hurting anyone's personal data rights as well as any data security issues. More questions arise from the technological developments in autonomous driving: how is a self-driving car insured? How does it react in critical situations, where human lives are under threat?

These legal issues might cause an even longer delay in the implementation of autonomous driving than the software development itself.
Additionally, current legal affairs such as “dieselgate” has increased the costs for cars because additional measures had to be introduced to prevent similar events to happen again (eg. In Germany, every single new Diesel car must go through a test-center from an independent firm).
As mentioned in the “political” and “environmental” chapter, new laws and regulations impose penalty fees on OEMs with a bad ecological footprint and OEMs are put under increasing pressure by rules and regulations for environmental sustainability.

2. Demand Analysis

2.1.Segmentation

Concerning the segmentation, the focus was placed on economic, middle and luxury class so as geography. Looking at the purchasing process, it is visible that the nature of buyers is very diverse as different age groups range from teenager to grandparents demanding for cars. Regarding B2B the nature of buyers closely related to businesses like car dealer or business owners for example. According to their social status and financial opportunities they are interested in a wide range of different cars type with varying features and services. These are the same for B2B and B2C.
For the purchase amount of how much it costs mostly comes down to Price and discount. They are generally similar for B2B and B2C but can be a bit different. Looking at B2C you will see more induvial discounts or will be more or less only applied to specific cars or purchases while in B2B the discount can be due to the quantity purchased.
The People who “consume” cars are often also the person buying it. Therefore, it is closely related to the nature of buyers. Who are consuming cars are more or less the same people within the category of who are purchasing them. This is valid for B2B and B2C. Nonetheless, there is maybe one major exception which are car rentals, which is a segment within the automobile industry becoming more and more interesting and popular for the customers such as for the businesses. You can see that by solely looking at the investment made by companies like VW, BMW or Mercedes offering their own car rental services. This correlates also with the most common motivations for purchasing cars. B2C purchase and consumption of cars are changes in live situations like getting a child or a new pet or upgrading or replacing the car or status. Concerning B2B it is often correlated with resale of cars or as mentioned above for car renting purposes.

Looking at the setting of the purchase people often purchase after earning or receive a large amount of money over time or within a short period like (Promotions or a bonus for example), otherwise maybe upgrading to a newly released model. This is similar for B2B or after a car clearance of old models or purchasing cars for promotional campaigns or newly arriving models on the market. The place of purchases is very similar globally for B2B and B2C with mostly Dealership stores, online or at the manufacturer itself. The same for options of payment with most of the time offline payments like cash or credit cards) where credit cards can also be used online as another alternative. Other options like a deferred payment or on credit are also not unusual but of course not as common. For the payment methods, these are the same for B2B and B2C.

2.2. Key Success Factors

Especially for the demand side within the automobile industry a very important aspect are the key success factors. Starting with the Economic cars especially important for customers is the price of course and connected to that the payment terms as not everybody wants or might be able to pay immediately and wants to spread the payment over years. As it is a lot about efficiency and low costs for economic cars you can see fuel consumption being important such as durability. It is similar for the competition factors with low operating costs or guarantees. Leading to Key Success Factors of low operating costs, solid quality with high durability and a wide dealer network so it is widely accessible for everybody.

Comparing this to the middle-class cars you will see similarities, but quality is getting more important and maybe the use of the car as well by reaching for families or for more practical use. Additionally, people tend also to take the design more into consideration than with economic cars. Regarding the competition factors service is getting more important as probably more factors need to be included and a higher service will be demanded from the customer. As cars are getting more expensive a certain degree of product differentiation is also expected.

Considering luxury cars, you'll see a greater focus on where you are buying as the brand is signaling you status and shows to others who you are. Of course, in these types of cars a high quality for is expected and necessary. As these are also sometimes more of fun cars a nice quality design is another purchasing factor. Regarding the competition offering exclusivity and outstanding service like consultation, repairs or 24/7 availability is a

crucial factor. In this type of segment, a product differentiation and innovation are key, and you always want to be better and faster with your car than the competition.

2.3. Sustainable Value Indicator

For this segment of the analysis, we decide on doing the analysis on two different segmentation types:

i) Geographic. Dividing the industry in 5 main regions (North America, South America, Europe, Africa, and Asia & Oceania). This way we could observe main differences in said regions, that contribute to the automotive industry in so different ways.

ii) By type. We categorized the automotive in Economic, Regular and Luxury cars.

Economic cars are, obviously, the smallest and more affordable type of passenger vehicle. Commonly known as class A and B.

Regular cars are more of a family type car, medium to large sized compacted vehicles, without including the luxury component. Include also the low-end segment of Sport Utility Vehicles (SUV). Segments C and D of the Euro Car classification.

Luxury cars are destined to a high-end client. Classes E, F, G and the luxury range of SUVs.

2.4. Geographical Segmentation

2.4.1. Sales and Growth by region

Motor Vehicles Sales (Where)	2013	2014	2015	2016	2017	2018	2019	2020 Est.	2021 Est.	2022 Est.	2023 Est.
North America	542 229	577 890	613 057	622 461	605 083	606 695	605 224	482 912	403 690	373 079	377 933
South America	91 238	87 029	85 892	83 341	79 109	77 278	77 460	61 538	55 844	53 802	55 018
Europe	380 883	395 390	420 019	445 893	446 488	443 928	457 208	382 560	329 635	308 412	315 555
Africa	25 842	25 351	24 518	23 672	23 092	22 688	22 296	19 130	18 233	17 514	17 620
Asia & Oceania	669 868	705 736	750 909	830 751	858 135	856 509	865 086	697 815	652 492	620 578	633 239
Total	1 710 059	1 791 397	1 894 394	2 006 117	2 011 907	2 007 098	2 027 273	1 643 955	1 459 893	1 373 386	1 399 366

Values in Million €

Automotive Segment	SL (2019)	G (2019-23)
North America	605 224	-11,11%
South America	77 460	-8,20%
Europe	457 208	-8,85%
Africa	22 296	-5,72%
Asia & Oceania	865 086	-7,50%

Values in Million €

Source: Statista

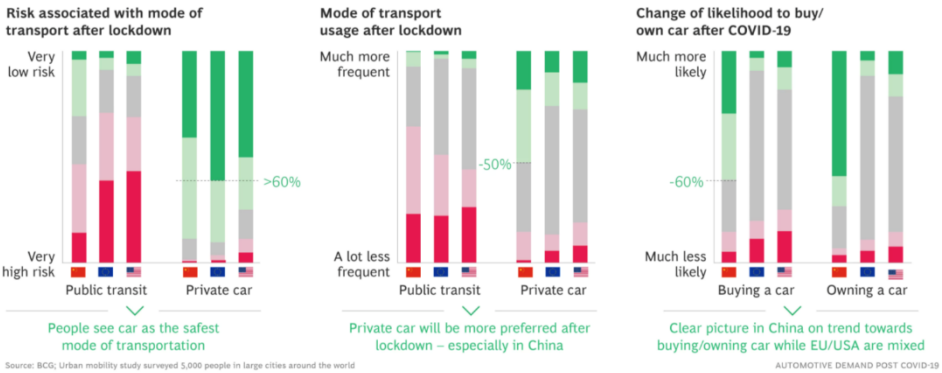
The global value of sales is expected to decrease in the next 4 years (counting with the current year of 2020), practically exclusively due to the Covid-19 caused recession. The recession started to impact the Automotive industry early on, first in Asia, where the city of Wuhan, both the epicenter of the epidemic and an important hub of China's automotive industry, showed severe repercussions of the spreading of the virus. The rest of Asia felt the impact subsequently and by the time it arrived in Europe, assembly plants and other facilities related to the industry had to shut down, and layoff their employees. The same happened in the US, who compose the vast majority of the North American market, although not to a greater extent because the economy wasn't automatically shut down, like in most European countries, but our research indicates that they are actually the region who will have to fight the hardest and the longest to obtain pre-Covid sales value. In a study from BCG, highlighting the impact of Covid-19 in these three major markets, one of the things that automatically jumped to our eyes is the in that China and Europe had sales plummet in the house of the 80%, as for the US the decrease was in the 40 to 50% ballpark, but, as previously mentioned, this impact is expected to remain for the longest time.

As we are talking about a future prospect, we think it might be important to mention other factors that will likely shape the industry's short term.

i) The solo instant impact of the pandemic in the automotive industry shouldn't cause this kind of disturbance in the future, it will also be worth tracking how this could change people's habits and how will that have direct or indirect repercussion on the industry. A great example to explain this is to look at telecommute and it is still unpredictable to which degree companies will adopt it and rely on it in the future, but we are potentially looking to something that will change urban areas as we know them, implicating a lot less traffic, better performance of public transportation, and less incentives for family to make such a large investment. On the other hand, recent studies and inquiries demonstrate that people will tend to prefer private transportation, car, to public transportation, as the last is seen as an unsafe mode of transportation, in regard of public health (see image below). Of course, this is highly hypothetical and hard to predict, even in the short run, but important to mention.

ii) Other aspect that can bring implications in the next few years, including the time that composes the scope of our assessment, is the ecological concern that is becoming increasingly relevant at micro and macro levels, as was described in the PESTEL analysis, and that is also implicated in short term analysis, as countries are already taking measures,

designing plans and alerting people to the environmental harm that individual transportation has. The industry is trying to tackle this trend and also looking to provide solutions that will keep potential clients engaged with the idea of buying a car, but, nonetheless, lithium batteries can also be prejudicial to the environment. Electric cars have been very well received by the market and are set to be one of the crown jewels of the automotive industry.



Of course, this whole sales value analysis will fall within the scope of uncertainty, and we might as well be looking for a rebound that matches the optimistic or the more pessimistic forecasts. For example, practically all the studies in which we sustained our analysis, were made before the most recent developments vaccine wise, as it was highly uncertain at the moment how long it would take until we came to this, so this very recent glimpse at the end of the tunnel, with several vaccines already approved around the world, can mean that we are going towards an easier rebound phase.

2.4.2. Margin by region

Automotive Segment	5 Forces Average	Margin after 5 Forces	Margin Index	Average Margin Rate	Margin Rate by Segment
North America	4,2	5,81875	1,02	6,5% (net margins in automotive industry are usually around 6%)	6,66%
Latin America	4,4	5,62125	0,99		6,43%
Europe	4,5	5,54875	0,98		6,35%
Africa	4,0	5,985139	1,05		6,85%
Asia & Oceania	4,6	5,439722	0,96		6,22%

The average margin we used as reference was 6,5%, since the automotive industry margins are usually around 6 and 7%.

2.4.3. Porter's 5 forces model

2.4.3.1. Threat of New Entrants

Threat of New Entrants Factors	Estimated Factor Level by Segment (Low 1-10 High)				
	North America	Latin America	Europe	Africa	Asia & Oceania
Industry capital requirements	9	8	9	7	9
Economies of scale in the industry	9	7	9	6	10
Differentiation of industry products	7	6	8	6	8
Switching costs in the industry	2	3	2	4	2
Legal restrictions on entry into the industry	4	3	2	2	2
Customer control by the industry	3	3	3	3	3
Knowledge/technological control by the industry	10	8	10	8	10
Control of scarce resources for industry	9	9	9	9	9
Control of strategic locations in the industry	9	9	10	8	9
Expectation of industry retaliation	10	8	10	7	10
TNE Avg.	2,8	3,6	2,8	4,0	2,8

The automotive industry isn't susceptible to the entrance of new competitors to the market, and some of the most important factors that inhibit new competition are:

Industry capital requirements. Starting an automotive company is a huge investment, only achievable maybe for other companies in other business trying to diversify, but, as we know it isn't very likely to happen, since a huge investment like this would probably fail, or take years to yield some profits. Already established companies have the control of the market, because of their implemented and certified car brands that hold customer trustworthiness, invaluable in this business.

1. Economies of scale obtained. The automotive industry is able to achieve enormous of scale, cars are very expensive to produce, but huge assembly lines and product necessities to produce the number of cars demanded each year, allow the industry to obtain huge economies of scale, very difficult to reach by potential entrants.
2. This is more determinant in markets that are fully developed, as the North American, European and Asian, than in those in that the automotive industry is a bit underrepresented, as in South America and Africa.
3. The technological know-how is one of the main reasons why firms fail or succeed in this business, and therefore over the time firms have been working on perfecting old technologies, but also trying to be disruptive and find the new technologies that are to be created or just implemented, so this leads to a situation where is very hard for new firms to come in an being able to establish a position, as they would be trailing all the other firms, in respect of technology.

A notable exception to this is Tesla, that came in 2003 and relied upon the vision of their founders and one of its first employees Elon Musk, that later became the company's CEO, to develop disruptive, state of the art, electrical technology. The company shocked the

industry and now, focusing primarily in high-performance luxury cars, is the company with the biggest market capitalization, way ahead of any competitor.

Threat of New Entrants Force: Low

2.4.3.2. Threat of Substitute Products

Threat of Substitute Products Factors	Estimated Factor Level by Segment (Low 1-10 High)				
	North America	Latin America	Europe	Africa	Asia & Oceania
Number of substitutes in the industry	4	3	5	2	5
Number of substitutes in the industry					
Customers' propensity to buy substitutes	3	3	5	1	4
Government support to substitutes	5	5	8	2	7
Price of substitutes	6	2	7	3	3
Performance of substitutes	6	3	7	2	6
Performance improvement speed of substitutes	3	2	5	1	4
Profitability of the substitutes industry	3	2	3	1	5
Differentiation of industry products	8	6	9	5	8
Switching costs for substitutes	4	4	2	5	3
TSP Avg.	4,0	4,0	5,0	2,9	5,2

In this case well consider substitute products as Public Transportation (subway, bus and railways), Individual Means of Transportation (motorcycle, bike, etc…) and Flight Services for medium to long course transportation.

As referred, there aren't many substitutes in the industry, and they are often outperformed by vehicles in matters like comfort and flexibility, but on the other hand public transportation is often a better choice in terms of price and environmental friendliness. Airlines are the obvious option for long distance travel, especially at the continental level. Europe and North America, have quite similar means of public transportation, with a slight better performance and more support from domestic governments in Europe. Both regions account for the highest prices in public transportation services.

In Asia, especially in the great urban areas, there's a great propensity for people to use public transportation in order to avoid chaotic rush hours.

Africa is the case of the continent with the most underdeveloped region in terms of public transportation. Sub-Saharan Africa has high structural deficits in terms of population wealth and general transportation infrastructures. Actually, this inhibits African citizens from both owning a vehicle and using substitutes, as 75% of African poorest populations daily commutes are done walking.

In the emerging African mega cities, the preferred alternative mean of transportation are motorcycles, that combine the car flexibility with the cheapest price that public transportation provides.

Airline services are present all around the world, especially in Europe, North America and Asia, where is the most effective mean of transportation for long distance, therefore relevant in this way.

Threat of New Entrants Force: Low to moderate

2.4.3.3. Bargaining Power of Suppliers

Bargaining Power of Suppliers Factors	Estimated Factor Level by Segment (Low 1-10 High)				
	North America	Latin America	Europe	Africa	Asia & Oceania
Number of suppliers	10	6	10	6	10
Size of suppliers	3	2	3	2	3
Concentration of suppliers vis-à-vis the industry	2	3	2	3	2
Differentiation of suppliers' products	4	4	4	3	4
Industry switching costs	3	4	3	3	2
Number of substitutes in suppliers	7	7	7	8	7
Possibility for suppliers to integrate downstream	1	1	1	1	1
Possibility for industry to integrate upstream	6	3	6	3	6
Importance of products supplied to industry	9	6	8	5	9
Industry weight in suppliers' sales	7	8	7	8	7
BPS Avg.	3,2	3,6	3,1	3,2	3,1

Typically, suppliers don't hold much power in the industry, the fact that there are many buyers and the raw materials needed, although important, are easily and vastly accessible, especially in regions where the biggest manufacturers have their main production facilities, like Germany.

Switching between buyers hasn't been a problem for the majority for the automakers, although this recent effort of the industry to develop towards a Connected, Autonomous, Shared and Electric type of transportation had an impact and now the industry has new key suppliers, which tipped a little the balance of power towards the new technological and uprising technological companies. Giant tech companies like Uber, Alphabet (Google's parent is developing this technology with Waymo) and Amazon are taking advantage from their top-notch technology, including AI and digital network, to enter this new market, but also technological start-ups are emerging and creating new functionalities that will complement the industry's product, in this area is worth mentioning companies like Zoox, Cruise or Embark. In order to put everything in motion the hardware part is also crucial, and Nvidia and Bosch are two important companies in this segment.

This new relation might have tipped a little bit the balance of power, since now the Automotive industry is looking to create strategic alliances with this new up and coming companies in order to be ahead of the competition, but this only happens to a certain extent, mainly because automotive companies hold as much power in this strategic relationship since the tech companies don't have the means to access huge car fleets in order to put their technology into practice, so they also depend highly from car companies. The startups also possess other factor, which is that they are exposed to upstream vertical integration from the automotive industry companies.

One particular region where the power of suppliers is worth mentioning, because it goes in an opposite direction, is in South America. In South America we have one country that

is the biggest player in the automotive market, and the market in general, which is Brazil, that accounts for nearly 50% of the vehicles sold within the region. Brazil has an interesting aspect, alongside Argentina, that is making them resilient in terms of the changes driving the industry, Brazil and Argentina have some of the biggest natural reservations of ethanol and natural gas, respectively, and due to the easy access and governmental protection to the natural domestic resources, automotive companies are producing cars running on ethanol and natural gas, rather than electric. At the end of the day the purpose is the same, going more sustainable, but the industry has to adapt to the particular conditions of the continent and so will be more exposed to the suppliers that make possible to produce these different kinds of fueling system.

Bargaining Power of Suppliers: Low

2.4.3.4. Bargaining Power of Buyers

Bargaining Power of Buyers Factors	Estimated Factor Level by Segment (Low 1-10 High)				
	North America	Latin America	Europe	Africa	Asia & Oceania
Number of buyers	9	4	9	3	10
Buyer size	2	5	2	5	3
Buyer concentration vis-à-vis the industry	2	4	2	4	3
Differentiation of industry products	7	6	8	5	7
Buyers switching costs	2	3	2	3	2
Number of substitutes in the industry	7	6	8	4	8
Possibility for buyers to integrate upstream					
Possibility for industry to integrate downstream					
Relevance of products purchased to the industry	7	5	7	3	8
Industry weight in buyers' purchases	7	6	7	8	7
BPB Avg.	4,1	5,4	4,1	5,9	4,3

The automotive industry has an incredibly high number of individual buyers, which is expected has normally each family owns one or two cars, and those make the bargaining power of buyers tend to be low, be here we need to factor in companies, or even governments, that buy big car fleets. Usually, companies want to provide employees with their own car as a business incentive, and of course there are companies that intrinsically use car fleets, namely car rental companies in the regions of North America, Europe and Asia, due to a more concentrated and developed business environment, but on the other end the number of individual buyers is exponentially higher than the two other regions in which we focus our study on. We also need to consider the number of substitutes, approached earlier in the report also has an impact on the buyers power towards the industry. Something that gives buyers more power in this relationship, is that they are price sensitive. Cheaper substitute opportunities will make customers change their mean of transportation quickly if presented with a cheaper alternative. This gives leverage to the buyer's side, making the pricing in the automotive industry an aspect that

manufacturers can't disregard. this effect will be more relevant in regions where alternative services are better developed and infrastructures are established.

Bargaining Power of Suppliers: Low

2.4.3.5. Industry Rivalry

Rivalry among Existing Competitors	Estimated Factor Level by Segment (Low 1-10 High)				
Factors	North America	Latin America	Europe	Africa	Asia & Oceania
Number of competitors in the industry	5	3	5	2	6
Industry sales growth	1	2	2	3	2
Fixed cost level in industry	10	8	10	8	10
Storage costs in the industry	7	8	7	9	7
Exit barriers in the industry	10	8	10	6	10
Differentiation of industry products	7	6	8	6	8
Switching costs in the industry	2	3	2	3	2
Loyalty to brands in the industry	7	6	8	6	8
Concentration of industry competitors	7	8	7	9	7
Benefits of cooperation between competitors	5	4	5	4	5
REC Avg.	6,3	5,8	6,0	5,4	6,1

Industry rivalry is probably the factor, in the Five Forces analysis, where we detect a bigger force, and the factors motivating that are heterogenous and should be carefully examined.

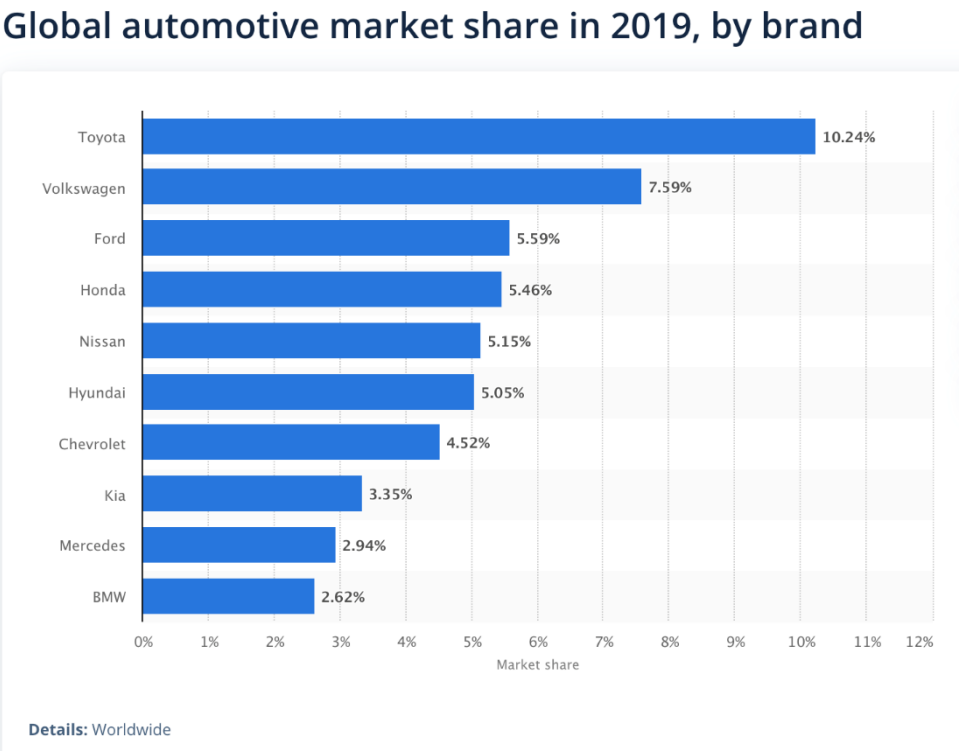
The number of competitors in the industry isn't that high, the biggest car companies are well known and they possess the majority of the market share through the differentiated brands they hold, making this market rather concentrated, but with some competition in price (in the low-end and regular segment due to the demand price elasticity highlighted above).

In terms of sales growth the tendency was for the market to be growing, despite being a matured market, the current shift towards sustainable energy and digitally advanced vehicles added this growing component, almost providing the industry with a second life cycle. Given this, and reenforcing the idea established in the beginning of this chapter, Covid-19 came to bring uncertainty to a thriving industry, we don't think this effect will last and sooner or later normality will be established and the same tendencies will prevail, but during the scope of this analysis we can't let pass this downwards tendency. In terms of fixed costs, an area of immense relevance to the automotive industry, firms need to establish certain economies of scale in order to be competitive, and this is only possible for companies with a certain degree of magnitude, they need to build huge assembly plants and also incur in big storage costs, that bring us to the need of a huge upfront investment. This kind of investment will make firms have to sell the highest number of car possible and have the biggest possible market share in order to raise profitability and dilute this fixed costs' weight.

For similar reasons the exit costs in the industry will be rather high, since companies will loose on a huge investments and profitability opportunities, making unlikely the prospect of the bigger players to exit.

Thanks to high differentiation in terms of products, clients are very brand loyal, as they offer sometimes different specificities and a client getting used to a type of car is likely to stick out with that brand for quite long periods of time and not have a huge incentive to change, so bearing in mind the points made before this one, brands will have a hard time fighting for costumers and market share, exacerbating the competition and diluting the margins.

Bargaining Power of Suppliers: High



Source: Statista

2.4.4. Risk by region

Automotive Segment	Margin Rate by Segment	Net Income by Segment					Risk by Segment
		2019	2020	2021	2022	2023	
North America	6,66%	40 281	32 141	26 868	24 831	25 154	0,218
Latin America	6,43%	4 980	3 957	3 591	3 459	3 538	0,162
Europe	6,35%	29 018	24 280	20 921	19 574	20 028	0,174
Africa	6,85%	1 526	1 310	1 248	1 199	1 206	0,104
Asia & Oceania	6,22%	53 826	43 418	40 598	38 613	39 400	0,144

2.4.5. Sustainability Index by region

Automotive Segment	Environmental		Social Sustainability		Governance		Sustain-ability by Segment	Sustainability Index by Segment
	Emissions	Recycling	Employee treat.	Tech Dev.	Ethics	Transparency		
North America	7	6	7	9	7	7	7,2	1,28
Latin America	4	3	5	4	6	6	4,4	0,78
Europe	9	7	9	8	6	7	7,8	1,38
Africa	3	3	3	2	5	5	3,2	0,57
Asia & Oceania	4	7	4	8	5	6	5,6	0,99

In order to access the Sustainability Index, we evaluated the Environmental Impact regarding Emissions and recycling concerns of the industry. Here is a place where the European companies have a slight edge over the other regions. This topic is somehow approached in other parts of the analysis, the reason why we won't be developing it much in this section.

In terms of social sustainability Europe and North America have better classifications, mainly due to more transparent labor law and conditions. In Africa, Asia and South America is common to disregard labor laws and offer subpar working conditions, which is a concern and the political volatility, or levels of autocracy, in these continents doesn't provide a bright view for the future in this particular area.

In terms of Technological Development, the North American industry has a comparative advantage, despite Europe and Asia being already trying to catch up and having success developing technologies. North America enjoys of a highly technological capable industry, with the world's most important digital development hub in Silicon Valley, San Francisco, where these companies that are preparing the digital future of the industry develop their operations. On the other end of the world, in Asia, thanks to the synergies created between the Korean and Japanese engineering, and the Chinese cheap hardware manufacturing and other Asian technological companies, is trying to catching up with the US. South America and Africa play a rather irrelevant role in this matter.

In terms of ethical and transparent management we can argue that the automotive industry has been a role model, and there are many cases of unethical behavior and misconduct, so we highlight some of the most notable ones:

- Suzuki, Mazda and Yamaha: False emissions Data (Asia, 2018)
- GM's faulty ignition switch (North America, early 2000's)
- Volkswagen diesel Emission scandal (Europe, 2015)
- Daimler international bribery (Europe, 2010)

As we can see, and at the light of the most recent concerns about the environment and earth general sustainability, several emission scandals have been coming up around the world, being the Volkswagen scandal the most present to our eyes, in Europe. This droves down a little bit the classification on ethics.

2.4.6. Sustainable Value Indicator by region

Automotive Segment	SL	G	M	R	SU	Sustain-able Value
North America	605 224	-11,11%	6,66%	0,218	1,28	103 239
Latin America	77 460	-8,20%	6,43%	0,162	0,78	13 217
Europe	457 208	-8,85%	6,35%	0,174	1,38	120 813
Africa	22 296	-5,72%	6,85%	0,104	0,57	5 511
Asia & Oceania	865 086	-7,50%	6,22%	0,144	0,99	214 567

In the aftermath of our research, Asia & Oceania end up having the biggest sustainable value indicator, by almost as double as Europe and more than twice the value of North America. For this the main contributions are sales values and mostly the predicted annual decrease rate in sales for the next 4 years, where the predicted easiest recovery from the Corona virus grants a big edge in comparison with the two other most relevant regions.

Europe and North America, with similar levels in terms of Margin (actually hard to differentiate between all countries) and Sustainability, actually has Europe with the biggest Sustainable Value Indicator, once again due to North America's presumably hard time in recovering from the effects of the pandemic.

Africa and South America and rather irrelevant in terms of the global industry, their social-economical structure and governmental instability don't allow the kind of societal development to be on pair with the other main markets.

2.5. Segmentation by type

2.5.1. Sales and Growth by type

Consulting Services (What)	2013	2014	2015	2016	2017	2018	2019 Est.	2020 Est.	2021 Est.	2022 Est.	2023 Est.
Economic	168 433	166 945	173 569	170 883	166 519	159 664	159 302	129 193	114 482	107 705	109 714
Regular	1 121 754	1 203 209	1 261 590	1 349 594	1 336 398	1 347 263	1 366 289	1 116 073	995 046	941 343	961 012
Luxury	423 777	425 098	463 192	489 645	512 990	504 184	505 728	401 937	353 334	327 170	331 530
Total	1 713 965	1 795 252	1 898 351	2 010 122	2 015 907	2 011 111	2 031 319	1 647 204	1 462 862	1 376 218	1 402 256

Values in Millions of €

Consulting Services	SL (2019)	G (2018-25)
Economic	159 302	-8,90%
Regular	1 366 289	-8,42%
Luxury	505 728	-10,02%

Values in Millions of €

Similar to the last analysis, we're we note how the Covid pandemic will affect the different segments of cars. The luxury segment will have a big negative impact, with expected decreases in sales in the order of the 10%, every year until 2023, while the Economic and Regular segments will also feel the impact, but in a smaller way.

In terms of gross sales, the regular segment has a huge upside, followed by the luxury and then, finally, the economic segment.

2.5.2. Margin by Type

Consulting Segment	5 Forces Average	Margin after 5 Forces	Margin Index	Average Margin Rate	Margin Rate by Segment
Economic	7,3	2,665	0,54	6,5% Margins in Automotive Industry are usually around 6	3,52%
Regular	4,9	5,138333	1,04		6,79%
Luxury	3,0	6,952917	1,41		9,19%

2.5.2.1. Threat of New Entrants

Threat of New Entrants Factors	Estimated Factor Level by Segment (Low 1-10 High)		
	Economic	Regular	Luxury
Industry capital requirements	3	6	10
Economies of scale in the industry	6	10	9
Differentiation of industry products	1	7	10
Switching costs in the industry	1	7	9
Legal restrictions on entry into the industry	5	5	5
Customer control by the industry	1	3	3
Knowledge/technological control by the industry	2	7	10
Control of scarce resources for industry	2	6	8
Control of strategic locations in the industry	2	6	7
Expectation of industry retaliation	3	8	9
TNE Avg.	7,4	3,5	2,0

Regarding the threat of new entrants we note huge differences between Economic and Luxury segment, so we'll detail each aspect:

In the economic car segment we don't have great capital requirements, in comparison with other segments, since car parts are cheaper there's no need for this type of cars to care too much about quality details and other aspects that raise industry's requirements

in other segments. On the other hand, luxury cars have a threshold of quality, safety and differentiation they need to obtain, and the parts cost more in general to produce, and require a bigger investment from the part of the companies.
In terms of economies of scale, they are defined by the number of cars sold in each segment, the bigger the number the bigger scale economies companies can obtain in production.

Differentiation of industry products is clearly lower in the economic segment, in fact most companies have established strategic alliances in order jointly develop similar structures for their economic cars. This is a way for companies to combine resources and lower costs, resulting in little to no differentiation between their products.
Luxury car brands and regular car brands compete in quality, is the difference in the detail and the performance that most of the times will persuade clients to buy one brand instead of the other.

For all the reasons mentioned above, in terms of competition, and how coopetition makes way more sense in the economic segment, we have a much higher probability in companies trying to penetrate the luxury market to cause retaliation from the industry, trying to maintain the status quo.

Threat of New Entrants Force: Low to luxury and regular segments, high to economic segments

2.5.2.2. Threat of Substitute Products

Threat of Substitute Products	Estimated Factor Level by Segment (Low 1-		
	Economic	Regular	Luxury
Number of substitutes in the industry	9	7	1
Number of substitutes in the industry			
Customers' propensity to buy substitutes	9	5	2
Government support to substitutes	10	6	2
Price of substitutes	3	5	7
Performance of substitutes	8	6	6
Performance improvement speed of substitutes	8	5	2
Profitability of the substitutes industry	4	4	5
Differentiation of industry products	1	7	10
Switching costs for substitutes	2	3	7
TSP Avg.	8,0	5,3	2,7

Economic vehicles, destined to a lower wage population and designed for urban areas in order to occupy less space and be more economical. This type of consumer will be compelled to change for a regular car at some point in life, although it will require a big investment, not doable by everyone, but the main substitute mean is actually the public

transportation services. As they're usually well developed, and highly price attractive, we consider this to be kind of a big threat for this segment.

For the regular segment we can also observe similar forces compelling customers to adopt new ways of transportation, although it wouldn't be quite as obvious as for economic cars, since consumers from this segment are a little bit less susceptible to look at price differences and to privilege performance and comfort.

For the luxury segment we realized that someone that buys a luxury car is someone who disregards completely the price, and focus on qualities such as comfort and performance, solely, in order to show a certain status within the society. For this type of consumer there isn't pretty much a particular substitute product that would replace exactly all the characteristics required. In a certain way the only reasonable substitutes would be regular cars and probably top-end railway and airline services, which they would use in addition to having a luxury vehicle.

2.5.2.3. Bargaining Power of Suppliers

Bargaining Power of Suppliers Factors	Estimated Factor Level by Segment (Low 1-		
	Economic	Regular	Luxury
Number of suppliers	7	7	5
Size of suppliers	7	7	4
Concentration of suppliers vis-à-vis the industry	2	2	3
Differentiation of suppliers' products	2	3	7
Industry switching costs	2	4	8
Number of substitutes in suppliers	7	6	5
Possibility for suppliers to integrate downstream	1	1	1
Possibility for industry to integrate upstream	1	3	4
Importance of products supplied to industry	6	7	8
Industry weight in suppliers' sales	2	4	8
BPS Avg.	4,3	4,4	4,9

This is probably the only for where we see an equilibrium between all three segments.

Suppliers hold some power of bargain, especially in the luxury segment, where companies can't just go around and switch suppliers, because a certain quality is demanded, and it's for important for luxury brands to have suppliers that understand and address their needs in a very specific way. So basically, there aren't many suppliers, they're quite essential for the segment in the way that they meet the demand.

For regular and economic cars this force, while being also quite strong, isn't as strong as the materials needed are more basic and the number of companies who supply them is quite vast.

Bargaining Power of Suppliers: Moderate

2.5.2.4. Bargaining Power of Buyers

Bargaining Power of Buyers Factors	Estimated Factor Level by Segment (Low 1		
	Economic	Regular	Luxury
Number of buyers	6	10	8
Buyer size	5	6	3
Buyer concentration vis-à-vis the industry	3	4	1
Differentiation of industry products	1	8	10
Buyers switching costs	2	6	7
Number of substitutes in the industry	9	5	1
Possibility for buyers to integrate upstream			
Possibility for industry to integrate downstream			
Relevance of products purchased to the industry	4	8	8
Industry weight in buyers' purchases	4	5	3
BPB Avg.	6,0	3,5	1,9

Here the key reference to distinguish all segments in terms of the strength that their buyers is to determine who they are and how dependent are they from the industry.

In the economic and Regular segment is worth mentioning that, besides the high number of individual buyers, the majority of companies that buy large fleets prefer cars in the lower range of prices (the exception being governments and the percentage of company cars that are bought for executives). This happens because these companies want to reduce costs due to the large number of vehicles that they purchase, and it wouldn't be profitable to invest largely in luxury cars, imagine a car rental service, renting only luxury cars, would end up raising the prices massively and end up losing on turnover, which ultimately is the strategy of this companies to be profitable.

In terms of differentiation, clients that seek quality and performance are more dependent on the industry to provide the right products for them, and therefore hold less power, allowing companies in regular, but especially in luxury segment, to compete in quality instead of competing in price.

Economic cars also have substitutes that are closer in performance, serve their needs the same way, and are competitive in price, so even the individual buyers will hold more bargaining power.

Bargaining Power of Suppliers: Low for regular and luxury segment, moderate/high for economic segment.

2.5.2.5. Industry Rivalry

Rivalry among Existing Competitors Factors	Estimated Factor Level by Segment (Low 1-		
	Economic	Regular	Luxury
Number of competitors in the industry	7	8	3
Industry sales growth	3	3	2
Fixed cost level in industry	7	9	8
Storage costs in the industry	8	8	9
Exit barriers in the industry	8	9	9
Differentiation of industry products	1	7	10
Switching costs in the industry	1	7	9
Loyalty to brands in the industry	2	6	10
Concentration of industry competitors	4	4	6
Benefits of cooperation between competitors	7	5	5
REC Avg.	7,2	6,2	4,7

Industry rivalry is exacerbated in the Economic and Regular segments as well, since here the competition for market share through price is more relevant than in the luxury segment, where loyalty to brands prevails, more often than not. It's easier and less costly for someone that possesses an economic car to change vehicle in detriment of substitutes within or outside the industry, whereas someone that has a very expensive vehicle will face other problems. First of all will have to trust other brands and car types to perform the same way and execute the same functions, which would be rather difficult in this situation, and other evident problem is that a luxury car purchase involves an investment unproportionally bigger than to buy an economic car, and since the moment that a customer buys that car it will automatically decrease his value (first hand sale is much more relevant in this segment, mostly because second hand selling indicates lower quality or defects) and an attempt to sell the car will result in huge losses for the buyers, resulting in much bigger switching costs.

Industry Rivalry: High for Economic and Regular Segment, Low for Luxury

2.5.3. Risk by type

Automotive Segment	Margin Rate by Segment	Net Income by Segment					Risk by Segment
		2019	2020	2021	2022	2023	
Economic	3,52%	5 610	4 550	4 032	3 793	3 864	0,173
Regular	6,79%	92 773	75 783	67 565	63 919	65 254	0,163
Luxury	9,19%	46 467	36 930	32 465	30 061	30 461	0,193

2.5.4.4. 2.5.4. Sustainability Index by type

Automotive Segment	Environmental Sustainability		Social Sustainability		Governance Sustainability		Sustain-ability by Segment	Sustainability Index by Segment
	Emissions	Recycling	Employee treat.	Tech Dev.	Ethics	Transparency		
Economic	10	6	4	2	6	6	5,7	0,86
Regular	7	7	6	8	5	6	6,5	0,99
Luxury	8	8	7	8	7	7	7,5	1,14

Using the same metrics as in the previous analysis we see that also here the luxury segment has more upside in terms of sustainability, especially if we see how much more companies will tend to be careful with their overall sustainability in order to not hurt their perceived image, that is more relevant in this segment than others. This is suggesting in the different grades we attributed to social and governance sustainability, where luxury companies are less likely to treat employees poorly, instead they will actually treat them better, since they depend higher on them to deliver top quality manufacturing and so on and so forth.

2.5.54. Sustainable Value Indicator by type

Consulting Segment	SL	G	M	R	SU	Sustain-able Value
Economic	159 302	-8,90%	3,52%	0,173	0,86	14 634
Regular	1 366 289	-8,42%	6,79%	0,163	0,99	303 947
Luxury	505 728	-10,02%	9,19%	0,193	1,14	131 256

At the end we see that Regular cars segment possesses the higher sustainable value, largely because of the sales value that surpasses the other segments in a big way.
The overall margins are very different from segment to segment, contrary to the other kind of segmentation that we did, where economic cars have little to no margin, compared with the higher-end segments.

2.6. Global Demand Trends

2.6.1. Political Factors influencing demand

The government subsidies in form of grants or tax-breaks, that are introduced by countries all around the world boost the demand for electric vehicles as these subsidies directly address end consumers. Even the subsidies towards the automotive OEMs in form of R&D support indirectly stimulate demand, as the technological development can progress quicker and the convince of electric vehicles increases, leading to quicker EV adoption.
The governments' high investments in public transport infrastructure and subsidies on ticket prices lead to a decline in the demand for cars, as these industries compete in the mobility market.
After the recent replacement of Trump in the White House, the industry can plan with more market stability, especially in the relationship between the US and China. The

decreased volatility stimulated demand and might also allow for lower prices as the supply chains are less volatile for the OEMs.

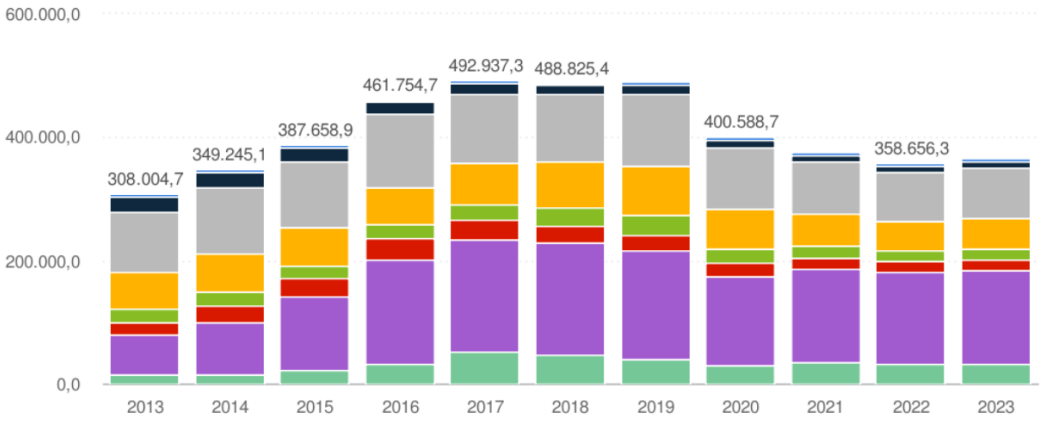
The successful lobbying of automotive representatives in politics is delaying the implementation of pollution regulations and other environmental measures. This delays and decreased the demand shift towards electric vehicles.

Many countries have introduced a luxury tax on premium cars. This measure could affect the demand for these high-priced cars, but the effect will be rather low as the price elasticities in these segments are very low and the customers will still afford it.

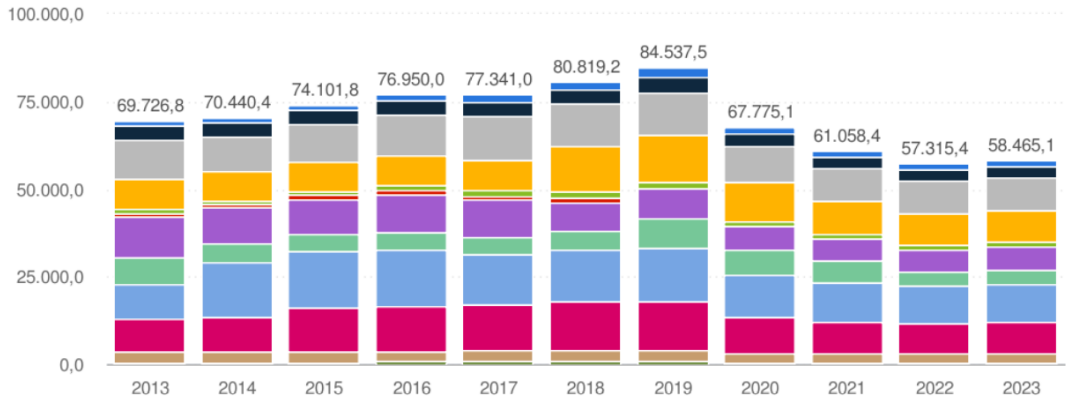
2.6.2 Economic factors influencing demand

The global pandemic has left huge economic destruction and millions of people around the world lost their job. The reduced wealth has led to a drop in car sales of about 23% worldwide.

In the long-term view there is still economic growth in the major markets, and India and China have very promising growth rates in the automotive market. Even though these growth markets were hit drastically by the COVID pandemic as well, until 2018/19 the revenue from automotive sales were steadily increasing in the 5 years before.



Sales figures for the Chinese automotive market between 2013 and 2023. (source: statista)



Sales figures for the Indian automotive market between 2013 and 2023. (Source: statista)

Other growth markets such as Brazil, Russia or South Africa have not demonstrated positive growth rates in the automotive industry over the past 7 years. These developing economies do not live up to their potential in the car industry compared to other industries that are booming there.

The current lack of electric vehicle infrastructure such as public charging stations reduces the convenience of the vehicles and therefore has a negative impact on EV adoption. Nevertheless, car companies, electricity providers and governments are investing more and more into the development of infrastructure which stimulates the demand for EVs.

2.6.3 Social factors influencing demand

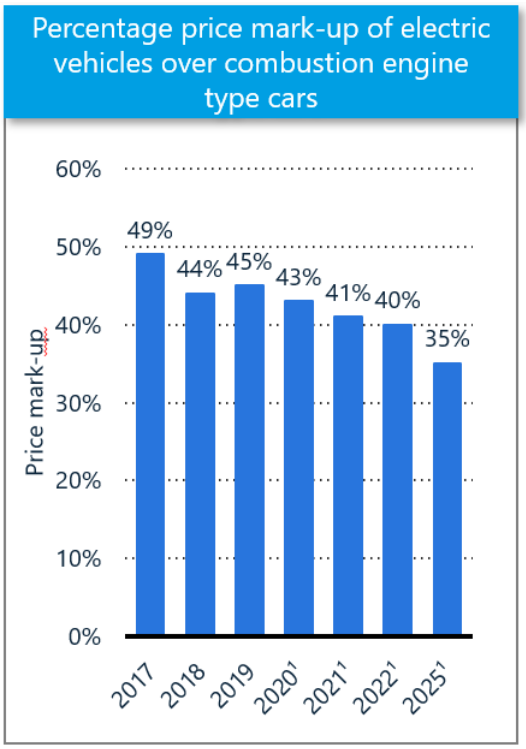
A major social factor is the increasing acceptance of shared mobility solutions. This has a negative effect on private sales of vehicles as less and less people see the need to own a private car. On the other hand, there is a growing B2B demand as the shared mobility providers need an increased number of fleets for their business.

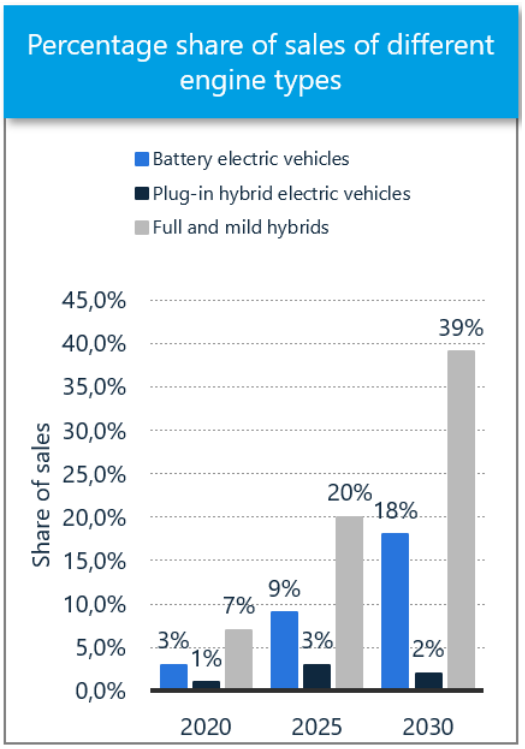
The boost in the electric vehicle demand is not only due to the measures by governments mentioned earlier, but also partly caused by social trends. Tesla was able to start a wave of enthusiasm for electric vehicles and established them as a trendy product that went through a hype; this “Tesla effect” caused a lot of new demand in this market segment.

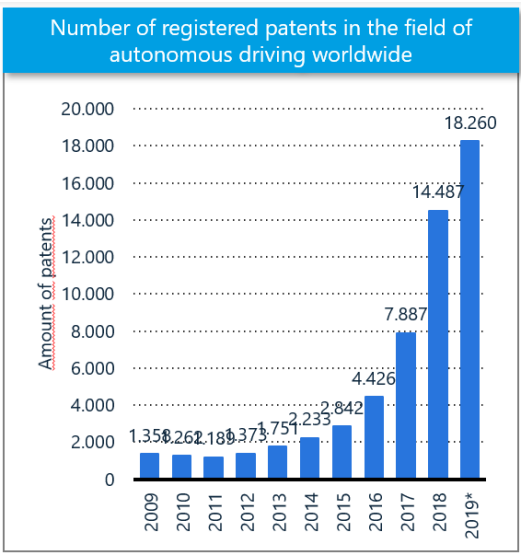
In addition, there are demographic factors that will influence the automotive market now and in future. First, there is a global population growth of 1% p.a. which increases the potential customer base for mobility and therefore also for cars. What will change the industry even more it the growth of urbanization by 0.9% p.a. globally. The more people live concentrated in urban areas the less dependent they are on private vehicles. Big cities have the necessary infrastructure such as public transport to replace the car as the main

tool for mobility. Additionally, urban areas are more profitable for shared mobility firms and the shift towards shared mobility is a lot quicker in big cities than in rural areas. Furthermore, there is reversed trend: despite the subsidies of public transport and the increasing urbanization, that makes public transport available to more people, the average passenger kilometers by rail are decreasing by 3.8% (CAGR) globally in the time of 2014-2023. In the same period, the average passenger kilometers by road have increased by 2.5% (CAGR) on a global level. This trend is beneficial for the automotive industry, as it implies increased usage of vehicles.

2.6.4 Technological factors influencing demand







1. *The percentage price mark-up of EVs over ICE cars from 2017 – 2015. (Source: statista)*
2. *The percentage share of global sales by engine type. (Source: statista)*
3. *The global number of registered patents in the field of autonomous driving. (Source: statista)*

The decreasing prices of electric vehicles increasingly stimulate their demand. The huge amount of R&D that is done in this field allows the quick emergence of new technologies that make the expensive parts such as the battery cheaper. Additionally, especially in the EV market, there is a rising competition with new players such as Rivian or Nio and also the more traditional car manufacturers speed up their shift to electric mobility. This increase in competition always boosts innovation and is great pressure for cost reductions. As the average range of electric vehicles is projected to increase from 300km in 2020 to 440km in 2030, the convenience of electric vehicles increases simultaneously attracting more demand.

The strong development and investment in connected car technology and autonomous driving has not yet had the full breakthrough yet. When the technology gets more sophisticated the autonomous industry will be able to offer new services and offerings to customers that will lead to new demand.

2.6.5 Environmental factors influencing demand

Country	Kyoto target 2008-2012	Pledged targets under UNFCCC
Australia	8% above 1990 levels	▪ 5% below 2000 levels by 2020 ▪ 15%-25% below 2000 levels by 2020 under different conditions of a global agreement that stabilizes GHG2 levels
Canada	6% below 1990 levels	▪ 17% below 2005 levels by 2020
China	-	▪ 40-45% reduction in CO2 emissions per unit of gross domestic product (GDP) from 2005 levels by 2020
EU	EU-15: 8% below 1990 levels	▪ EU-27: 20% below 1990 levels by 2020 ▪ 30% below 1990 levels by 2020 if comparable and adequate actions by other countries are taken
India	-	▪ 20-25% reduction in emissions per unit of GDP (excluding agriculture sector) from 2005 levels by 2020
Japan	6% below 1990 levels	▪ 25% below 1990 levels by 2020
Russia	Remain at 1990 levels	▪ 15-25% below 1990 levels by 2020, range depends on accounting of forestry sector and actions by all major emitters
USA	-	▪ In the range of 17% below 2005 levels by 2020, in conformity with anticipated legislation

The overall awareness of the global environmental challenges has peaked in recent years. On country/governmental level as well as on individual level people are more willing to act in favor of the environment. Countries from all around the world have committed themselves to different environmental targets such as the Kyoto targets, the United Nations Framework Convention on Climate Change, and the Paris agreement. This forces countries to impose measures as the ones mentioned in the "political" part of this analysis and lead to a social trend of environmental awareness. This trend goes along with an increase in demand for electric vehicles since they are proven to be more environmentally friendly in the long term.

Criticism emerged that the production of necessary metals (eg. Lithium, Cobalt) for the battery production has an immense impact on the environment and that the environmental footprint of the production is higher for an EV than for a conventional vehicle. Even though some of the claims are true, in the long-term calculation studies agree on the environmental superiority of electric mobility.

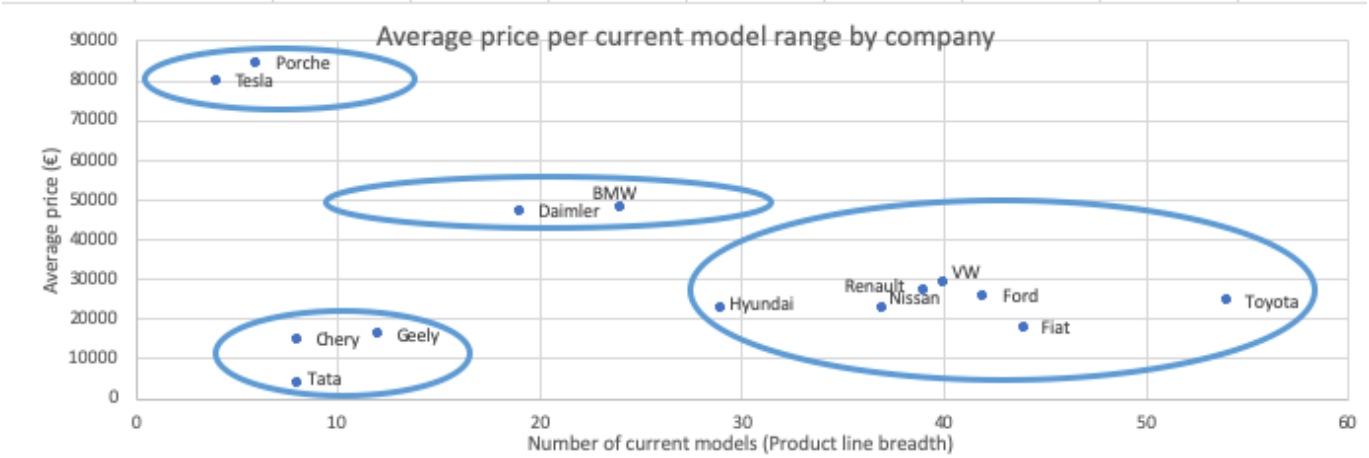
3. Supply Analysis

3.1. Strategic Groups

Strategic groups are sets of companies in a certain industry that assume identical or comparable strategies regarding specific variables.

On a first analysis, we decided to segment groups based on "average price" and "number of current models". This will give us more understanding about automotive groups.

According to these criteria, we can see four main strategic groups, as demonstrated in the visualization below. Number of current models examines to what degree companies have an extensive or a narrow product line breadth; whereas the second variable, average price, shows the correlating price the company offers for its car models in the market.



Strategic groups considering average price and nº of current models (own model)

Luxury cluster

These are companies with a high average price per car and a reduced number of car models, such as Porsche or Tesla. Luxury cars are built to take the breath away of consumers as they aim to excite people and to develop excellent reputation. Their main goal is to achieve value-generating growth by making sustainable investments in innovative technologies and products (Cars Insights, September 2020).

High-class cluster

In this cluster, the price of cars is usually higher than average due to the reputation/brand image and the performance of the engine of cars. The range of models is lower than the low-class groups because of the focus on the higher income group. In this group, we can find, for instance, BMW or Daimler.

This segment is categorized by low product diversification with above average car prices. Cars are quite similar in terms of product attributes, like design, price, performance, quality etc., therefore, car manufacturers have to distinguish their cars from competitors through customer satisfaction (The Economic Times, March 2012). This highlights the importance of building brand equity in order to achieve and gain competitive edge.

Low-class cluster

They have the widest range of products which cover most of segments of the automotive market. They have the brand image as low price/ low class. Almost all of these firms have the same short-term strategy which is cost orientation. In this groups, we have companies, such as Ford, Fiat or Toyota. Toyota is an example, as they have a wide range of current traditional engine product, which can give them a stable fundamental for them to innovate to build newer models, as it happened with the case of their hybrid engine (Sites Insights, *Competitive Market Analysis and Positioning*).

Emergent Players Cluster

Players like Chery, Geely or Tata are characterized by products with low price and reduced number of models. The players in this group usually make several investments in R&D and scientific management to improve energy efficiency, safety or to grasp opportunities that have not have yet been seen by other companies (Academia.edu Insights, *The international strategies of Chery*).

To summarize the whole map, we can say that, considering **average price** and **product line breadth:**

- ⇒ There's a relationship between the two variables- most luxury companies opt for reduced number of models, while economic companies offer more variety in their product line;
- ⇒ On the side, new emergent players are breaking this pattern by offering lower prices and lower model variety.

On a second map analysis, now considering "geographic reach" and "product range", we have the following illustration:

Strategic groups considering geographic reach and product range

In this second map, we can see the *high-end international players*, such as Daimler, BMW, Porsche, Aston Martin or Tesla, which strive to deliver to an international market high quality and high-performance cars, while maintaining a narrow offer of models; *Low-class international players* such as Toyota, VW or Ford which differ from the previous group on the number of models offer, since they have a more complete range of model when comparing to the high-end group (when considering these two variables); finally, we have the *Local players* as is the case of Chery, Tata or Geely which are present only in local or regional markets under a narrow range of models. These emergent players pay much attention to consumer wants and needs and are a force to be recognized.

To summarize the second map, we can say that, considering **geographic reach** and **product range:**

⇒ There's a greater concentration in Global and multi-regional market

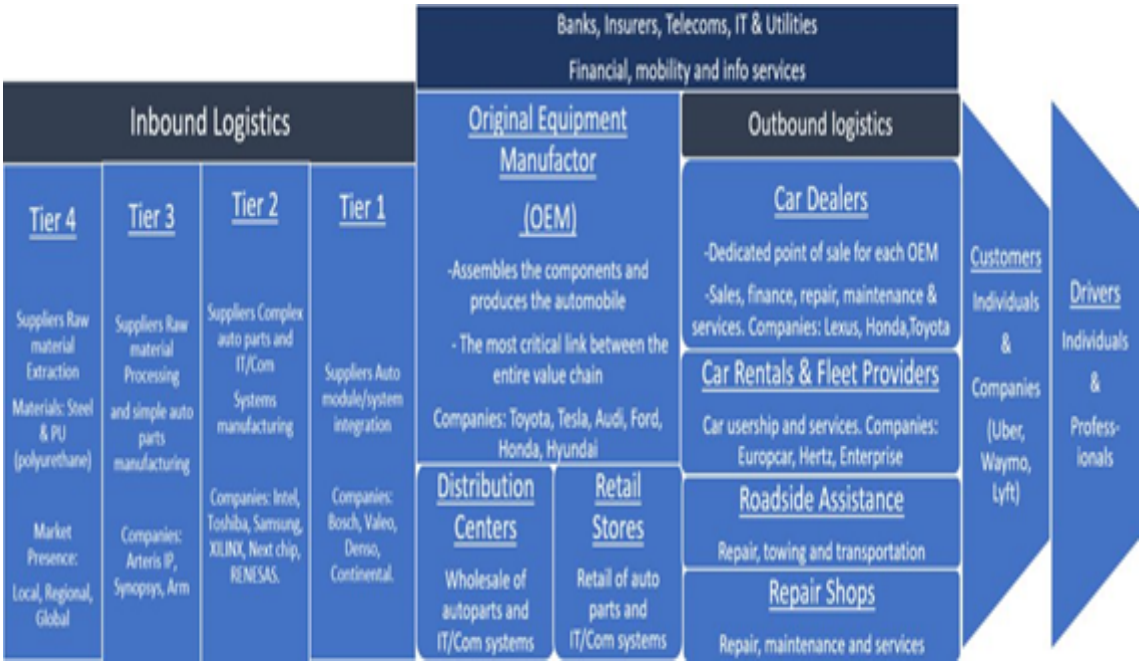
⇒ Less product range for upscale companies and local players

⇒ More product range for economic companies

Key take-aways of strategic groups mapping:

- Strategic group maps reveal companies that are close to competitors and those which are distant – companies in the same cluster are competitors, since they present products that can be considered to be substitutes; when they don't belong to the same cluster, they are not consider to be direct competitors.
- They also reveal that not all positions on the map are equally attractive, since competitive pressures and industry driving forces favour some strategic groups and hurt others and the profit potential of different strategic groups differs according to the strengths and weaknesses in each market position. This is particularly interesting to notice in the first map, as there's no company positioned on the top right corner, as there's a need for car companies to explore economies of scale and economies of experience, in order to target the mass market with cheaper cars.

3.2. Industry Value Chain



Automobile Industry covers the entire range of activities ranging from the supply of raw materials to the final product being delivered to the customers. As we will see, all the processes down the value chain add value to the product until it is ready to be sold.

The first element of the value chain is the supply chain where all the suppliers all around the world produce different parts necessary for the final product. This initial section of the value chain is divided into 4 tiers, with each tier representing a different type of supplier, and representing a period of inbound logistics between each tier. Tier 4 represents the supply of the very basic raw materials; these materials are collected from all over the world and then distributed to tier 3. In this tier we have the processing of raw materials and the beginning of the production of simple auto parts manufacturing, all done by specialized companies such as Arteries and Arm for example. Next, we have Tier 2 where the supplies from the previous tier are now put together to form a more complex manufacturing of auto parts as well as IT/Com systems, with companies such as Samsung and Intel being this type of supplier. At the end of the supply chain, there's a final Tier 1 where an integration of auto modules and systems is put together and then delivered to the Original equipment manufacturers. However, there's already an additional Tier 0.5 nowadays, as there are sub-contracted companies hired specifically to assemble all the car components for the brands.

After the supply chain, the supplies can either reach the original equipment manufacturer (OEM) for assembly, or they can be sold in the after-market. The after-market consists of supplies from Tier 3 to 1 being sold in different types of businesses that only require auto parts such as retailers, distribution centres, repair shops and road side assistance. Nevertheless, if the car is assembled in the OEM, it will then enter a period of outbound logistics with different possible destinations. Firstly, the majority of the cars are sold to car dealers which represent a dedicated point of sale for each original equipment manufacturer. Afterwards, these cars will be sold to different customers such as individuals, or companies such as uber and Waymo for example. Even though this is the most common path for the majority of the cars, there's already a company such as Tesla that sells directly to the final customer, eliminating the need for car dealers and improving the efficiency of their automobile value chain, which could be a possible step for other companies in the future of the automobile value chain in order to increase their efficiency and reduce costs.

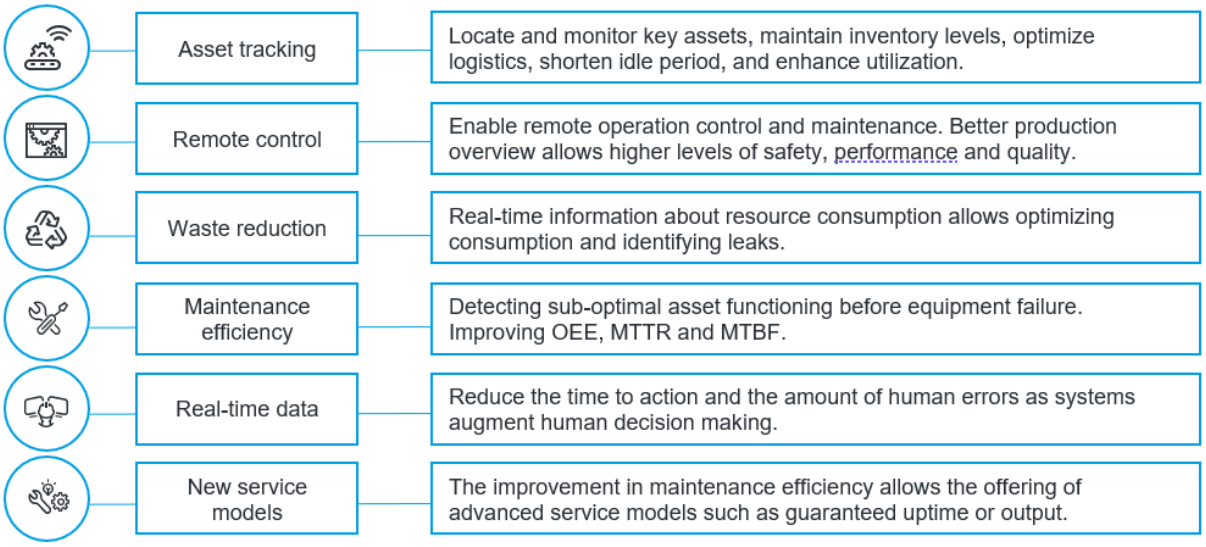
Additionally, once the final product leaves the OEM, it can be sold to car rentals and fleet providers. Although both provide the same service, the end customer is different, car rentals are sold to individuals, whereas car fleets are sold to companies. For all these activities to happen in the value chain, we have to take into consideration additional stakeholders such as banks, insurers, telecoms, IT & utilities. All of these provide the financial, mobility and info services that are much needed throughout the entire value chain.

3.3.3. Digitalization

3.3.1 Car Production

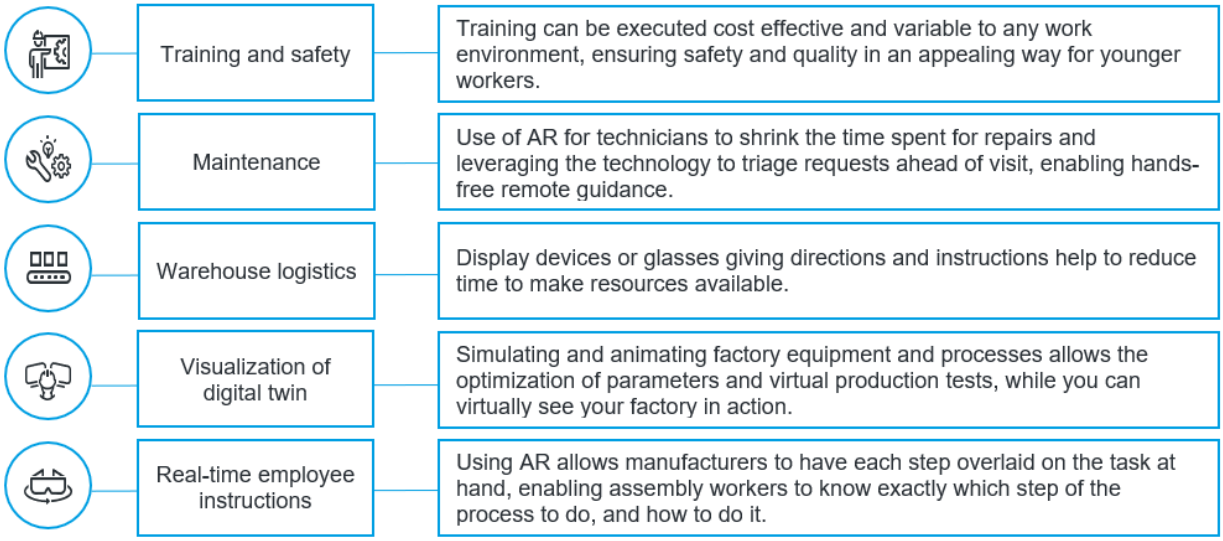
3.3.1.1 IIoT

The market size for global IIoT platforms in manufacturing is projected to grow with a CAGR of 40% over the next 5 years. In combination with appropriate data analysis or AI based data insights, this technology provides various use cases to industrial car manufacturers, such as:



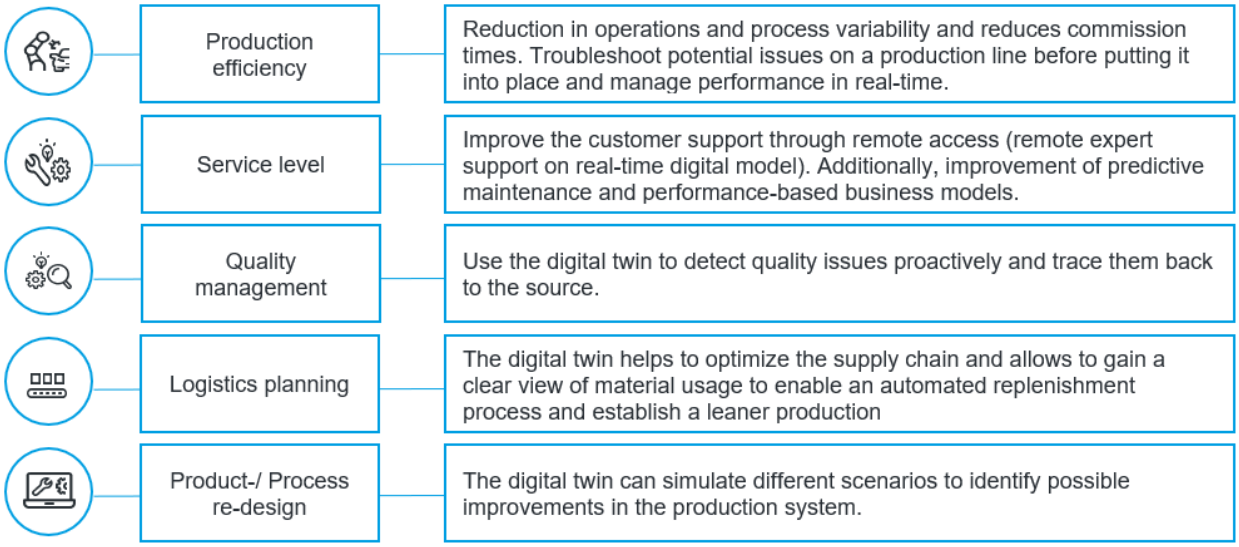
3.3.1.2 Virtual and Augmented Reality in the Factory of the Future

Augmented or virtual reality is often mentioned in the context of the next generation video games, but also offers a wide range of use cases in the manufacturing business. Industrial companies from all sectors make substantial investments into this technology, as the application becomes increasingly affordable. Possible use cases for OEMs would be:



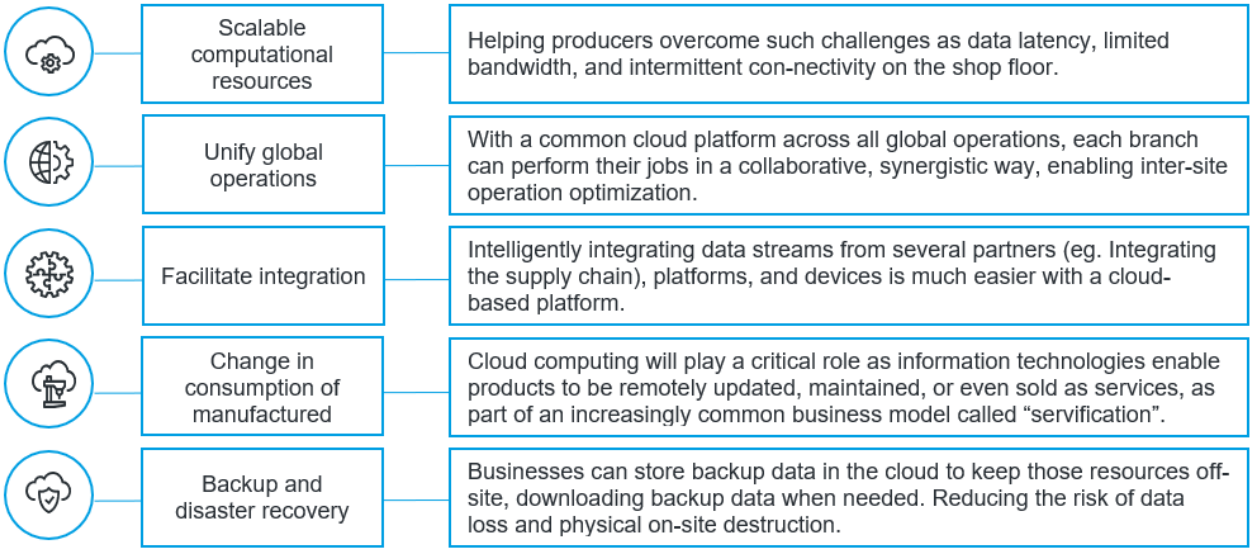
3.3.1.3 Digital Twin

The use of digital twins is expected to triple by 2022, compared to the 2019 level. Most industrial companies already identified the advantages of simulations are investing into digital twins on product-, process- and R&D level. Automotive OEMs could leverage on the technology in the following ways:



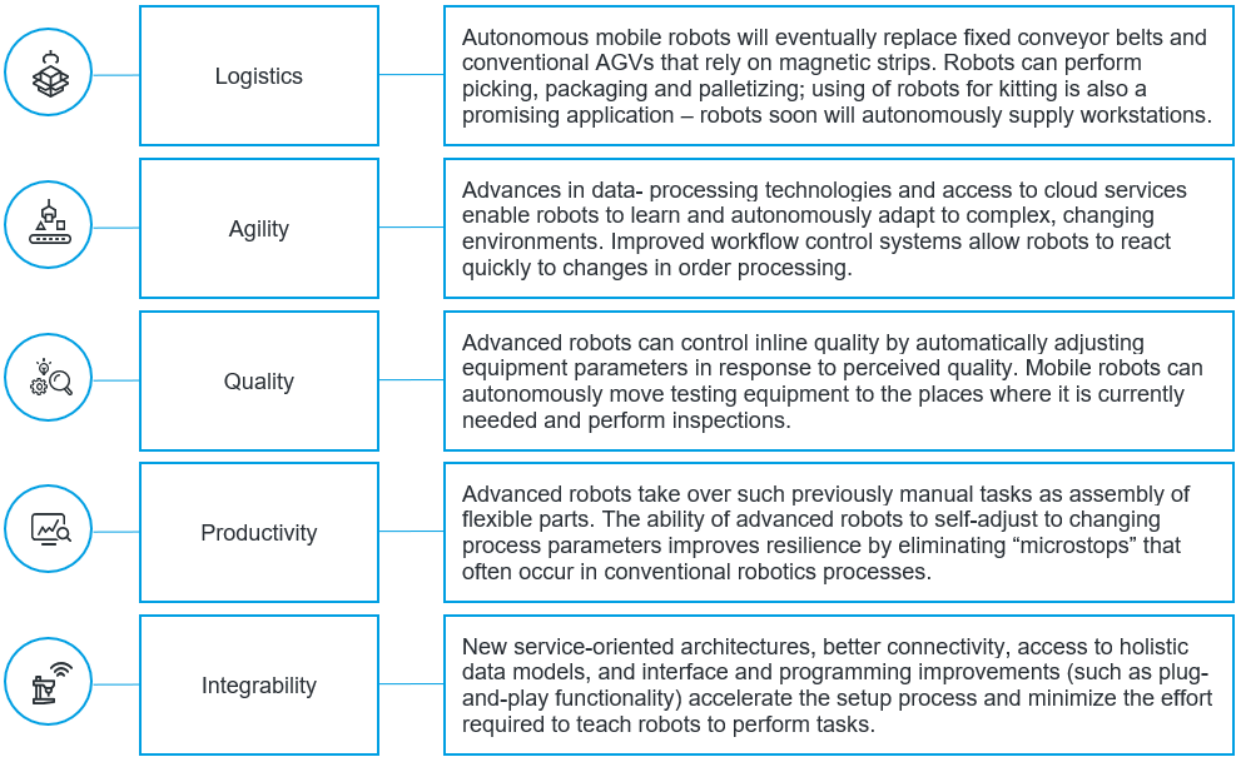
3.3.1.4 Industrial Cloud

The Global Cloud Manufacturing Market is expected to grow at a 19.8% CAGR during the forecast period 2019–2024. Manufacturing companies that move development to IaaS and PaaS clouds from Amazon Web Services (AWS) reduced downtime by 72% and improved application availability by 3.9 hours per user per year. Some use cases for car producers are given by:



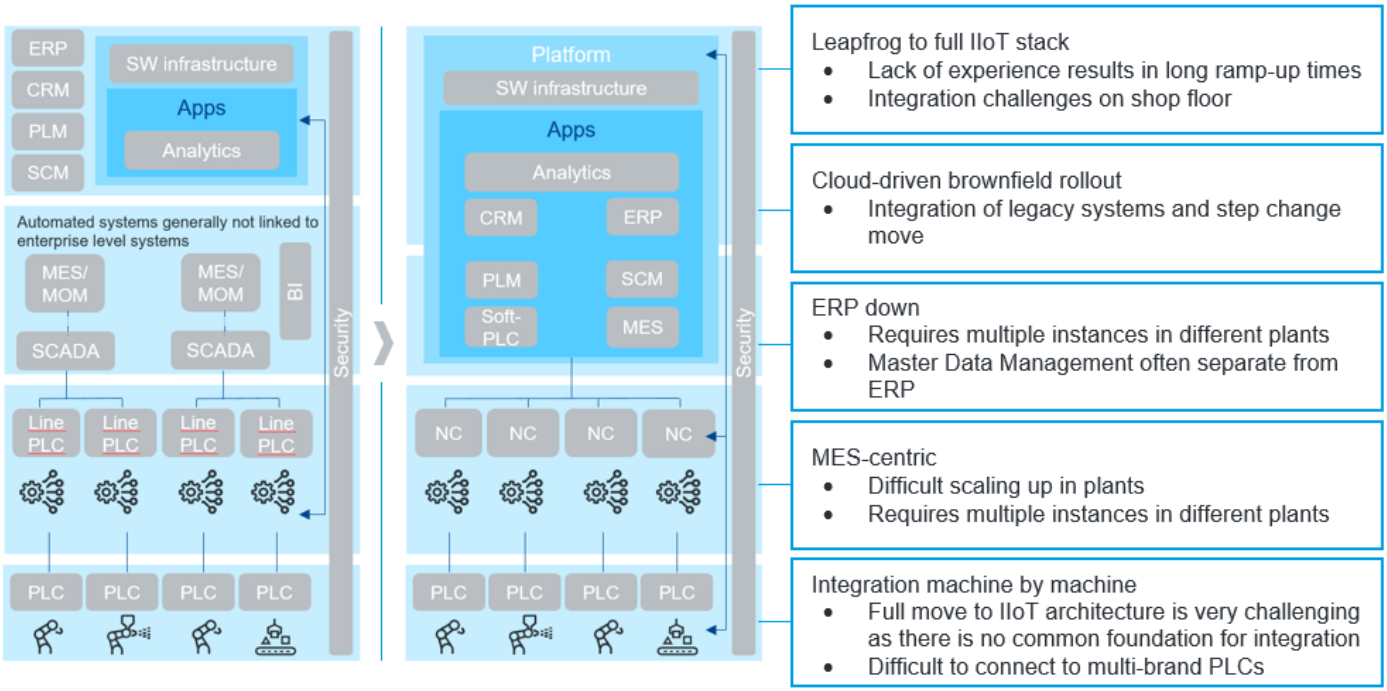
3.3.1.5 Advanced robotics

The global market value of advanced robotics in manufacturing is going to triple by 2021 – from 1.2 bn USD (2018) to 3.7 bn USD. A great development is also happening in the global market value of advanced robotics in logistics, with a rise from 0.5 bn USD to 0.9 bn USD. In the car production process, they can specifically be used to:



3.3.1.6 Vertical System Integration

The next generation of system integration will implement and leverage the advantages of the OPC UA IoT framework form the control level upwards and will allow a greater use of data from different sources to be included in the analytics, this leads to more valuable insights and higher operational transparency. Furthermore, the network will enable companies to optimize operations on a cross-plant level with a holistic view on the supply chain.



Shift in the IT infrastructure of car manufactures. (Source: McKinsey)

3.3.2 Connected Vehicles

Vehicles can be called “connected” due to various reasons.

There are many ways for vehicles to be connected vehicles. Drivers of connected cars can contact and exchange information with multiple connection points surrounding them, either in their in-car surrounding or far away. The most typical connection points are referred to as:

- V2I – Vehicle to Infrastructure
- V2V – Vehicle to Vehicle
- V2C – Vehicle to Cloud
- V2P – Vehicle to Pedestrian
- V2X – Vehicle to Everything

Connected cars have the ability to interact with any of these points of contact. Typically, contact is made through internet connection or a wireless local area network.
The connectivity is a critical pre-step to autonomous driving as it allows OEMs to collect driving data that can be used to train the necessary machine learning algorithms.
Moreover, it allows cars to have a wide range of entertainment features such as integrated digital support features known from your smartphone, for example Android Auto, Apple CarPlay or Amazon Alexa. Another good example for using connectivity for the car entertainment system is Tesla, who integrated a Netflix app into their car entertainment system.
The largest potential of connected car data lies outside the actual vehicle. It allows the emergence of several new use cases and business models. The data can be used to realize the goal of "smart cities" by provides deeper insight for congestion management, traffic flow optimization (real-time traffic flows, efficient traffic light controls, public transport, and dynamic signage) and route optimization, transportation system planning, emissions management, parking management, and more.
Connectivity in cars has the potential to improve the safety of traffic. This is through all the driving assistance and communication between connected vehicles, but also due to external analysis of the data retrieved while driving. Data such as airbag triggering, hard braking, speed, and location give emergency responders a head start and also identify problem areas to transportation planners.
The geographic driving data can further be leveraged to create a efficient infrastructure for electric mobility: Optimally place EV charging stations to distribute energy across the grid by using historical EV traffic data. Offer EV charging applications that simplify the driver experience and stage charging to minimize energy costs.
Another way to use connected car data would be for optimizing the operations of fleet management: Automate driver tasks such as parking or road usage tax payments or hours of service tracking for compliance. Improve driver safety monitoring, vehicle tracking, fuel management, and remote diagnostics. Connected to the remote diagnostics of possible malfunctions is the facilitation of predictive maintenance. This is already rather common in industrial production (as mentioned in the car production part of the digitalization chapter) and car connectivity could extend this feature to the end consumer. It would be possible to predict when a vehicle will likely experience a fault or need maintenance, based on diagnostic trouble codes and statistical inference from historical trends. Plan maintenance to keep the fleet working at peak performance.

A new business model could develop from connected cars for insurance companies. Connected car data provides a deeper and much more accurate view into driving behavior and can be used for pay-as-you-drive (PAYD) and pay-how-you-drive (PHYD) usage-based insurance, driver behavior monitoring and feedback, mileage verification, first notice of loss (FNOL) and claims processing, accident reconstruction, and advanced underwriting models.

3.3.3 Autonomous Driving

The development of autonomous vehicles (AV) is progressing quickly, but adoption will take place rather slow and evolutionary. Level 4 autonomy operating within virtual geographic boundaries is expected to be available in 2021/22 and full autonomy (level 5 technology) will not be operated before 2030. These advances will change how people think about mobility in urban environments, with the greatest impact seen in car ownership and public transportation use. Two major use cases are robot-taxis and automated logistics (commercial trucks).

In the near-term, advanced driver-assistance systems (ADAS) technology will be important as the market prepares for full autonomy and seeks to increase profits from AV-critical technology capabilities. The market for ADAS doubled by 2021 compared to 2017 values, reaching $35 billion in revenue.

Generally, the path to autonomous driving is structured into 5 levels, of which the first one is “driver assistance” we already experience commonly today. Driver assistance systems support drivers on the road and help ensure additional safety and comfort. Example functions could be cruise control with stop&go function, which independently adjusts the distance to the car in front of you. And then there is the collision and pedestrian warning with city brake activation, which prevents collisions via automatic braking.

Semi-autonomous driving assistance systems, such as the steering and lane control assistant including traffic jam assistant can brake automatically, accelerate and, unlike level 1, take over steering. The technology including these features would be referred to as “partly automated driving”

In the third level – “highly automated driving” - drivers will be able to hand over complete control to the car. The car will be able to drive autonomously over long distances in certain traffic situations, such as on motorways. The driver, however, must be able to take over control within a few seconds, such as at road construction sites.

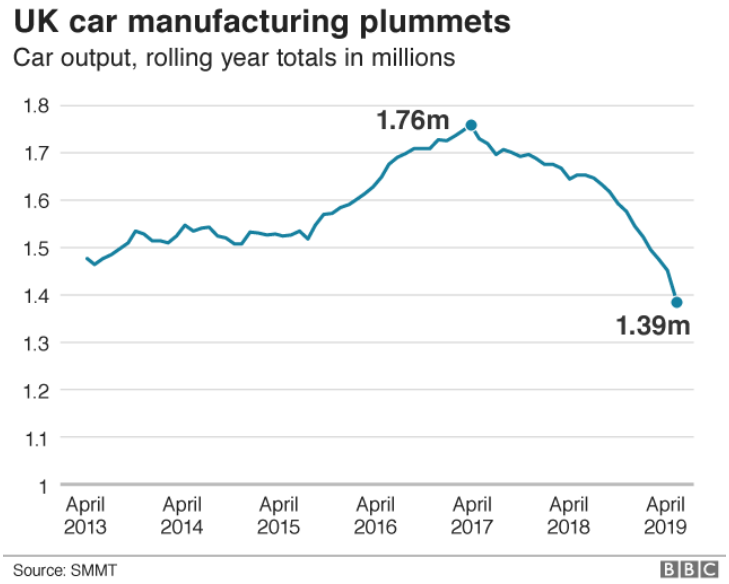
In level 4 “fully autonomous cars” can handle the majority of driving situations independently. The technology is developed to the point that a car can handle highly complex urban driving situations, such as the sudden appearance of construction sites, without any driver intervention. The driver, however, must remain fit to drive and capable of taking over control if needed.

The final destination will be “full automation”. Unlike levels 3 and 4, the “Full Automation” of level 5 is where true autonomous driving becomes a reality: Drivers don’t need to be fit to drive and don’t even need to have a license. The car performs all driving tasks – there isn’t even a cockpit. Therefore, every person in the car becomes a passenger, opening new mobility possibilities for people with disabilities, for example.

3.4 Supply Trends

3.4.1. Political

The global political landscape has a dramatic impact on supply trends in the automotive industry. One large effect is the effect of political instability: Political instability in countries with manufacturing or management capabilities can have a negative effect on supply chain as companies may need to restructure and manage their supply chain to accommodate for the changing political landscape. This can be associated with a strong increase in costs if manufacturers are not able to manage these transitions efficiently, which also affects supply. For example, when Britain began to implement their considerations to leave the European Union in 2016, colloquially referred to as “Brexit,” it caused a large effect on the automotive industry. The legal processes surrounding Brexit Several automobile manufacturers, such as Ford and Volkswagen, have manufacturing capabilities in Wales, and this succession from the European Union was predicted to increase import costs to the EU. Upon this evaluation, companies decided that it was no longer profitable to maintain these factories and decided to close their factories. For example, post-Brexit, Ford started making plans to shut down their engine production plant in Wales by 2020 (BBC, 2019).



Following the timeline of Brexit's progression in the graph above, detailing the UK car output in millions, it can be seen that the announcement has had an impact on the industry, and it's predicted that the effects will continue into 2020 as companies continue to shift their supply chain.

Political looking at the effects on supply chain, legislation, and possible property destruction. Continuing into the 2020's, political instability continues, looking at the presidential elections in the United States, Brazil, and Taiwan, just to name a few, and the rising political tensions in Chile, Hong Kong, and India. The ongoing protests in India from the agriculture industry are being monitored closely by manufacturers: protests have destroyed property and are closing highways, which affects supply chain and ease of mobility (BS Web Team New Delhi, 2020).

Another trend that will continue to affect supply is the continuing escalation and de-escalation of trade wars between major suppliers and markets which decreased and stabilised supply costs. Prior to 2019, there was an escalating trade war between the United and China in several industries, which levied tariffs that increased the prices of steel, aluminium, and consequently, automobiles. With the stabilization of these trade wars, this may signal a decrease and stabilization in these prices. (Deloitte, 2020)

In the past few years and going forward, many governments are pushing for companies to invest more heavily in green and alternative energy. For example, Germany is in the process of negotiating a deal that would provide the Automotive industry with up to two billion euros to subsidize green research and development (Meyer, 2020). This has the effect of decreasing costs for automobile suppliers investing in research and development

of Green energies, but it also signals a shift in priorities which is associated with greater costs for many companies. China announced their initiative in April 2020 that would incentivize Chinese consumers purchasing electric vehicle with a cash subsidy (Cui & He, 2020) and France announced an 8.8-billion-euro initiative in May to subsidize French consumers in purchasing new electric vehicles, with up to 7,000 euros per purchase (Rose, 2020). In recent news, the new 2030 deal asks countries to take measures to cut emissions of environmental pollutants, signalling that more countries will need to cooperate with their respective industries to meet these goals (Mathiesen & Oroshakoff, 2020).

Another potential political factor is the potential for an increased minimum wage in some countries of production: several countries are facing increasing pressures to raise their minimum wage, for example the United and Germany: two large players in the automotive industry (Aiello et al., 2020). This will present an increase in costs for automobile suppliers as they either pay their employees more and restructure their manufacturing processes accordingly.

3.3.3.4.2 Economy

Some of the largest trends affecting the Economy in 2020 have been the disruptions and effects due to COVID-19: from issues with Chinese parts exports, large scale manufacturing interruptions across Europe, and the closure of assembly plants in the United States (Vitale, 2020).

Aside from the extraordinary pandemic circumstances, there are some more general economic trends affecting the automotive industry in 2020, such as the growing interconnectedness of international markets and growth of previously underdeveloped economies, which increases the market supply and allows companies to explore alternatives for manufacturing and sourcing (for example, there are factories being built in Morocco, and the Manufactuing plants of Mercedes Benz, Renault, BMW, and Toyota in South Africa continue to grow. Multinational vehicle manufacturers currently setting up production plants in Angola, Ethiopia, Ghana, Kenya, Namibia, Nigeria, Rwanda, South Africa and other countries, indicating potential to expand supply capabilities in sub-Saharan Africa (*Sub Sahara Africa automotive sector: potential to boost manufacturing and create decent jobs*, 2020) Many of these larger multinationals are cooperating with existing production facilities in these countries, which decreases the investment cost of setting up new facilities while still increasing the potential for supply.

Another economic factor is the increasing prices of raw materials, namely in the price of steel, iron, and other raw materials (Onstad, 2020), which decreases supply as competition for resources increase.

3.4.3 .Society

Societal trends currently reflect a customer base with an increased taste for personalised products, which grows niche markets and gives disruptive competitors, such as Tesla, a major platform in the market. This increases competitiveness in niche markets, and adds demand for a diversified product supply.

Society's shifting preferences are also affecting supply: many consumers in the 2020's are becoming more concerned with the ethical and environmental impact of their purchases, forcing manufacturers to take these new preferences into account in their production methods. Many manufacturers are experiencing pressure to conduct more CSR ventures, such as engaging in community efforts, awareness projects, scholarship campaigns, and other educational events to boost public image (Toyota, 2019).

3.4.4 .Technology

Looking at the modern automotive industry: it's more innovation driven than ever. New technologies and software innovation (alternative energy and fuel sources, self-driving cars, "smart" cars with VUI/Bluetooth) are becoming increasingly recognized as factors that give demand and can give companies a competitive advantage. While these technologies have a large effect on demand, they also pose a large development cost on the supply-side, with everything from R&D to associated legislation and government approval of these new technologies, and keeping up with market demands forces automotive manufacturers to expand the breadth of their supply.

Another consequence of this is the need for increased spending on the protection of these technologies and software's; not only is this visible in the increasing spending on patents and intellectual property protection, but also the growing global automotive cybersecurity market. According to some metrics, the market is expected to grow from $1.34 billion in 2018 to $5.77 billion by 2025: an unprecedented historical rate (Aiello et al., 2020). This contributes to an increasing cost for automotive manufacturers.

Automation in Manufacturing

From Toyota's Cobots ("Collaborative Robots" designed to work with humans in manufacturing capacities) to Tesla's Robotic Process Automation (fully automated robots that work in manufacturing (Miller, 2019 and Workstream, 2020). Automation in manufacturing has costs when shifting over, but decreases production costs long-term. This also can include the advancement in 3-D printing of complex parts, which can simplify supply chain and distribution. While there are large initial costs associated with the development of these technologies, there's also a large potential for company savings long-term with these processes.

Data Analytics

One of the fastest growing technological influences on the automotive supply chain, there are several ways that increasing availability of data and advances in data analytics can affect the industry (Woodward et al., 2015).

Customer Behaviour Analytics

The usage of data analytics in investigating customer behaviour can begin from looking at the customer's initial research and purchase of vehicles (internet cookies, search engine tracking, etc.) and can continue into investigations of how customers maintain and manage upkeep of their vehicles, and there's developing technology that can even analyse how they drive. By analysing their customer behaviour, automotive industries will be able to more effectively segment their customers and track and analyse their experience. This analysis can then be used to improve customer experience and retention, and potential acquisition if automotive brands can significantly improve their experience against their competition.

Marketing Spending Management

Feeding off of customer behaviour and analyses, companies will be able to track their marketing efforts more effectively, from digital efforts in online marketing and social media engagement to analysing footpath patterns in dealerships.

Global Supply Chain Management

On the pure production side, as opposed to retail, manufacturers are more capable than ever before to analyse their production processes. From navigating and avoiding parts shortages, government scrutiny, product recalls, lost growth opportunities, data analytics tools can help manufacturers to notice issues in their

supply chain and react more quickly by providing ease and speed in comparing and selecting alternative solutions. (Koenig, 2019)

Predictive Analytics

For example, in the first half of 2020, over 13 million vehicles were recalled globally, indicating issues with product quality and recall management are still an issue in the automotive industry (*News 18, 2020)*. Giving the increasing complexity of the technology used in automobiles. Predictive analysis tools and the availability of data gives

3.4.5 .Environment

Going into the 2020's, the automotive industry is evermore feeling the effects of the environment: from natural disasters to growing public concern over conservation efforts. Natural disasters, from extreme droughts to floods and earthquakes, can affect a company's supply chain and distribution networks. For firms, natural disasters can destroy physical assets such as buildings and equipment, disrupt and displace human capital, and harm the overall production capacity of firms, affecting everything from factors on the production side to dealerships and retailers. In an increasingly international world, a natural disaster in one part of the world can affect the supply and production: a flood in Japan in 2018 halted production of a key component which affected Mazda's production globally (Greimel, 2012). These natural disasters pose a risk to firm value, and increase company costs in diverting and mitigating the effects. While companies can prepare for these disasters and try to plan for these possibilities, the preparation also has a cost. Some companies such as Toyota, have shifted their supply chain to accommodate for these natural disasters, such as how Toyota shifted their supply chain around water shortages in California earlier this year, when the wildfires and droughts affected one of their manufacturing facilities (Toyota, 2019). Historically, Mazda has also faced issues with their supply chain in Japan post-tsunami.

The social attitudes about the environment are also having an effect on the automotive industry: there is a growing increase in conservation and sustainable business practices. The automobile industry is heavy on the manufacturing front, which uses a lot of water, electricity, and has significant carbon emissions. This factor also ties into Social and Political trends: the social movement has garnered political support and is driving changes to protect the environment. Environmentally friendly production increases implementation costs, especially when looking to research and development for new

methods of production and the development of new technologies (such as alternative energy for cars), but decreases resource consumption in the long term, which can save money for the company.

3.4.6 .Legislation

Overall, there has been an increasing trend of more restrictive legislation in the automotive industry over the past several years, which is estimated to continue. Increases in legislation are normally associated with greater costs in managing the legislation (lobbying and dealing with governmental entities) and time costs in following new procedures and protocols associated with the legislation. Further costs are associated with non-compliance, such as fines and fees.

Intellectual Property Licensing

As the technologies utilised by the automotive industry increase, many companies have strong vested interest in protecting these technologies through patents. According to World Intellectual Property Organization (WIPO) data, 3,400 global patents for automotive battery technology were filed in the past year, up 57% from 2,167 the year before (Crossan & Cairns, 2020). The protection of intellectual property and compliance with global legislation is an investment cost and a time cost for many automotive manufacturers.

Vehicle and factory emissions and environmental impact

These measures strike the automotive industry two-fold: not only do companies need to be cautious of their factory emissions but also need to be mindful of the restriction s and regulations on the vehicles they produce. On the manufacturing front, this legislation requires companies to invest more in alternative energy and emission reduction measures (such as carbon sinks), which increases costs for many companies. If firms decide to not comply with these regulations, there are heavy costs, looking back to the Volkswagen scandal. This December, every EU member agreed to raise the emissions reduction goal for 2030 to net 55 percent. An increase from the current target of 40 percent (Mathiesen & Oroshakoff, 2020), which may signal more upcoming legislation on a country-by-country basis. In the United States, Biden's presidency is expected to increase environmental protection regulations.

Safety requirements for vehicles

Safety legislation comes in several different forms in the Automotive industry. On some fronts, it is the mandatory inclusion of certain safety features in vehicles (an additional cost for the company) and the implementation of mandatory safety testing. This safety testing is not only an additional cost for vehicle manufacturers, but also a time cost since.

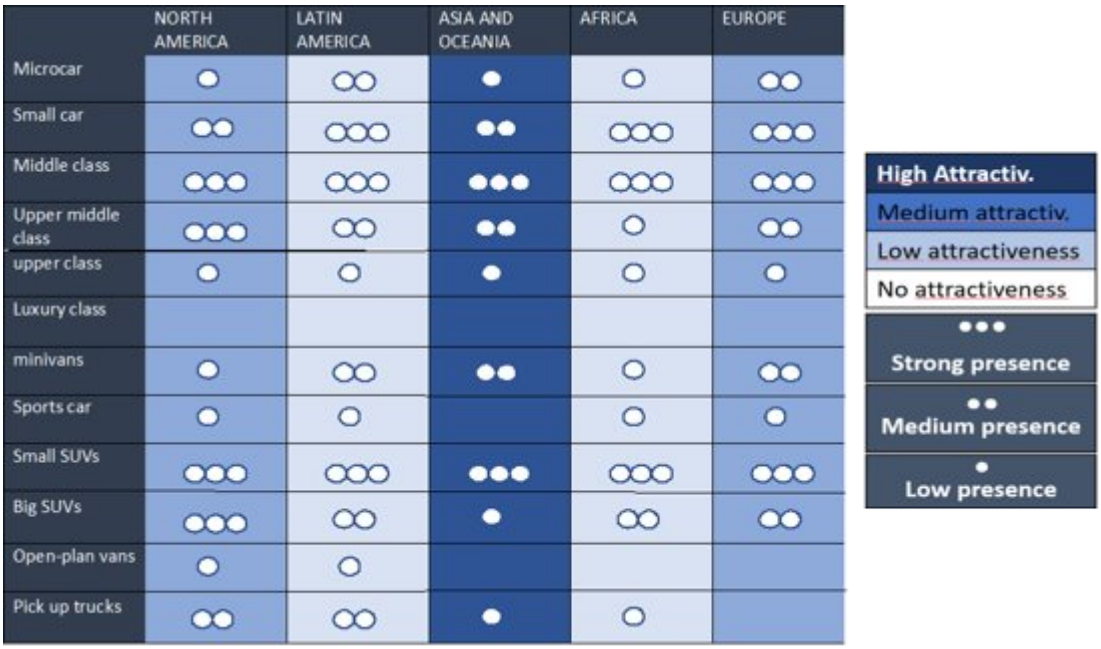
Regulation and approval of new technologies

With the technological advancements in the automotive industry, come the regulations by governments seeking to protect citizen safety. Autonomous driving is of particular concern, with ongoing debates in many countries over implementation, regulation, and safety measures. In the United States, these laws are passed state by state, which is an immense time cost for the industry, as well as an immense expense in regards to lobbying and working with legal bodies to create these regulations (Husch & Teigen, 2017).

4. Strategic Issues

4.1 Product-market matrix

The first product market matrix presented put in relation on the vertical axes the segmentation by different kind of cars and on the horizontal axes the geographic market where they are sold.



The attractiveness of each continent is evaluated according to the results of the Sustainable Value Creation Index presented in the beginning of the report. Asia and Oceania represent the most attractive country (S.V.C.I. equal to 218517), followed by

Europe and North America (S.V.C.I. respectively equal to 122798 and 102782). The less attractive markets are Latin America and Africa (S.V.C.I. respectively equal to 13105 and 5403). The presence of each segment has been evaluated according to the market share in each continent computed with the data on the number of cars sold. A strong presence is associated with a market share higher than 15%, a medium presence is associated with a market share between 15% and 5 %, a low presence is associated with a market share between 5% and 1%, and no presence is associated with a market share lower than 1%.

The distribution of the presence of each segment present only few differences among continents. The most popular segments, that present a strong presence worldwide, are the middle class and small SUVs. The less popular instead are luxury cars which have a market share lower than 1% worldwide, the upper class, sports car, and open plan vans. We find the biggest difference in the pick-up trucks that have medium presence in North and Latin America, low presence in Asia and Africa, and no presence in Europe; the big SUVs have strong presence in North America, low presence in Asia, and medium in the rest of the world; the upper middle class have strong presence in north America, low presence in Africa and medium in the rest of the world.

4.1.1Product-market matrix

	World wide	North America	South America	Europe	East-Asia	Australia /Oceania	All Asia	Africa
Toyota	●●●	●●●	●●●	●●	●●●	●●●	●●●	●●●
Volkswagen	●●●		●●●	●●●	●●●	●●	●●	●●●
Ford	●●	●●●	●●	●●	●	●●	●	●
Nissan	●●	●●	●		●●	●●●	●●	●●
Honda	●●	●●			●●	●	●●	
Hyundai	●●	●	●●●	●●	●●	●●●	●●	●●
Mercedes-Benz	●●	●		●●●			●	●
Chevrolet	●●	●●	●●●					●●
BMW	●●	●		●●●	●		●	●●
Audi	●●			●●	●		●	
Fiat			●●					
Kia		●	●			●		●
Renault			●●	●●				●
Jeep		●●	●●					

High Attractiv.
Medium attractiv.
Low attractiveness
No attractiveness
●●● **Strong presence**
●● **Medium presence**
● **Low presence**

In this products market strategy, we analysed 14 well-known brands from all over the world and their presence, considering the attractiveness from markets of each continent as well as worldwide.

For the most attractive markets we have East Asia, Australia and All Asia mainly due to an enormous amount in sales and better rebound from covid-19, where Toyota is the clear market leader, followed by Volkswagen, Nissan and Hyundai.

The second most attractive markets are North America and Europe. These two markets are very similar as they have the same size, risk and sustainability. Concerning the market presence, Toyota stands out in North America as the major leader, followed by Ford, Nissan and Honda. On the other hand, In Europe Volkswagen has the strongest presence, followed by Mercedes and BMW.

Lastly, In Africa and South America, we have the least attractive markets as these are underdeveloped markets with very few penetrations compared with other regions. Additionally, these two markets have the worst industry development indicators, which makes them the least attractive of all for equal reasons. Nevertheless, there are brands with strong presence in these markets with Toyota and Volkswagen dominating the market, followed by Chevrolet with a stronger presence in South America than Africa.

Overall, it is clear that the impact of Covid-19 had some impact in the overall strength of the markets, with Asia and Oceania having a clear lead. In terms of market presence worldwide, Toyota and Volkswagen stand out as the global leaders in the overall market performance.

4.2 Vertical Integration

The automotive industry is a quasi-vertical integrated industry. Quasi-vertical differs from full vertical integration, since the downstream firms still contracts with a supplier for the actual manufacture of the component, while with full vertical integration the production process itself is made in house (R&K Insights, 2016).

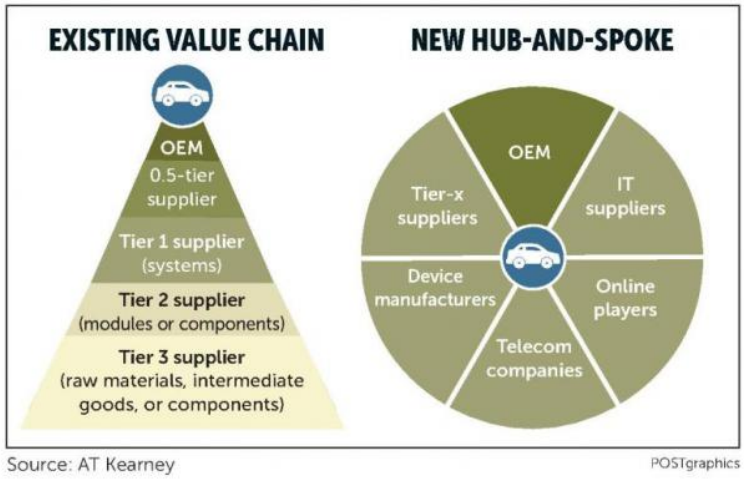
This usually happens in the auto industry, as auto assembler and their component suppliers have a component which is specific to a particular make and model. When the amount of R&D investment in the component is elevated, it's dangerous for the component supplier and auto assembler to be independent. Both are susceptible to opportunistic re-contracting, especially when the model is an unexpected success or failure. To escape the hazards of bilateral monopolies or oligopolies auto assemblers tend to enter into close-knit contractual arrangements – long-term contracts - with carefully chosen suppliers. The force of relationships and contracts prevents risks of opportunistic exploitation.

Another reason to have this type of integration is that creates barriers to entry to new players. Thus, potential entrants may have to enter all stages to compete, this increases capital costs and the minimum efficient scale of operations, consequently increasing barriers to entry. For instance, auto manufacturers may develop strong dealer networks to have exclusive dealerships. This means that new entrants must establish widespread dealer networks, which is pricy and time costly. Deprived of their dealer networks, manufacturers such as General Motors would have lost more market share than they already have to the Japanese players (McKinsey & Company Insights).

Changes in manufacturing

In the past, the supply chain used a waterfall model, meaning OEM would choose a Tier 1 supplier, which decided the Tier 2 supplier, and so on down to Tier 3 and Tier 4. Nowadays, carmakers don't have the complete picture of what they're getting when they involve certain technology in their cars, OEMs are starting to directly contact the technology providers; now the trend is to share knowledge of a supplier's intellectual property among suppliers and auto OEMs (Bangkok Post, December 2016).

Consequently, traditional automakers have higher transaction costs when compared to new automakers due to the hierarchal structure of the supply chain; in contrast, new automakers have more flexible and direct supply chain which allows better integration to the new market demands. An example of the traditional model would be Ford, which in 1920s, managed a tightly integrated chain by owning every part of the chain (History Insights, Henry Ford, November 2009). Regarding the new model, it's important to mention the hub-and-spoke system. The hub-and-spoke model is a method in which a centralized "hub" exists. Everything either is originated in the hub or is sent to the hub for distribution to consumers. From the hub, goods travel outward to smaller locations owned by the company, called spokes, for further processing and distribution (Biz Fluent Insights, September 2019). An example of that would be Tata Motors which is adopting the hub-and-spoke manufacturing model by planning to set up mini-hubs in potential markets like Africa (South Africa, East Africa and North Africa), the Middle East and South East Asia. The second phase will embark on setting up small assembly bases in Europe and Latin-America (The Economic Times, August 2014)

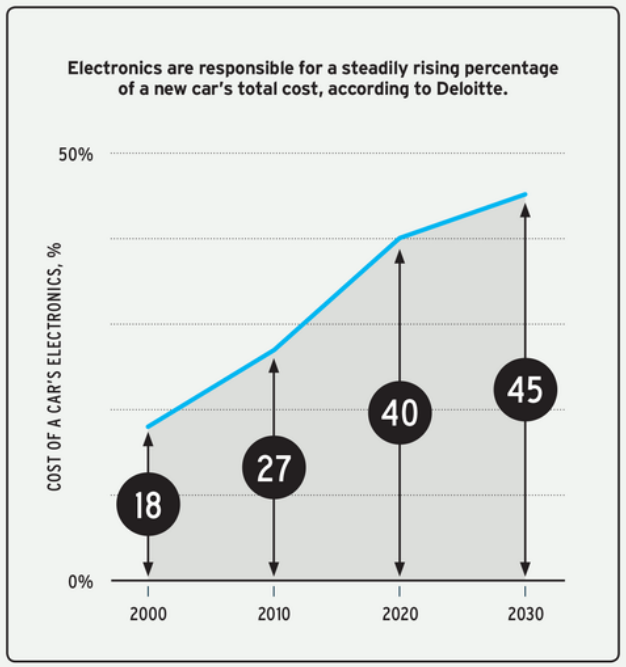


Existing Value Chain model and the New Hub-and-Spoke model

Moreover, the shift to electric cars also impacted this manufacturing process. Electric cars production has already led to change but will challenge carmakers in the future even further regarding their production structure. A potential solution for this challenge could be, on the one side, a high degree of inhouse competency and vertical integration from innovation to manufacturing. On the other side, high levels of cooperation with suppliers and low vertical integration.

Changes in car's costs

The microprocessors and chips that power the current cars are so predominant that they are almost a commodity in the same manner as aluminium or steel. Computers are used throughout the all process, they've made vehicles quicker, cleaner, safer, more reliable and efficient. According to a study made by Deloitte, electronics are now responsible for 40% of a new car's total cost, and this number is expected to be 45% by 2030 (Car and Driver Insights, May 2020).



Evolution of the electronics' cost on a car's total cost over the years

4.3.Internationalization

In last years, there has been an increasing trend towards trans nationalization. Companies may internationalize for various reasons and, in order to do so, they have to decide its internationalization strategy, which can either be through investment in other countries, international trade, transactions, exports, franchising, depending on their needs and assets to do so. However, internationalization may imply factors such as: legal frameworks, market and resources access, competition, costs, and also require their analysis (Freire, 2020).

The decision on whether strategy to follow is a result from an advantage analysis that include studies both about the firm and the country's advantages, as well as each region's strategic role in terms of internationalization. Besides that, it is important to look at the market responsiveness and to able to meet local needs, assuring responsiveness (Freire, 2020).

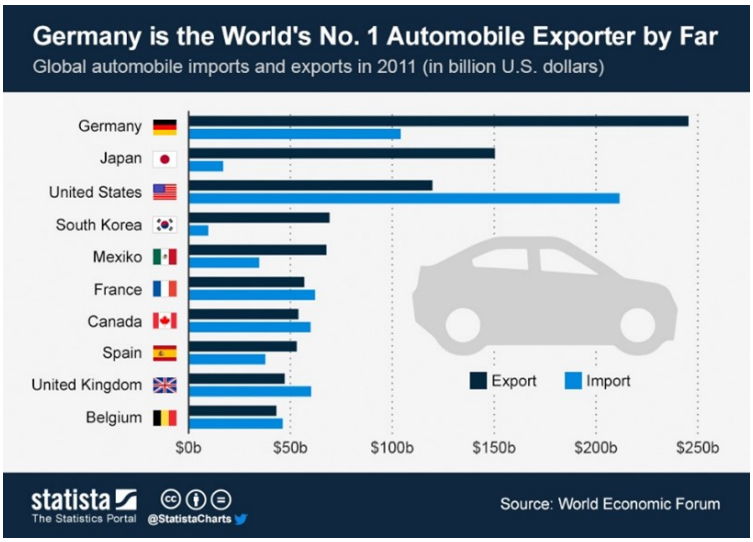
In this section we will analyse two different strategies in the automotive industry: international trade and international investments.

4.3.1. International Trade

As expected, different strategies profit from different benefits. When talking about international trade, it is possible to observe that it gives the company better market access,

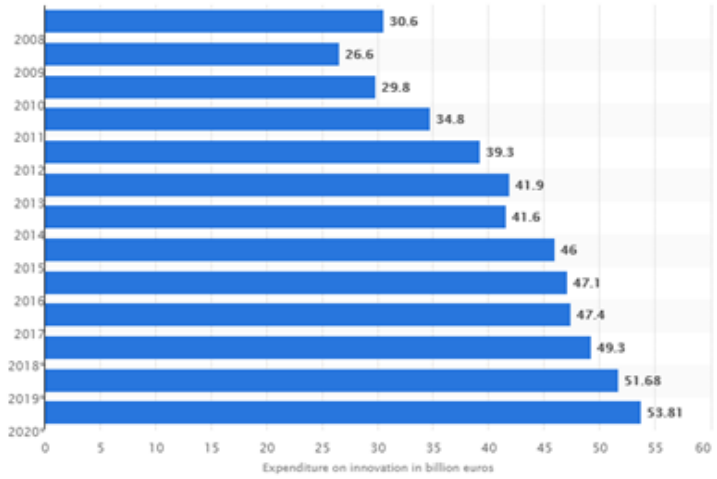
may decrease its costs, expand its reach and give more options for consumers (ACEA, s.d.).

When talking about numbers in international trade, it is indispensable to talk about Germany. In terms of export, the country is, by far, the largest in the world to so, followed by the United States and Japan (World's Top Exports, s.d.). The U.S., in its turn, is the leading import country for vehicles from Germany (Statista, 2020a).



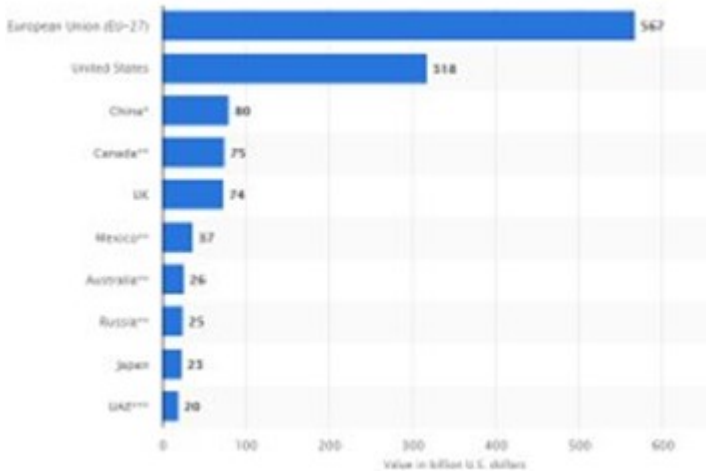
(Source: statista)

The tremendous difference between Germany's exports and other countries is due to the country's know-how and huge investments in research and development, with 53.81 billion euros invested in innovation in 2020, and an increase of 12.21 billion euros from 2014 (Statista, 2020c).



(Source: statista)

In terms of imports, the U.S. is not only the leading import country for vehicles from Germany, but the biggest importer in terms of countries as a whole (Statista, 2020a). However, when looking at the European Union as a block and not as separated countries, it is clear to see that the block is the biggest importer of automobile products in terms of value (Statista, 2020d). An important and relevant data to look at is that, together, the European Union and the United States import more than all the other countries at the table below together, showing the power of these two actors in the automobile import scenario.

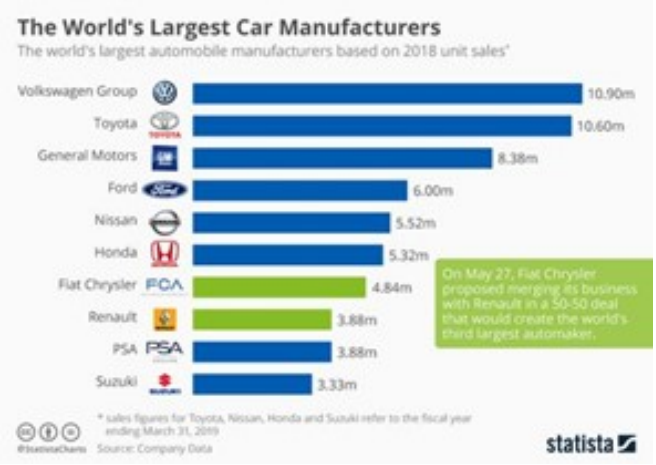


(Source: statista)

4.3.2. International Investments

Another important subject when talking about internationalization is international investment and can be done through manufacturing in other countries, mergers and acquisitions, and many others. This gives companies better market access, decrease its costs, contribute to other countries economy, use other country's know-how, may expand the company in terms of market share and make it possible to produce more for a smaller cost.

On the chart below, it is possible to analyse one of the aspects about international investments: manufacturing in other countries. When looking at the world's largest car manufacturers, it is interesting to analyse in which countries they are present.



(Source: statista)

On the table, it is possible to see that the world's largest car manufacturers operate in, at least nine countries, with this number reaching thirty-one with the Volkswagen Group.

No. of Countries Where the World's Largest Car Manufacturers Are	
The Volkswagen Group	31 countries (The Volkswagen Group, s.d.)
Toyota	26 countries (Toyota, s.d.)
General Motors	30 countries (Vault, s.d.)
Hyundai Motor Group	09 countries (Hyundai, s.d.)
Ford	20 countries (Ford, s.d.)
Nissan	16 countries (Nissan, s.d.)
Honda	25 countries (Honda, s.d.)
Fiat-Chrysler	14 countries (FCA, s.d.)
Renault	23 countries (Groupe Renault, s.d.)
PSA	18 countries

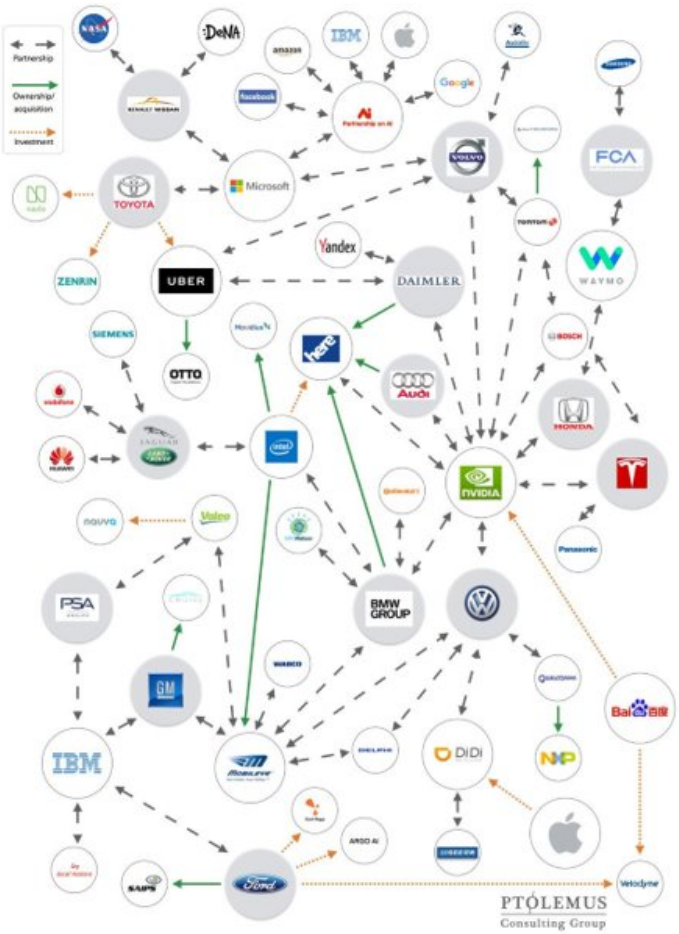
	(Groupe PSA, s.d.)

An important aspect of note is that all groups have a strong or growing presence in China. This can be attributed to the country's affordable labour and cheap manufacturing costs, plus the easy access to resources and huge market in terms of consumers. The increasing presence in the region was also facilitated by the cut in tariffs on imported cars from 25% to 15% and on imported car parts in 2018 (Privacy Shield, s.d.).

The sector is also one of the top pillar industries for China's economy and major employer (Daxue, 2020) and, even though the COVID-19 crisis, the market started growing again from August 2020 on, showing its ability and speed to recover fast due to its increasing population (Focus2Move, 2020).

4.4.Strategic Alliances

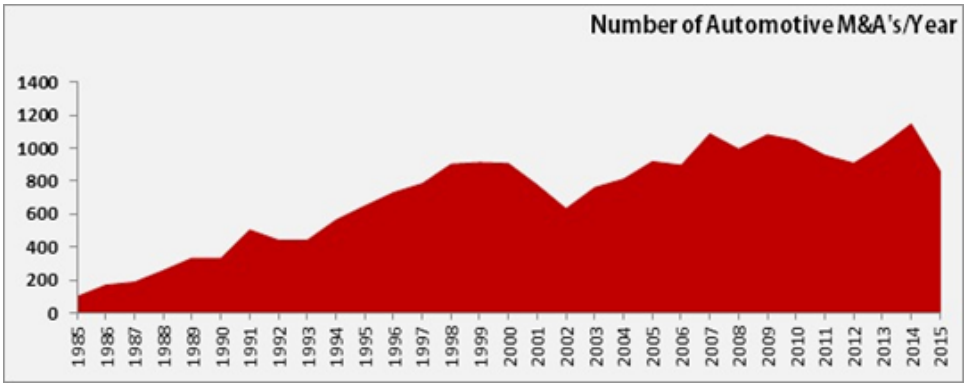
Over the past years, we had sight in different kinds of strategic alliances that was able to create some advantages to the companies in the automotive sector. We can explain as Parkhe (1993) defines strategic alliances as, "Relatively enduring interfirm cooperative arrangements, involving flows and linkages that use resources and/or governance structures from autonomous organizations, for the joint accomplishment of individual goals linked to the corporate mission of each sponsoring firm" (p. 794). This kind of agreement in a fast technological driver society to create the opportunity to different companies in another sector to partner up, by collaborating, companies can get what they need much speedier for half the fetched. We can see in the following table how software and hardware companies as Uber or Nvidia are being included in an overall alliance with a common goal to achieve the know-how of better connections, environmental-friendly and self-driver cars tech which has been a major trend for now and the future. So numerous exterior impacts happening at once have pushed the industry into a receptive state. Innovation must be created, and must be done so rapidly, or the monetary punishments of fines and misplaced deals will be tremendous.



(Source: Ptomelus Consulting Group)

4.5.Mergers and Acquisitions

Worldwide Business extension through mergers and acquisitions is one of the foremost important forms of development within the last decades and withing the automobile sector having the established giant companies and confirmed by Trompenaars and Asser (2010) who comments that global market extension and create through mergers and acquisitions is huge commerce. In a market needing to develop and follow the trends that are shaping the automotive future, companies with high power of acquisition prefer to buyout small/medium companies to absorb their new process or technologies, making development faster and cheaper, in the car segments that are developing. As a result, they may have more time and assets to prepare with the challenges and differences in the integration process



We can highlight the recently one M&A between FCA and PSA in a deal valued around 38B Euros, that will make the new company the fourth biggest company in the market, with more than 10 brands in its portfolio. This deal will turn out to be the 4th Big Carmaker in the sector

Fiat Chrysler and Peugeot Fast Facts

	FCA FIAT CHRYSLER AUTOMOBILES	PSA GROUPE
Headquarters	London, UK	Rueil-Malmaison, France
2019 Revenues	€108 billion	€75 billion
Geographic Segments	North America- 68% Other- 32%	France- 56% Rest of Europe- 23% Other- 21%
Select Brands	FIAT CHRYSLER Jeep	PEUGEOT CITROËN

Sources: CapIQ, FCA and PSA company websites
All trademarks, trade names, or logos referenced herein are the property of their respective owners. 5

5. National competitiveness

5.1 National Diamond Model

In this chapter Germany will be used as an example for a country with a very successful and worldwide established automotive industry. By using Porter's national diamond model, we analyze the factory that allowed it Germany to become so successful and specialized in this one certain industry.

5.1.1 Factor conditions

Germany has the highest population of all EU countries, which simply benefits the industry through a wider talent pool of potentially smart engineers. Furthermore, the

financial power of the country helps the development of the industry through the government-backed R&D and other support measures. The human resources that are fundamental to grow such a technical industry are provided by a free higher education system and very popular engineering studies. Additionally, all the knowledge from related industries helped to transfer skills and solutions between the industries (eg. BMW started off as an aircraft company and later specialized in cars). To ensure that the automotive OEMs remain an attractive employer very strong labor unions have emerged (e.g. IG Metall) that allows the industry to attract the best talent. Lastly, Germany benefits from a large group of foreign workforces that add additional labor force to the talent pool.

5.1.2 Demand conditions

In EU comparison Germany's large population of currently around 83 million represents a large potential customer base. As new industries usually start nationally and later internationalize it is an advantage to have a big national market to begin with. In addition, the average wealth level is high, and people have a lot of purchasing power. This enables the German population to afford higher quality cars. Not only that they can pay, but the German culture is also willing to pay higher prices for high quality goods. People are proud of the car industry in their country and the strong brands are internationally recognized increasing the willingness to pay. The EU common market further improved the demand conditions for the German automotive industry as it allowed an easy internationalization to a large market without trade barriers.

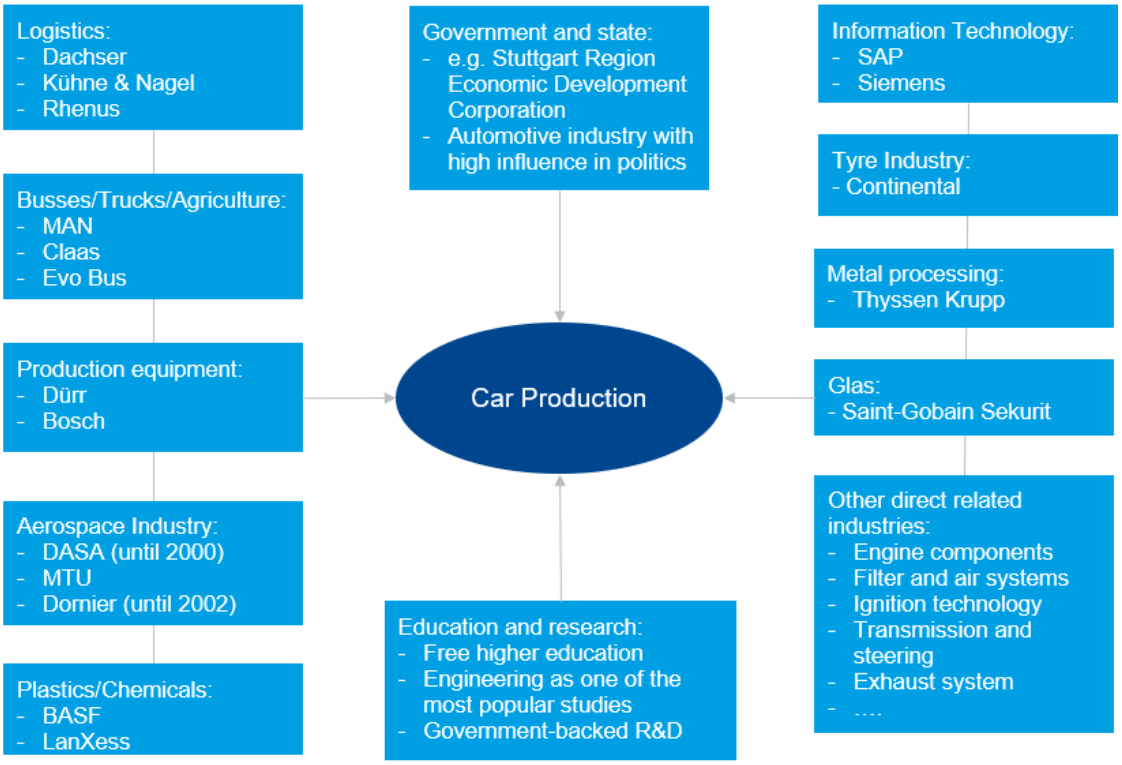
5.1.3 Competitive structure

From the very beginning on, with the invention of the car, there was rivalry between Carl Benz, Nicolaus August Otto and Gottlieb Daimler and Wilhelm Maybach. This competition within the German automotive industry continued over the years. The strong competition is based on quality and enforces pressure on the OEMs to innovate. The competition doesn't only focus on quality and R&D, but also on worldwide brand reputation. The major German car companies have a high geographic concentration within the country which allows short distances and close relationships to suppliers, aggregation of R&D, and enhances cooperation between competing companies. The collaboration is also facilitated by a strong industry association (Verband Deutscher Automobilhersteller) which sets standards for the whole industry and enhances coopetition. The huge success of few national players (Mercedes, BWM and the VW

Group) form an oligopoly-like market in which the OEMs have high power and are able to force a lot of pressure in their suppliers. This leads to the very close relationships between companies in the value chain and further reduces costs for the OEM.

5.1.4 Related and supporting industries

Due to the presence of large OEMs suppliers from all levels, the value chain evolved in Germany and a strong presence was established. Several supporting industries fully depend on the automotive manufacturers in Germany and the related engineering industries flourish through the similar resources and capabilities. Additionally, the local



car manufacturers prefer suppliers from Germany to keep the “made in Germany” brand strong. The long-lasting relationships to the partners from the value chain have led to quasi-integration and very close collaboration due to the interdependencies.

5.1.5 Chance

The central location inside the EU and access to the sea is a great advantage in international trade. The distance to other national markets in the EU is rather short as well as the supply chains ranging into other countries. Sea access is an advantage for global trade with an increasing importance of imports and exports to countries outside of Europe.

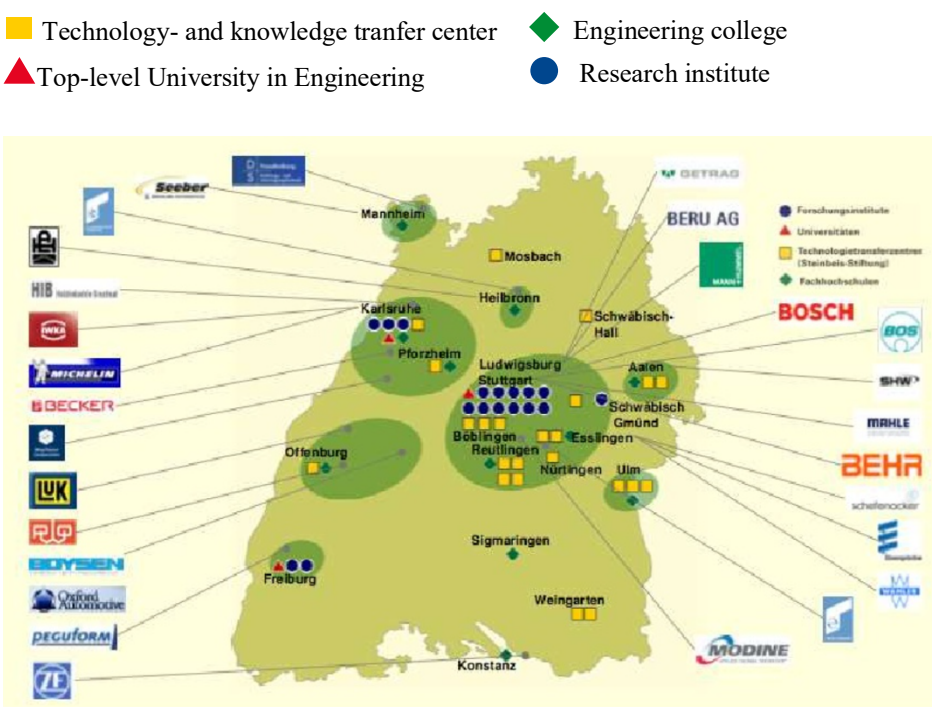
Secondly, the German automotive industry was strongly promoted during the time of war. Government initiatives increased production from 52,000 to 352,000 units and the Autobahn construction was initiated, which is one factor increasing the fascination for fast cars. In general times of war led to fast technological advancements which the car industry could leverage from.

5.1.6 Government

The German government provides subsidies for R&D as well as financial incentives to end-consumers as mentioned in the early chapters of the report. Additionally, good worldwide trade relations make it easier for the national industry to export and expand to global markets.

5.2. Industry Cluster Baden-Württemberg

Baden-Württemberg is a state within Germany in which the presence of Mercedes and Porsche led to a strong concentration of companies within the automotive industry. In the following we will elaborate on the factors that made the region so competitive in a certain industry.



Karlsruhe and Stuttgart have two of the best engineering Universities of Germany, educating high skilled labor for the regional industry. The inventor of the automobile, Carl Benz, actually studied in Karlsruhe and the education and research done at the Universities is essential for the success of technical industries such as the automotive. Linked to University research are

also other institutes Karlsruhe, Stuttgart and Freiburg that are government-backed and fully focussed on R&D providing innovative solutions for the automotive industry. The geographic proximity is essential to facilitate the collaboration between different departments and the R&D institutes and the industry companies.

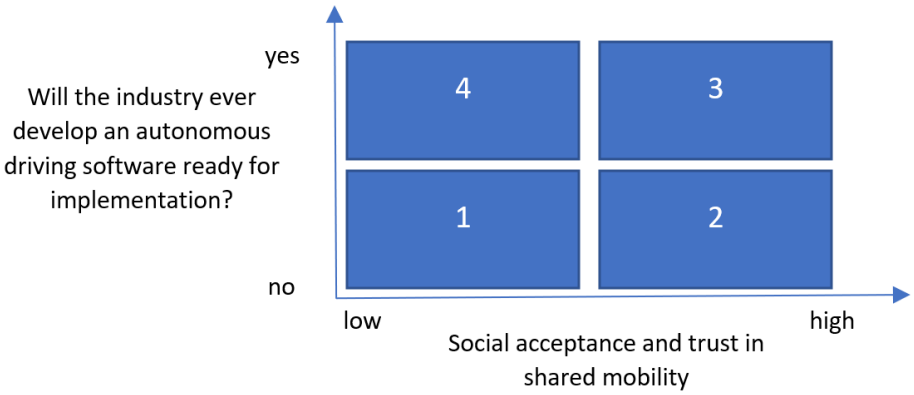
Furthermore, Baden-Württemberg has a historic advantage in automotive production. Carl Benz studied in engineering in Karlsruhe, built the world ‘s first car in Mannheim and established the Mercedes-Benz factory in Stuttgart. This enabled the region to fully focus and to perfect the industry with surrounding suppliers. Several Mercedes, AMG and Porsche production plants are located around the Stuttgart area and most of the value chain is in the close region, allowing efficient coordination and close partnerships, e.g.:

- Tier 3: BASF (Mannheim)
- Tier 2: Mann + Hummel
- Tier 1: Bosch, Boysen, ZF, Siemens, Michelin, Schaeffler, Dürr

5.3. Industry challenges and strategic scenario

The major challenges for the automotive industry are abbreviated as CASE (connected, autonomous, shared, electric). As discussed in the “digitalization” chapter, major investments are made in the development of connected and autonomous vehicles and these topics will be in development for at least another 10 years. The environmental pressure and political incentives push the shift to vehicle electrification, as analyzed in the demand and supply trends. This industry segment is relatively new and the pace of development is promising for further improvements in the near future. The last big shift in the industry will be the growth of shared mobility. The increasing urbanization and the convenience that shared mobility platforms can offer will make more people adopt shared mobility (see: graph in the “social” chapter of the PESTEL analysis).

From these major challenges we derived two, in order to create strategic scenarios for the automotive industry.



We considered 4 strategic scenarios regarding the implementation of autonomous driving software and the social acceptance and trust in shared mobility.

In quadrant 1 the situation is very similar to the status quo we live in right now. People are purchasing private cars that are individualized to their needs and wished. Because almost every household our individual has a car, the total amount of vehicles is high and causes a lot of traffic. If the acceptance of shared mobility continues to stay low only few shared mobility providers will be able to survive. The failed implementation of autonomous driving in this scenario will further lead to a lot of financial losses due to all the failed investments in autonomous driving software.

In quadrant 2 the shared mobility and mobility on demand providers act in a competitive and growing market. The success will push their services outside of urban areas and give people in rural areas access to new mobility solutions. There is a huge shift in the business of OEMs as they focus in a completely new customer group now. The main customers will be fleet providers and not individuals anymore, so there is a shift from B2C to B2B business. Because shared vehicle fleets are usually standardized in terms of interior, models and colour the car production will be much more standardized allowing for lower production costs. Because autonomous driving software is not implemented, there is also no large software cost component in the vehicle manufacturing leading to rather low prices.

In quadrant 3 the mobility will be “CASE”. The development of autonomous cars depends on the successful roll-out of car connectivity, since all the data collected with connected cars is used to develop the autonomous driving software. The high demand and acceptability of shared vehicles leads to a shift towards e-mobility. This is because the mobility providers benefit from easier operations with electric vehicles as it is easier to coordinate the charging process than sending customers to a gas station and electric

vehicles. Additionally, because electric vehicles have way fewer moving parts in their motor and therefore less wear-down, the maintenance costs of EVs are lower. The self-driving cars revolutionize the business as no driver is needed and the customer base increases by all people without a driving license. Operational efficiency is at peak, since the cars can drive to a charging spot by themselves, park or pick-up customers all alone. Similar to quadrant 2 the shift on customer from B2C to B2B will take place and the increased standardization in production reduces prices, nevertheless, high software costs will be the main part of vehicles prices.

In quadrant 4 there will be a slower shift to autonomous driving compared to quadrant 3. The car prices will be very high, since they are still highly customized, and the software costs will add to the costs substantially. Therefore, not many people will be able to afford the new autonomous car generation and the shift to autonomous vehicles will be evolutionary (in quadrant 3 the fleet providers have more financial power to finance completely autonomous fleets). Without car sharing the overall demand for new vehicles will be higher in the long term, as each individual will shift to autonomous cars eventually.

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